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विशेष :

1. पत्रिका में प्रकाशित शोध पत्र/शोध लेख की मौलिकता का दायित्व लेखक का होगा।
2. पत्रिका में प्रकाशित शोध पत्र/शोध लेख की स्थापनाओं से 'हंसराज कॉलेज' या 'संपादक' की सहमति असहमति आवश्यक नहीं है।
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About the Journal

"Hans Shodh Sudha - Vigyaan-Vaanijaya-Kala ka Shodh Sangam" is a multidisciplinary quarterly bilingual research journal.

The primary objective of the journal is to cater to the research articles/reviews from diverse disciplines from students and faculties working in colleges/ universities /research institutes in India and abroad.

Articles (Research/reviews) on contemporary topics and issues are invited from faculties and students across different disciplines (Arts, Commerce, and Science). The submitted manuscripts are subjected to a peer-review process before being accepted for publications.

Authors shall address the Editor-in-chief of the journal for submitting their manuscript to the provided e-mail id and must follow all the required instructions given on the website.

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DAV COLLEGE MANAGING COMMITTEE
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MESSAGE

It gives me immense pride and pleasure to write about the inaugural issue of a multidisciplinary research journal "Hans ShodhSudha – Confluence of Science, Commerce and Humanities". This new journal is a high-quality publication that provides space for generation of knowledge and collaboration between various disciplines. The vision is to have a diverse range of relevant, challenging and thought-provoking perspectives of academicians.
I am extremely pleased that this e-based journal makes it possible for everyone connected to the developments in the field to pursue ongoing knowledge construction. This journal will accept the original research, theoretical contributions, reviews of the literature, critical commentaries, case studies, book reviews and work in progress.

As the world is reeling under the Covid-19 pandemic, Hansraj College along with the teaching and non-teaching staff took the great initiative to start this new journal. Besides this, the college is also engaged in various activities like organising workshops and webinars with the National and International experts of different fields.

The launch of this new research journal in these difficult times indicates that our premier institute is constantly progressing towards its ultimate goal of excellence not only in teaching but in academics also. The story of success of the college in last Five years has been scripted under the leadership of its dynamic Principal, Dr. Rama. The multidisciplinary approach of this journal caters to several disciplines together under one umbrella, imparting the importance of diversity but with an underlying unity.

I extend my heartiest congratulations for this multidisciplinary research journal of our institute Hans Raj College "Hans ShodhSudha" and wish for its successful journey in the fast-growing changing academic world.

Dr. PUNAM SURI
CHAIRMAN
DAV COLLEGE MANAGING COMMITTEE

संपादकीय

विश्व इस समय असामान्य स्थितियों का सामना कर रहा है। असामान्य स्थितियां सदैव नहीं होतीं इसीलिए इन्हें असामान्य कहा जाता है। लगभग 215 देश कोरोना महामारी की चपेट में हैं। मानव जाति ऐसे उद्वेलन का सामना कर रही है जिसके साक्ष्य इतिहास में शायद ही दिखाई पडें। इस भयावहता से जो प्रभावित हैं उनके दुख में मानसिक सहभागिता उन सभी की है जो हृदय से उस दुख को महसूस कर रहे हैं । महापुरुषों ने साहस और धैर्य की गिनती सद्गुण के रूप में की है। संकट के समय हमें साहस और धैर्य के संग एकजुटता की भी आवश्यकता होती है। कोविड-19 के संकट को मानव जाति के एकजुट साहस का संकल्प कहा जाना चाहिए। दिनकर जी ने कहा था 'मानव जब जोर लगाता है पत्थर पानी बन जाता है।' यह समय उसी सामूहिक प्रयास का आह्वान है।

कोविड-19 ने प्रकृति के सामीप्य का विलक्षण अवसर प्रदान किया है। प्रकृति अपने स्वच्छ और निर्मल रूप में कितनी मनमोहक है इसका आभास उन लोगों को भी हुआ है जो इसे मात्र किताबी ज्ञान समझते थे। प्रकृति ने हमें चुनौती और अवसर दोनों दिए हैं। ऐसा लगता है कि प्रत्येक चुनौती कई-कई अवसर प्रदान कर रही है। वैज्ञानिक हों या डॉक्टर, प्रशासन व्यवस्था हो या समाजसेवी लोग, गृहिणी हों या बालक, समाजशास्त्री हों या अर्थशास्त्री यानि समाज का प्रत्येक वर्ग अप्रत्याशित, अनापेक्षित और अपूर्व चिंतन का सामना कर रहा है। शिक्षा जगत के लिए इस दौर ने जो चुनौती दी है उसका आकलन करना आसान नहीं है। शिक्षा संसार में प्राथमिक शिक्षा से लेकर उच्च शिक्षा तक का बडा संसार समाहित है। यहां प्रत्येक वर्तमान पल में भविष्य की मजबूत इमारत स्थापित है। शिक्षा से जुड़े हुए लोगों के लिए हर क्षण परीक्षा का क्षण साबित हो रहा है। इस क्षेत्र से जुड़े प्रत्येक व्यक्ति ने प्रतिपल की परीक्षा को वक्त की कसौटी के रूप में स्वीकार किया है। यह देखकर प्रसन्नता होती है कि जिस एकाग्रता के साथ समाज हितैषी शोध दृष्टि का विकास इस दौरान हुआ है वह आने वाले कल को नई दिशा देने वाला है।

हंसराज कॉलेज ने शिक्षा जगत में अपनी जो पहचान बनाई है उसके मूल में महात्मा हंसराज की वह दृष्टि काम करती रही है जब महात्मा हंसराज जी ने डी.ए.वी. कॉलेज लाहौर में प्रधानाचार्य के रूप में काम करते हुए आत्मनिर्भर समाज का स्वप्न देखा था। उन्होंने डी.ए.वी. के विद्यार्थियों के लिए इंजीनियरिंग की बात सोची तो सिलाई मशीन और कढ़ाई बुनाई की शिक्षा के महत्व को समझते हुए छात्र-छात्राओं के लिए इसकी भी व्यवस्था की थी। अभाव किसी प्रतिभा का दमन न करदे इसके प्रति सजगता डी.ए.वी. के संस्कार में निहित है। कोविड-19 के दौर में हंसराज के शिक्षक, विद्यार्थी और कर्मचारियों का दायित्व बोध मैं निकट से देख रही हूं। मैंने यह भी महसूस किया है कि पूरे शिक्षा जगत में शोध की गति तीव्र हुई है। यह शोध कार्य समाज के लिए अधिक से अधिक हितकारी हो सकें इसके लिए यह सुनिश्चित करना आवश्यक है कि शोधार्थियों की मेहनत को ससम्मान समाज के सम्मुख उपस्थित किया जाए।

समाज इनके चिंतन से सार्थक मार्ग खोज सके यह ध्यान में रखकर हंसराज कॉलेज की त्रैमासिक शोध पत्रिका 'हंस शोध सुधा' का प्रवेशांक आपके सम्मुख है।

पत्रिका में विज्ञान, वाणिज्य और मानविकी के क्षेत्र में हुए शोध कार्य संकलित हैं। विषय विशेषज्ञों द्वारा अपना समय निकाल कर शोध पत्रों का मूल्यांकन करना शोध क्षेत्र के प्रति उनकी समर्पणशीलता का प्रमाण है। मैं सभी विद्वानों के प्रति आभार व्यक्त करती हूं। भविष्य में आप सभी का मार्ग दर्शन मिलता रहेगा ऐसी अपेक्षा है। पत्रिका में प्रकाशनार्थ जिन विद्वानों ने अपनी शोध स्थापनाओं से इस पत्रिका को मूल्यवान बनाया है उनके प्रति मैं आभार व्यक्त करती हूं। आशा करती हूं कि आपके शोध की स्थापनाएं समाज को वांछनीय फल देने वाली होंगी। इस पत्रिका के संपादकीय दायित्व में महाविद्यालय के प्राध्यापक साथी जुड़े हैं उनकी कर्मठता का मैं अभिवादन करती हूं।

पत्रिका में अपेक्षित सुधारों के प्रति आपके सुझावों की प्रतीक्षा रहेगी।

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Mental disorders & Suicides in COVID-19 Era : A Preventable Pandemic?

Dr Nalini Kaushik[1], Dr Ravi Kaushik[2]*

Abstract

Corona Virus Disease -2019 caused by novel Corona virus is the pandemic of 21st century. The world has earlier also witnessed the corona virus diseases like Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS CoV). However the Corona Virus Disease-2019 (COVID-19) caused by novel corona virus is unprecedented in terms of its severity, and the impact it has brought to the lives of people across the globe.

The bad news, lockdowns, economic slowdown and other related factors emerging during the COVID 19 era have adversely affected the mental health of people. Mental health and suicides are related. We are witnessing a surge in the COVID 19 related suicidal deaths these days. This paper is an attempt to assess the reasons for the mental illnesses and increased suicides and try to mitigate this emerging public health problem especially in these difficult times of the COVID 19 pandemic.

Key Words

COVID-19, Corona, Mental Health, Suicide

Introduction

Corona Virus Disease -2019 (COVID-19 or SARS CoV 2) is caused by novel Corona virus. The world has earlier also witnessed the corona virus diseases like Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS CoV). However the Corona Virus Disease- 2019 (COVID-19) caused by novel corona virus is unprecedented in terms of its severity, and the impact it has brought to the lives of people across the globe.

The factors emerging during the COVID 19 era have adversely affected the mental health of people. Mental health and suicides are related. We are witnessing a surge in the COVID 19 related suicidal deaths these days.

An Indian Council of Medical Research (ICMR) report published in 2017 states that about 197 million people in India suffer from some kind of mental disorder, with depression and anxiety disorders being the most common, affecting nearly 45 million people each. The Global Burden of Disease (GBD 2017) report predicts that depression will be the second leading cause of disability worldwide by the end of this year[2].

The National Mental Health Survey 2015-16 by the National Institute of Mental Health and Neuro-Sciences (NIMHANS) reported that 150 million people require active intervention for their mental disorders while less than 30 million are seeking the support[3].

According to World Health Organization (WHO), around 800,000 people commit suicide every year in the world. Suicide prevention comes under the Sustainable Development Goal (SDG) number 3 i.e. "Ensure healthy lives and promote well-being for all at all ages". Still we are witnessing an uptrend in the suicidal deaths in recent years. Suicide causes more deaths than malaria, breast cancer, war, or homicide. In 2016, suicide was the second leading cause of death (2 lakh casualties) among young age group (15-29 year olds), beaten only by road injury deaths[4].

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India's National Crime Records Bureau (NCRB) publishes yearly reports on suicides. The NCRB reports showed an uptrend in suicide rate per lakh of total population from 6.3 in 1978 to 8.9 in 1990. Another uptrend is reported in last three years as well. The Global Burden of Disease (GBD) study shows a much higher suicide rate in India. India GBD study estimated 230,314 suicide deaths in 2016 while NCRB reported 133,623 the same year, and 134,516 in 2018[5].

Discussion

Number of reported COVID 19 cases has reached nearly 12.5 million with more than 5,58,000 deaths as on 10th July 2020[6]. These numbers are fearsome and the reactions by the media have made the pandemic even more dreadful. Though the reports of vaccine and drugs are coming, confusion on a definitive preventive and curative aspect of the disease is still prevailing. With physical distancing and isolation tools to prevent the disease spread, governments across the globe took measures like lockdowns to curtail the spread of the disease.

Lack of socializing among one's network builds up the mental stress for the individual. A report from Ludhiana district in Punjab alone shows 100 cases of suicides and 1500 cases of domestic violence during the lockdown period which is nearly 75% higher than the pre-COVID time[7]. Another report by a group of researchers shows that suicide was the leading cause of death in the 300 non-COVID deaths in India during initial one and a half months of lockdown[8].

Such data are alarming and warrant the need to assess the gravity of the problem, the factors responsible and the preventive actions which can be taken at individual, societal, and policy level.

Probable factors for suicides

During the COVID 19 era, a new set of factors leading to suicides has emerged. Fear of getting infected, social stigma of the disease, social distancing, isolation, anxiety, depression, lack of information and knowledge, domestic violence, migrants displaced and financial turmoil can be few factors leading to the drastic step of suicide.

Social cut-off

In these times of social media, socialization by physical means had already taken a back seat. With advent of COVID 19, people have been pushed to cut off most of the ties with family and friends and limit them to virtual platforms. This has drastically affected the mental health of people especially the ones who are not very inclined to e-platforms or are not very tech-savvy; our elderly being most susceptible to mental ailments. The reports like that of suicide by an elderly woman in Phagwara district Punjab in April 2020 are testimonies to this. The lady used to live alone in the house as all her daughters were married and lived away from her. Hence she was socially isolated after the lockdown and reportedly depressed because of this[9].

Social stigma and misinformation

With information overload about COVID 19 on all channels whether it is on TV, radio, internet or others, people often end up baffled and clueless about the right information. With incidences like that of retraction of anti-HCQS papers from Lancet and New England Journal of Medicine (NEJM), the authentic information today can become false the day after[10]. This ambiguity of information and lack of clear and succinct guidelines about the origin, prevention and treatment of this novel disease has lead to a large scale social stigma and anxiety in society, especially in countries like India, in which social fabric plays a very important role in the well being of the individuals. The suicide by an Indian Revenue Services (IRS) officer in New Delhi in June 2020, due the fear of spreading the disease to his family is a glaring example that even well read people are so ill-informed about the disease[11]. Suicide by a German minister also shows the widespread crisis across the globe[12].

Increased stress among Healthcare workers

With highest degree of exposure to the virus, difficult working conditions, watching the COVID deaths each day, and increased infection rate despite taking the precautions; the healthcare workers bear the brunt face on. With more than tens of thousands healthcare workers infected and at least 70 doctors died due COVID 19, the situation is frightening for these Corona-warriors[13]. This can lead to burn out, stress, anxiety and depression in them. Multiple reports of suicide attempts and suicides in frontline healthcare workers have emerged in many countries. The incidences like the suicides by two healthcare workers in New York and by a post graduate lady doctor in Kolkata reveal the grim situation. Reportedly, in all these cases, the deceased were stable and normal before the pandemic and went into depression after doing the hospital duties treating COVID 19 patients[14, 15].

Financial crisis

The disease and the lockdowns have given a big jolt to the economies of most of the countries. The situation is worse in middle to low income group

countries. The lockdowns adversely impacted the economy with businesses affected and jobs axed. According to the McKinsey' briefing note of 2nd July, 2020, globally 20 to 60 % of the household's decision makers fear for their own jobs, with more than half concerned about their future[16]. Lack of social support has worsened the situation in such depressed people. These factors have aggravated the pre-existing clinical and subclinical mental health conditions; leading to suicides in many cases. According to a research group, till May 02, 2020, India had witnessed more than 80 suicides with many owing the financial crisis[8].

Workers' migration and livelihood crisis

This problem is peculiar to India and probably only a few other countries. With a large number of factory workers in industrialized cities coming from rural and poor areas of a handful of states, COVID 19 lockdown left them jobless. Lakhs of workers had to migrate back to their native places due to poverty, but still the livelihood crisis persisted. There have been reports of such jobless workers committing suicides[17].

Domestic violence triggering suicides

With low economic growth, people are rendered jobless. Reports show that abusive husbands' ill-behavior has increased due to lockdowns and domestic violence has increased in many countries. The report of four Israeli women committing suicides during the pandemic because of domestic violence is such an example. Moreover, the report mentions increased cases of abused females with suicidal thoughts and behavior seeking help[18]. Such cases are suspected to be there in many other countries including India.

Social discrimination and boycott

Social distancing and social discrimination are two very separate things. There have been reports of people being boycotted and discriminated for being either COVID positive or even in ignorance. Suicide by a man in Una district in Himachal Pradesh showed that the social fabric of our culture needs to be maintained otherwise it will have dreadful results[19].

Inability to access community and religious places

Social health is important, and so is the spiritual health. People socialize in community events like in clubs and functions. Religious places like temples, churches and mosques play very vital role in maintaining the social relations and mental stability of people. It is known that the frequent visitors to religious places have less mental ailments and commit significantly less suicides. Hence restricted access to these places can be one of the contributory factors to the pandemic of suicides[20].

Decreased access to mental health treatment

Many hospitals are converted to COVID 19 dedicated hospitals. COVID screening is done in every healthcare setup. It has become difficult to access psychiatrists and psychologists and seek mental health treatment[20]. This can be one triggering factor.

Neglect of other diseases

The planned surgeries are postponed. Government and hospitals are focusing on COVID more and other diseases are neglected. Decreased footfall in screening OPDs and other curative OPDs can lead to neglect, progression or worsening of other organic diseases including cancers, heart diseases, diabetes etc. These chronic diseases are known to be stressors and can cause anxiety and depression which can lead to suicidal tendencies[20].

Remedial Actions/Recommendations

While the medical scientists worldwide are working to come up with the drugs and vaccines for COVID 19, there is an urgent need to address the problem of this growing pandemic of mental illness and suicides. With these known triggers and factors leading to the increased suicide cases, we need to make sure we address them and support the susceptible individuals. There are many strategies to contain the mental illnesses and suicides. Some are already implemented and few are proposed to be considered at policy level as well as individual level.

Strategies at Individual/societal level

Deferring the illness: Prevention strategies

People can prevent themselves from getting infected and from the resulting mental trauma by few simple measures like using a mask/face cover with proper fitting, maintaining adequate distance from others, and avoiding going to public places unless it is extremely urgent. While on workplace or outside home, avoid touching any surfaces and practice frequent hand washing with soap and water for at least 20 seconds.

Combating misinformation

The Arogya Setu mobile application is developed by the government of India to "protect yourself, your family and friends and help our country in efforts to fight COVID-19". This app tracks the interaction with someone tested COVID-19 positive through a Bluetooth and location generated social graph. This app has self assessment test, instructions to self-isolate, several informative videos like the "Break the

Stigma", and guidance by top doctors of the nation[21]. The app shall be downloaded and used by one and all. This will go a long way in preventing anxiety and misinformation.

Physical distancing and not social distancing

Physical distancing shall be practiced everywhere. Social events like parties, processions etc should be avoided. However it's a good idea to connect to people through the telephone or electronic media. This helps in building social bonds and reduces the anxiety and stress, which are often the factors responsible for suicides.

Socialize within family

Spending time with family relieves stress. Special attention need to be given to adolescents and aged people at home.

Develop hobbies

Lockdowns have given adequate time to people to develop new hobbies or revive the old ones. Engagement in hobbies is a stress buster and can help preventing the mental burnout from the negative news surrounding us.

Develop skills

Skill enhancement is another constructive activity which should be considered in the COVID era. Enhanced skills whether they are job related skills or life skills help in giving meaningful purpose to the life.

Practice Yoga

Yoga means Union. This union can of one's soul with the supreme soul or the union of mind, body and the soul. Yogic practice is known to alleviate many mental illnesses and boost immunity. This will help the body and mind to be in a better state to fight the infection.

Exercise and Diet

Exercise and nutritious diet are vital to maintain good immunity and proper mental and physical health and will help tide over the mental exhaustion and stress.

Avoid too much of news and negative information about the COVID 19 pandemic

Information bombardment can lead to preoccupation of thoughts by that information. This applies more to the negative news and COVID is a suitable example for the same. Media is focusing on COVID news and delivering information, sometimes half baked and from unreliable sources. Hence information from reliable sources like government data, government websites and Arogya Setu app should be considered for taking information. Any uploading or forwarding of unauthentic information should be avoided.

Seek and provide help

If one thinks that he is encountering anxiety, stress or depression due to any reason, he should seek help from the healthcare providers. Telemedicine is legal and is practiced widely now. Most of the psychiatrists and psychologists are practicing through telemedicine, with few also opening the clinics. Further, mental health/psychiatry OPDs are also functional in many government and private hospitals. Mental health helplines are another important modality to seek help.

If one observes changed behavior, increased stress, or suicidal thoughts in a known person, he should be made to approach the facilities as mentioned above. Sometimes these clues can be obtained from the phrases like 'being fed up of life', 'tired of life' 'purposeless life', 'no one loves me', 'I am useless' etc. This act of solidarity and care can save someone's life.

Policy interventions

Early detection of mental health problems and suicidal behaviors

First and foremost, early detection of mental illnesses and of suicidal behavior is essential. We won't be able to fight the pandemic unless we identify the susceptible people and do the requisite interventions. We need to come up with easy and reproducible scales for assessing the depression and anxiety especially focusing on the COVID 19 times. One such scale has been developed by Lee et al, and needs to be adopted or modified according to regional needs[22].

Mental Health assessment of COVID 19 positive patients in healthcare and societal settings

COVID-19 patients encounter high levels of anxiety and stress. Their mental health assessment shall be done both in healthcare set-up and in societal settings. This interaction needs to be done on frequent basis and help if needed should be provided to them on priority.

Tele-counseling/ helpline

On March 30th 2020, NIMHANS launched a national helpline (080-46110007) to provide counseling on mental health and psycho-social issues related to the pandemic and lockdown. The availability of vernacular languages and dedicated healthcare warriors helpline make it even more effective. There are many such helplines by state governments and NGOs, which are being utilized for the work[23].

More 24-hour mental health help-lines should be started and their popularity should be increased through all the government platforms, media including

social media, and through private players. Associated round the clock crisis support teams should be formed for any immediate intervention if needed.

Multisectoral approach

Mental health is related to many factors including social, financial, spiritual and physical health. Government has rightly taken steps with "Unlock- 1 and 2" in opening businesses, religious places and public transport to a limited extent, normalizing the lives of people. Policy intervention for the multisectoral approach should be considered for containing the pandemic of mental illnesses and suicides.

Conclusion

COVID-19 is a modern world challenge and so are the mental disorders and suicides being increased during the pandemic. While we fight the COVID-19, it is imperative to acknowledge, prevent and fight the growing pandemic of mental illnesses and suicides at individual, societal and policy level through a pragmatic approach.

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Dietary Antioxidants and Human Diseases

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Abstract

Oxidative stress has been implicated in the development of cancer and various chronic inflammatory and degenerative human diseases of cardiovascular, neurological, respiratory and gastrointestinal origin. Dietary antioxidants intake as part of normal diet or supplements can attenuate free radical induced cel damage and reduce the morbidity and mortality associated with these diseases. In this review, role of dietary antioxidants in common oxidative stress associated human diseases will be discussed.

Key words: Oxidative; stress; disease; defense; therapy; protection

1. Introduction

Along with the well-known immune defense system, our body has evolved to harbor an antioxidant defense system that functions to maintain the important redox balance. Oxidative stress that plays a major role in pathogenesis of several clinical conditions involving cardiovascular, respiratory & liver diseases, gastrointestinal & neurological disorders, muscle damage, diabetes, and aging (Pizzino et al 2017), is naturally countered by antioxidants. An antioxidant is defined as a substance that inhibits oxidation. For a better understanding, we can state that any substance that has an oxidizable substrate, and when present in low levels, significantly delays or inhibits the oxidation of that substrate, is an antioxidant (Halliwell and Gutteridge 1995). Owing to essential role of antioxidants, these have deemed interesting candidates to be used in therapy for several diseases (Pizzino et al 2017). In the present review, we aim to summarize the available information on the role of dietary antioxidants in several diseases. This will be relevant to understand the protective role of antioxidants and the implications of our dietary habits.

2. Types of Antioxidants

The types of antioxidants range from those generated endogenously by the body's own cells to exogenous agents such as dietary supplements (Kurutas 2015). Based on the activity, antioxidants can be categorized as enzymatic or non-enzymatic (Flora 2009). The antioxidant enzymes include catalase, superoxide dismutase, and glutathione peroxidase and glutathione reductase and these enzymes aid in repair or elimination of damaged bio-molecules. Non-enzymatic antioxidants constitute chain breaking antioxidants, and transition metal binding proteins (Nimse and Pal 2015). Chain breaking antioxidants are again of two types, viz., lipid-phase chain breaking antioxidants and aqueous-phase antioxidants. Vitamin E, carotenoids, flavonoids, and Ubiquinol-10, come under lipid-phase chain breaking antioxidants, whereas aqueous-phase chain breaking antioxidants include Vitamin C, uric acid, albumin-bound bilirubin, protein-bound thiol groups and reduced glutathione. Transition metal binding proteins, like, ferritin, ceruloplasmin, lactoferrin, and transferrin, sequester iron and copper and prevent the production

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of free radicals (Nimse and Pal 2015; Pizzino et al 2017).

3. Sources of dietary antioxidants

Majority of antioxidants are supplied in diet and contain one or more of polyphenols, lipoic and ascorbic acid, carotenoids, resveratrol, lycopene, quercetine, genstein, ellagic acid, ubiquinone and indole-3 carbinole. Several plant-based polyphenolic antioxidants, proanthocyanidins (PACs) from different fruits, vegetables and edible plants, have come into focus for their antioxidant properties (Huang 2018). Apart from these, spices and culinary herbs, such as, ginger, turmeric and garlic, which are routinely used in our cuisines, have also been regarded as good sources of antioxidants with broad spectrum of health promotion properties (Yashin et al. 2017). For a quick reference, various antioxidants and their sources are presented in the Table 1 and the role of anti-oxidants in different diseased conditions in humans is presented in the Figure 1. It is always good to understand how our dietary habits affect our system. The de-lineation of the molecular mechanisms indirectly re-enforces the age-old maxim, 'You are what you eat'.

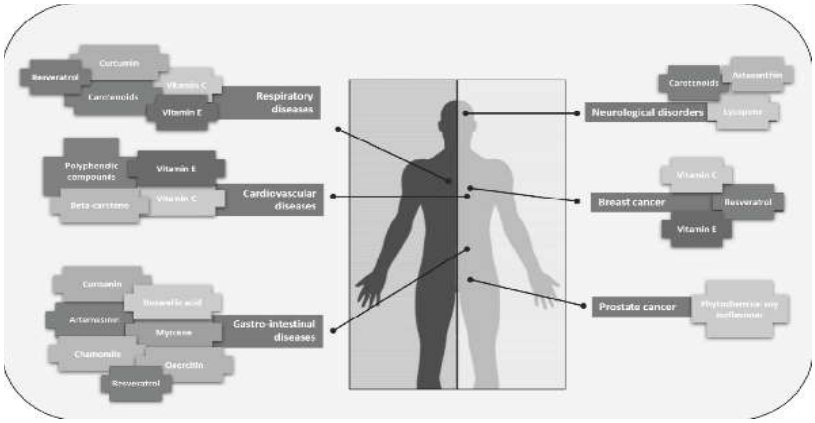

Figure 1: Dietary antioxidants linked with different human diseases.

Table 1. Sources of Natural antioxidants

Antioxidants	Common Sources
Beta-carotene	Carrots, spinach, tomatoes, sweet potatoes, papayas, apricots (Grune et al. 2010)
Vitamin C	Citrus fruits-orange, lemon, bell pepper, broccoli, kale, strawberries, kiwi, pineapple (Chambial et al. 2013)
Vitamin E	Cooking oils-sunflower, safflower, olive, cauliflower, sprouts, broccoli, cereal grains, meat, milk, butter, eggs (Grilo et al. 2014; Rizvi et al. 2014)
Flavonoids polyphenol	Potatoes, tomatoes, lettuce, onions, wheat, dark chocolates, red wine, grapes, black tea (Tsao 2010)
Isoflavones, Neoflavonoids and Chalcones	Soybean, red clovers, apple (Tsao et al. 2006, Tsao et al. 2003)
Flavones, Flavonols, Flavanones and Flavanonols	Citrus fruits (Kawaii et al. 1999)
Proanthocyanidins	Grapes, apple, blue berries (Tsao 2010)
Anthocyanidins	Black rice (Anderson et al 2006)
Polyphenolic Amides	Oats, chilli pepper (Davis et al 2007; Bratt et al 2003)
Non-flavonoid	Green tea, blue berries (Tsao 2010)

polyphenols	
Resveratrol	Grapes, red wines (Salehi et al. 2018)
Ellagic acid	Strawberries, raspberries (Abe et al 2012)
Lignan	Flaxseed, sesame (Rodríguez -García et al 2019)
Curcumin	Turmeric (Stanić 2017)
Lycopene	Tomatoes, papaya, watermelon, guava, pink grape-fruit (Emmanouil et al 2016)
Coenzyme Q 10	Organ meat- heart, liver and kidney, fish, wheat bran (Saini 2011)

4. Role of antioxidants in diseases

4.1 *Cancer*

Several observational studies showed that the risk of cancer is inversely related with dietary vegetables and fruits rich in antioxidants (Willett 2010). In most cancer models, tumor dependent immunosuppression promotes evasion of malignant cells via host's anti-tumor immune responses, which can also be modulated by antioxidants. In a mouse experimental model, antioxidants like curcumin were shown to restore tumor-induced depletion of host CD4+/CD8+ T cell proliferation and inhibition of apoptosis of thymocytes and splenocytes (Bhattacharyya 2010). In cases of breast cancer, Resveratrol, a dietary polyphenol inactivates Stat3, prevents generation and function of tumor-evoked regulatory B cells and inhibits lung metastasis of breast cancer(Lee-Chang et al. 2013). Chemotherapy, radiotherapy and immunotherapy are widely used in the management of majority of cancers. After treatment with these modalities, a sizeable number of patients experience adverse effects due to chemotherapy and/ or radiotherapy induced free radical injury to normal cells. Antioxidants like phytochemical soy isoflavones, protects normal cells from radiotherapy induced toxicity in prostate cancers (Raffoul et al. 2007). Dietary antioxidant supplements like Vitamin C and E reduces risk of breast cancer recurrence and overall mortality from breast cancer (Greenlee 2012).

4.2 *Cardiovascular Diseases*

After several *in vitro* and *in vivo* studies suggested role of antioxidant vitamins C, E and beta-carotene in preventing or slowing down the progression of atherosclerotic processes (Maeda et al 2000; Devaraj et al 1996; Romanchik et al 1995), large scale clinical trials were conducted. Some experimental studies indicated that antioxidant vitamin supplementation cause reduction in cardiovascular events by preventing endothelial damage and proliferation and production of foam cells (Stephens et al. 1996; Hozawa et al 2007; Wannamethee et al 2006). Polyphenolic compounds are abundant in plants and are readily found in fruit and vegetables. In addition, they are important components of herbs and spices and are likely to be critical ingredients in Chinese medicines. Polyphenolic compounds can directly interact with ROS, block generation of free radicals by inhibiting xanthine oxidase enzyme and chelates iron and copper (Quideau et al. 2011). Polyphenols prevents lipid peroxidation and uptake of oxidized LDL by macrophage (Yamakoshi et al. 1999; Kaplan et al. 2001). Joshipura*et al*. found that intake of green leafy vegetables and a vitamin C rich fruit provides protection against coronary heart diseases (Joshipura et al. 2001) A significant reduction in ischemic stroke, unstable angina, acute myocardial infarction was seen when vitamin E supplements were given to pre -existing coronary heart disease patients (Stephens et al. 1996; Boaz et al. 2000).

4.3 *Neurological Disorders*

Oxidative stress induced cell damage, impaired damaged DNA repair and mitochondrial dysfunction are well established factors in the development of neurodegenerative disorders like Alzheimer's disease, Parkinson's disease, Huntington's disease and familial amyotrophic lateral sclerosis (Kim et al. 2015; Federico et al. 2012).In addition, increase in protein aggregates activates microglia cells and leads to sustained neuroinflammation (Masgrau et al 2017).Microglia releases several cytokines and chemokines which aggravates oxidative stress and results in neuronal damage(Frank-Cannon et al. 2009). Dietary antioxidants have the potential to prevent, delay, or ameliorate these disorders. In vitro and animal model studies support the potential

beneficial role of various dietary antioxidant compounds in neurodegenerative diseases. In murine models of Alzheimer's disease, dietary lycopene administration attenuates mitochondrial oxidative damage, inhibits pro-inflammatory cytokines in brain and suppress protein aggregation (Prakash and Kumar 2014; Katayama et al 2011).

In Parkinson's disease, lycopene-rich tomato powder intake prevented decline in striatal dopamine neurotransmission and degeneration of nigral dopaminergic neurons in rodent models (Suganuma et al 2002; Di Matteo et al 2009). Similarly, lycopene showed protection against Huntington's disease induced by 3-nitropropionic acid in rodent models (Prakash and Kumar 2009). Also, lycopene treatment was shown to be effective in in cultured cell models of Alzheimer's disease and Parkinson's disease (Qu et al. 2011; Yi et al. 2013). Dietary carotenoids like fucoxanthin, astaxanthin, and crocetin were found to be protective against Alzheimer's disease (Xiang et al. 2017; Lobos et al. 2016; Tiribuzi et al. 2017). Astaxanthin inhibits oxidative stress and provides neuroprotection in Parkinson's disease and familial amyotrophic lateral sclerosis (Ye et al. 2013; Isonaka et al. 2011).

4.4 *Gastro-intestinal Diseases*

Irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD), which includes Crohn's disease and ulcerative colitis are associated with oxidative stress (Balmus et al. 2016; Mete et al. 2013). Several studies suggested role of dietary antioxidants in CD, UC and IBS. Curcumin, derived from Curcuma longa plant, found to be useful in ulcerative colitis when combined with mesalamine drug in a random double-blind controlled study (Lang et al. 2015). Other dietary antioxidants, like, boswellic acids (Gerhardt et al 2001), artemesinin, myrcene (Krebs et al 2010), *T. wilfordii* (Zhu et al 2015), and fish oil (Feagan et al 2008), found to be beneficial in Crohn's disease. Also, Chamomile (Langhorst et al 2014), and fish oil (Barbosa et al 2003) improved the oxidative stress in Ulcerative colitis. Liver is the principal detoxifying organ. It metabolizes various compounds that produce reactive oxygen species. Oxidative stress as a result of environmental pollution, drug overdose, alcohol intake and high calorie intake leads to liver diseases (Jadeja et al. 2017). Curcumin and Quercetin has demonstrated hepatoprotective actions on acute and chronic liver injury (Wang et al 2012; Reyes-Gordillo et al 2007; Hernández-Ortega et al. 2012). Resveratrol protects against alcohol-induced lipid peroxidation in animal models (Kasdallah-Grissa et al. 2006).

4.5 *Respiratory Diseases*

Vitamin E, vitamin C, beta-carotene, polyphenols, catechins, flavonol and flavone have been speculated to have therapeutic effects in Chronic Obstructive Pulmonary Disease (COPD) patients (Grievink et al. 1998; Santus et al. 2005). Elevated levels of dietary antioxidants lead to lower prevalence of chronic bronchitis and dyspnea (Rautalahti et al. 1997). An increase of Vitamin C levels by 20 mmol / L was associated with a 13% reduction in the risk of COPD (Sargeant et al. 2000). Resveratrol and curcumin inhibit inflammatory response seen in COPD (Kode et al 2008; Biswas et al 2005). Recently, a cross-sectional study in Korean population, revealed that dietary antioxidant like carotene, vitamin A and C intake was beneficial in male smokers with COPD (Hong et al 2018). Oxidative stress might exacerbate asthma by increasing airway inflammation, and responsiveness (Fitzpatrick et al 2009). Several studies suggested an association between low vitamin E intake and increased severity of bronchial asthma (Nurmatov et al 2011; Pearson et al 2004). Vitamin C intake aided recovery in exercise induced asthma (Kurti et al 2016). Carotenoids consumption was found to reduce airway inflammation (Lovett-Racke et al 2002) and associated with low prevalence of asthma in women (Romieu et al. 2006).

5. Conclusion

Oxidative stress occurs from the imbalance between free radical production and antioxidant defenses. Oxidative stress is involved in various diseases such as cancer, cardiovascular, respiratory, gastrointestinal and neurological disorders. Dietary antioxidants are widely reported to exert a protective effect in cells and animal models. Therefore, further research should focus on disease specific, molecular target oriented dietary antioxidants.

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AUTHOR DECLARATIONS

The authors declare that they have no conflict of interest for this piece of work. JS conceived the

the review article, collected information, prepared the rough draft, proof-read and revised the manuscript, constructed the table and provided final approval for submission of the manuscript. RR provided substantial intellectual input for different sub-sections, created the figure, proof-read and revised the manuscript and approved the final version of the article.

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Detection of adulteration in daily food items : Insights into laboratory procedures

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Abstract

Food adulteration is a widespread global problem. Consumption of adulterated food has both short and long- term health implications. Presence of adulterants in immunity booster foods, plant beverages, spices and condiments are a growing cause of concern as these are taken almost daily and can pose high health risks. Most incidents of the food adulteration go unnoticed as small doses of adulteration do not show immediate effects. Deaths of infants and children due to intake of adulterated food, especially infant milk and powder milk has pushed the regulatory agencies to impose strict penalties on individuals and industries involved in such acts. Detection of adulterants require huge investments and often regulatory agencies, or small food testing labs do not get adequate support to setup of sophisticated equipment for detection of adulterants. Therefore, microscopic techniques and micro-chemical tests that do not need extensive paraphernalia and that can be carried out in any basic science laboratory can be reliable and alternative methods to detect adulteration in common food samples. These techniques are scientific, qualitative standard techniques that are authenticated and accepted worldwide. Lately, techniques like DNA analysis and ELISA based techniques are also being used for detection of food adulterants. Sensors with enzyme-based probes are also being used and these are used by many industries. However, the methods come with their own pros and cons. Further improvements in the techniques that are portable and simple will help in containing and detecting the problem of adulteration. The methods are cost-effective and approved by the food regulatory agencies and certified protocols are available. The methods are mostly qualitative and are reliable and dependable.

Key words: Adulteration, Health risk, Laws, Regulations, Laboratory methods

1. Introduction

Food is an important resource that is required to lead a healthy life. Food contains carbohydrates, proteins, fats, vitamins, and minerals that provide nutrition to the body, helps in the growth of the body and build a strong defence system to fight diseases (Das et al., 2017; Uauy 2005). It is not only the quantity of food but the quality of food that is important to lead the healthy life (Chen 2011). The quality of food is compromised on account of various reasons such as improper storage, contamination on field or during transport or due to adulteration (Grunert 2005). Most of the food that is derived from natural resources in unprocessed form is generally unadulterated. Adulteration of food can occur unintentionally at various stages of supply chain or is carried out with a proper intent (Khan 1992). Around fifty seven percent of people across the globe have developed health problems due to ingestion of adulterated and contaminated foods. It is estimated that around 22% of foods are adulterated every year. According to Singh and Dwiedi (1995) the incidents of food adulteration all over the world and in India increased substantially due to spurt in small and medium scale food processing units. Food adulteration has been termed as an emergency as ingestion of adulterated

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food items is causing adverse health effects. Incidents of adulteration of basic food items such as cereals, pulses, oilseeds, spices, and food products derived from these have been reported in many countries including India (Srivastava 2015; Verdu 2016). Debasing the quality of food intentionally by either adding or replacing the food substances with undeclared alternative components has become a regular practice of some traders. Food industry has also noticed that some traders indulge in removal of some valuable components from the food which is also considered as a fraudulent practice by the industry. It has also come to the notice of Food Corporation of India (FCI) that many food commodities from India that were exported were confiscated and rejected on the grounds of adulteration. Practices such as addition of some flavours and substances to improve shelf life of processed food items randomly can also result in food adulteration. According to a study carried out on the meat products by Montowska and Fornal (2019) fraudulent adulteration of food products with undeclared components might also have allergenicity potential. Food adulteration practice by unscrupulous traders is usually done to lower the cost of the food items so that sales can be improved. Small vendors add cheap adulterants to increase the bulk of a given food product for economic gains. In a review on adulteration of food at global level, Ayeza and Billet (2015) have pointed out that food adulteration is a global problem and the industry and market of adulterated food constitutes a billion-dollar industry.

Food adulteration besides having health implications also has economic implications on a country like India. India is an exporter of spices, beverages, and many other plant-based foods. Jaffee (2005) in an exhaustive economic evaluation study on adulteration of spices pointed out that many consignments of red chilli were recalled by European Union as these were found to be adulterated with Sudan III. Common food commodities like milk, milk products, pulses, spices, packaged juices and meat and poultry products collected from various places in separate studies by CSE (Centre for Science and Environment) and Food Safety and Standards Authority of India (FSSAI) laboratories have found some amount of adulteration in all India survey of food items by random sampling. Scientists working in food industry and research institutes have studied the impact of adulterants in food on nutritional quality and other parameters. It is important to forecast risks involved in food adulteration as it can protect the consumers. People who are at more risk, especially people with comorbidities, children infants and adults should be protected, and adequate care should be taken about their diet. However, it is only after the comprehensive food policy that adulteration of food was noticed as an issue requiring concern. It was clearly mentioned that Food Testing and Analysis is an essential part of the food safety ecosystem of the country. FSSAI recognizes and notifies NABL accredited food laboratories under Section 43 of FSS Act, 2006 and these laboratories have been licensed to test the food items for their health and nutritional quality and to detect the fraudulent adulteration. Government of India has also clearly specified the punishment and penalties to be imposed on people or an industry who are found guilty of any adulteration in the food. The consumer protection bill presented in the parliament on 5th January 2018 called for strict punishment for person who indulges in fraudulent practice of adulteration.

2. Food Safety Regulations, Government of India (2011)

Food Safety and Standards, Government of India, Ministry of Health and Family Welfare has put forward various regulations regarding the food safety issues. These regulations are important from the consumer perspective as these are guiding principles from food processors, manufacturers, small traders, and other organizations that are involved in packaging, storage and procuring of food. Main guidelines that are included in 2011 document include: Licensing and Registration of Food Businesses by both small and medium enterprises; Packaging and Labelling of food; Laboratory and Sampling Analysis of processed and unprocessed food and Food Product Standards and Food Additive Regulation.

Besides, the laws and legislations that meet the consumer needs are important. It is also important that consumers are made aware about the undesirable components in food, health implications.

Punishment for Adulteration

1. Minimum imprisonment of six months and a minimum fine of Rs 1,000 is penalty for the person who is convicted for import, manufacture, storage, sale, or distribution of adulterated food.

2. Penalty is minimum imprisonment of six months that may extend up to 3 years and minimum fine of Rs 1,000 is the punishment sanctioned for import, manufacture, storage, sale, or distribution of food that causes adverse health impacts.
3. Imprisonment of six months that may extend up to 3 years and minimum fine of Rs 1, 000 if problems are created while audit and collection of food samples by food inspectors.
4. Minimum imprisonment of six months that may be extended up to 3 years and minimum fine of Rs 1, 000 can be put on person who gives false warranty for the quality of food.
5. Minimum imprisonment of one year that may extend up to six years and minimum fine of Rs 2, 000 for safe and distribution of adulterated food.
6. Minimum imprisonment of three years that may extend up to life and minimum fine of 5, 000 rupees for sale or distribution of food products that are likely to cause death or serious harm to the body.

3. Adulteration of Common Food items of daily use

The recent data of food items shows that almost 50% of the foods that we eat everyday are adulterated. According to FSSAI report (2011), milk is one of the most adulterated food commodities. In a study carried out all over the country, in 1,791 milk samples, 68.4% of the samples departed from Food Safety Standards Authority of India. Kamal and Karuoi (2015) found that many milk food products and dairy products procured from the local vendors were adulterated with variety of substances ranging from less harmful to dangerous. Analysis of the common non-alcoholic beverages such as tea and coffee that are consumed for various health benefits almost daily are adulterated with various substances that affect the digestive and renal systems (Fang 1988). Tea leaves *Cammelia sinensis* are adulterated with artificial colour or with inferior quality tea. Top three leaves are used to make best quality tea, however inferior quality tea contains lower leaves that have low tannins and phenolics. Moreover, tea leaves are dyed with artificial colour to increase profit. Tea is also adulterated with dried consumed leaves to increase the bulk. Analysis have been carried out on samples collected from open markets, factories and fields by various people both from industry and academia to find out the adulteration source and quantum of adulteration. Interesting analysis (Bhatt 2003) and Pal and Das (2011) on tea samples independently to determine the presence of different adulterants showed high degree of adulteration and it varied with the cost of the packaged product. High cost tea sold in air-tight packs was less adulterated than low cost tea sold in open markets. Coffee, *Coffea arabica* beans and coffee powder were also found to be adulterated with coffee husks and stems, maize, barley, chicory, wheat, brown sugar, soybean (Toci et al., 2016). Honey, the other popular item of daily use is adulterated with various compounds both natural and synthetic. Honey adulteration is a topical issue as its importance in alternative medicine has increased widely. Besides, people are using sophisticated adulteration methods to earn profits. There are no quality indicators to detect honey adulteration. Fruit juices that are available in stores from various brands have also been implicated with adulteration. Colours, dyes, plant extracts of weeds are used to adulterate the juices. Authentic saffron is a trifid stigma that is collected from flowers of *Crocus sativus* and is an expensive spice and considered highly valuable in international market, but it is adulterated with ray and disc florets of Asteraceae flowers. Turmeric is adulterated with synthetic yellow dyes, both of organic and inorganic nature. Shuai et al. (2014) established that flax seeds that are a source of vegetable oil and are now-a-days used in baking and nutraceuticals is also adulterated with other vegetable seeds and detection possible only by chemometric methodology. The dropsy epidemic in Delhi in early 1990s brought into notice the adulteration of mustard seeds used to extract mustard oil, the most common cooking medium with Mexican yellow poppy seeds. The addition of papaya seeds to black pepper is also commonly done to make easy profit. Pulses are mixed with seeds of legumes with low protein value in many parts of India.

4. Detecting adulteration in Foods using Various Methods

Table 1. Low cost Laboratory Methods for Detecting Adulteration

Checking Adulteration in Tea

Detection of artificial colour	Spread tea leaves on the surface of clean glass containing water	Changes in the colour of water.
Detection Iron fillings	Spread tea leaves in a plate and hold a magnet near the leaves	Attachment to magnet confirming the presence
Detection of coal tar dye	Tea in water +5 ml of concentrated Hydrochloric acid	Pink or crimson colour indicated the presence
Detection of Catechu	Tea leaves + 5ml water +few drops of lead acetate solution. Addition offew drops of silver nitrate.	Appearance of greyish cloudiness
Test for Azo colour	Sample + strong alcohol and solution evaporated to dryness. Add water	Red or yellow or orange) indicated adulteration with azo dye.
Detection of Chicory	Tea + few drops of HCl+ 15 drops of potassium ferrocyanide solution. Boiledtill the appearance of dark green colour.	Brown and murky suspension

Detection of Adulteration in Common Foods

Food Product	Adulterant	Detection
Milk	Water	Pour milk on a polished slanting surface. Pure milk flows slowly, whereas milk adulterated water will flow fast.
Milk	Starch	Few drops of tincture iodine or iodine are added to milk and observation of blue colour indicates the presence of starch.
Milk	Urea	Mix the soybean flour or pigeon pea flour to milk and agitate the mixture with shaking. Colour change from red to blue indicates the presence of urea in the milk.
Milk	Detergent powder	Frothing of milk by continuous shaking and soapy tinge indicates adulteration.
Milk	Synthetic chemicals	Bitter taste and soapy touch after boiling indicate synthetic adulterants.
Spices	Excreta and other particles such as stones, vegetable waste, dust	Visual examination by looking at the mixture and sieving show the additions
Pepper corns	Papaya seeds	Papaya seeds can be separated out from pepper as they areshrunken, oval and greenish brown or brownish black in colour and have perisperm when section is cut.
Green chilli andleafy vegetables	Malachite Green	Cotton soaked in liquid paraffin and rubbed on the products. If the cotton turns, green shows presence of malachite green. Washing with water and detection of colour also shows use of malachite green.

Cumin seeds	Coloured grass seeds and charcoal	Rubbing of green seeds with palms is done and if palms turn black adulteration is indicated.
Saffron	Dried tendrils of Maize cobs and vegetable stuff	Genuine saffron is a stigma of saffron flower. The adulterants break easily and if put in water loose colour immediately.The authentic saffron can be verified by microscopic examination and checking the colour change.

Source: FASSI Manual, 2011

It is becoming increasingly important to have methods that are reliable, reproducible, and dependable to detect the adulterants. Various methods that are being used to detect food adulteration. Paper Chromatography, Column Chromatography, Spectroscopy, Nuclear Magnetic Resonance, Stable Isotope analysis are some the sophisticated and advanced techniques that are being used (CABANero et al., 2006). The advanced instrumentation is highly priced but works with precision and even minute quantities of adulterants are detected. Metabolomics and proteomics and other throughput technologies are also used now-a-days in Food Industry (Cordella, 2002). These methods rely on expertise in handling the equipment, high quality analytical reagents and costly machines that need to be housed in laboratories that are facilitated with support system and uninterrupted power supply. Scanning Electron Microscopy can provide rapid information concerning the morphology of a solid sample, as well as identifying the chemical elements present. The method does not require prior sample preparation, as in optical microscopy, it entails a series of comparisons between samples and potential adulterants (Lopez, 1983). It has been found that DNA based techniques focused on the detection and determination of nucleic acid probes and their sequences, serve as a characteristic fingerprint to detect the adulterants, and determine the authenticity of a variety of food products. Contemporary techniques such as polymerase chain reaction (PCR) offer the potential for the identification of DNA. DNA molecular markers are employed to identify different species or varieties of plants and thus can identify if the product is from the authentic source. Molecular markers such as microsatellites have been used in the characterization of *Coffea* species, enabling discrimination between *C. robusta and C. arabica* and detection of the presence of adulterants. Martellossi et al. (2005) demonstrated that DNA can be obtained from roasted beans and even from instant coffee and then amplified by PCR and further used for finger printing. According to Lee et al., (2005) pH differential method has been used extensively by food technologists and horticulturists to assess the quality of fresh and processed fruits and vegetables. Pigments such as carotenoids and anthocyanins can also be used as makers. Determination of total monomeric anthocyanin content based on the structural change of the anthocyanin chromophores is frequently being used to determine the authenticity of beverages extracted and made from fruits. Quality control of anthocyanin-containing fruit juices, wines, natural colorants, and other beverages is determined by pigment estimation using spectrophotometers. Johanathan et al. (1980) suggested that honey has many components that are added to enhance the flavour of the end-product. Baroni et al. (2016) carried out studies on detection of adulterants in various honey samples by looking at pollen proteins. Besides this, SDS page and electrophoresis are used for detecting adulteration in honey (Won, 2008). Hand cut sections of pepper show distinct features such as wall structure and perisperm which is not present in papaya seeds. Hand cut sections of tea can also be identified as the leaves have characteristic anatomical features such as oil glands and tannin cells (Kochhar, 2016, Verma 2009). Most of these methods need both expertise, understanding and training. Also, some background knowledge of chemistry and biology is important.

Some low-cost practices and rapid qualitative tests are being used by many small-scale industries and food testing laboratories. These procedures require simple laboratory glassware, few reagents, and instruments. These procedures can be carried out by anyone with basic knowledge of science. Most of these methods are qualitative and portable.

Conclusions

Technological advancements are making it easy to detect fraudulent adulteration in food. Traders have also become alert and smart to use methods that can escape surveillance. Though there are many methods of finding adulteration in foods, no method is universal. Efforts need to be made to devise novel methods of

detection of adulteration. Biosensors that are universally acceptable and can be adopted to many food commodities need to be made available. The entire supply chain needs to be warned and educated. A cross talk between producers, suppliers, marketers, risk assessment researchers will help in developing a safety assessment protocol. The local food vendors need to be educated about food safety by food safety inspectors, and experts from industry and academia. The affordable portable kits should be made available to the households so that the safety of common foods is ensured. Food safety has implications on society and thus more campaigns against adulteration need to be carried out. Educational institutions can play an important role in raising awareness and also in developing innovative safety kits as part of their social responsibility.

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E-waste in India: a concern for environment and public health

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Abstract

Modern computerized world and progression in Information Technology (IT) has revolutionized our lifestyle drastically. Human life is highly dependent on electrical equipment; simultaneously it has also led to the production of huge amount of electronic wastes (e-wastes). Over the time, e-waste accumulation has caused heavy metal toxicity and contaminated the environment. Globally, India is among the top importer of e-wastes from other countries for recycling and extracting important metals for reuse. India has a load of almost two million tonnes of e-waste per year along with an undisclosed amount of imported e-scrap. Ever rising demand of electronic devices has forced up countries to develop regulations for proper disposal and transport of e-waste but concern remains about their strict application. Majorly, disposal of e-waste is crude and improper that causes leaching of inorganic substances (Tin, Lead, Cadmium, Nickel, Arsenic, Copper, Mercury, polychlorinated biphenyls and plastics) in the environment. Under these circumstances, it becomes mandatory to device means for proper disposal of e-wastes and focus on reduce, recycle and reuse. Herein, we highlight the status of e-wastes in India and the subsequent impact on soil quality, human health and environment.

Keywords: Disposal of e-wastes, Environ-mental pollution, E-waste, Human health, Heavy Metal Toxicity.

1. Introduction

"E-waste (electronic waste) or Waste Electrical and Electronic Equipment (WEEE) are mainly discarded, surplus, outmoded, broken electrical (electronic) devices. These also include electronic goods destined for refurbishment, reuse, resale and salvage recycling through material recovery or disposal*" (*Perkins et al 2014). Briefly, "E- waste is any such discarded electronic product which cannot be put to use further and needs recycling or may be dumped" (Heacock et al 2016). The industrial revolution and the upswing in Information Technology (IT) has tremendously changed the way of working; although this development has proved to be beneficial but the mismanagement has posed new challenges of contamination and pollution. With new handy inventions like laptops, tablets, mobile phones and other electronic gadgets; the number of electrical products consumers has increased manifolds. They have now become the most commonly used devices for various purposes at schools, offices, houses, manufacturing companies and IT sectors.

In India and most developing countries, there are fewer guidelines on e-waste disposal and therefore people lack awareness, resulting in compilation of waste electronic products from households and industries. E- waste is not completely waste as the term implies, it comprises of various elements and

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substances that can be preferably harvested and reused such as precious (gold, silver, platinum and palladium) and useful metals (aluminium, iron, copper, tin, silicon, zinc) (Pradhan, 2013). India is also one of the major importers of discarded e-scrap as it serves as substantial resource to retrieve back precious and useful metals into the production cycle.

The "e-waste trade and recycling alliances" sector has provided a source of living to a major section of the population. In India, 25,000 workers and children are working in "crude dismantling units" in national capital itself wherein approximately over 20,000 tonnes of e- waste is being handled without proper precautions. These perilous content can cause serious health-hazard and environment implications, which is of utmost concern (*The Conversation)*. This is a global challenge as the consumption and ultimately dumping, are gaining rapid speed and has emerged as major contributors to the total municipal wastes. Therefore, here is an urgent requirement of efficient and eco-friendly system for "e- waste management" (Awasthi et al 2016).

2. Sources of E-waste

E-wastes are mainly generated by wastes from the IT world, which often deals with the use of electronic devices and equipment but their usage in household is equally gaining popularity. The sources of e-waste can be computers, monitors, keyboards, printers, speakers etc; or from electronic devices used for entertainment purposes such as TVs. DVDs, and CD players, etc. It can also be from equipment or devices used for communication such as mobiles, landline phones, I-Pods, Tablets, Fax etc.; household equipment's like vacuum cleaner, microwave oven, AC, washing machine, CFL, bulbs, fluorescent tube lights etc.; audio-visual components such as VCRs, Stereo equipment etc.; monitoring and control devices; toys and sports machines; medical equipment such as CT scan, MRI etc (Osibanjo et al 2007). Out of many electronic devices, a computer itself is manufactured using many toxic components. such as heavy metals ranging from Pb in Circuit boards, Cd in batteries; Lead oxide and Barium in cathode ray tube (CRT); Brominated Flame – retardants (BFRs) dioxins and furans (highly toxic) that are released from casings (plastics and cables) while extracting valuable metals upon combustion, Hg used in flat screens and switches; polychlorinated biphenyls (PCB) used in transformers and capacitors etc. (Ramachandra et al 2004). According to Basal Action Network (BAN), millions of computers in the world have produced 2.87 billion Kgs of plastics, 716.7 million Kgs of Pb and 286,700 Kgs of Hg (Ghatge et al 2013). For instance, the average 14 -inch monitor contains 2.5 to 4 Kgs of Pb, which is known to leach and subsequently contaminate the surrounding air, water and soil (Song et al 2014).

Table 1. Toxic substances released from E-Wastes and their harmful effects

Toxic substances	Sources	Potential harmful impacts
Sulphur (S)	Found in lead acid batteries	Can cause damage to eyes, heart, kidneys, liver, throat etc.
Mercury (Hg)	In switches and circuit boards	Affect aquatic life by forming Methylated mercury (toxic) and affect central nervous system , kidneys and immunity of human beings
Lead (Pb)	Used in CRTs, microchips releases lead as powder and fumes.	Acts as neurotoxin that may affect kidneys, reproductive system and cause mental retardation in children.
Chromium (Cr) – VI (hexavalent)	Used to save computer plates metals coverings from corrosion	Causes bronchitis and lung cancer, asthma by inhaling hexavalent Chromium, can affect functioning of liver and kidneys.
Beryllium (Be)	Used in CRTs, circuit boards, and released as powder when crushed.	Carcinogenic, may cause severe pain in joints and spine may also affect bones and kidney.

Cadmium (Cd)	Used in Nickel-Cadmium batteries, light-sensitive resistors, corrosion-resistant alloys, etc	May cause leaching into the soil and adversely affect soil ecosystem by harming soil microorganisms inhalation may also damage kidney and lungs.
Brominated Flame Retardants (BFRs)	Plastic coverings of circuit boards	Affect endocrine system functioning.
Barium (Ba)	CRTs for its top cover damage the heart and vital organs like spleen	It's hazardous as short term exposure may and liver. Sometimes mild effects like muscle weakness may also occur.
Americium	Some detectors	Radioactive and carcinogenic.
Plastics including PVC	Used in manufacture of circuit boards and cables immunity.	Carcinogenic BFRs releases carcinogenic chemicals that can affect reproduction and

3. Current status of E-waste burden on India

The IT & Communication industries are increasing at the rate of approximately 20% yearly. With the increasing per capita income and advancement, India ranks 2nd largest e-waste producer in Asian continent. Ministry of External Affairs (MOEF') 2012 report states that in the last 7 years the e-waste output has jumped 8 times reaching 8 lakh tonnes. E-waste comprises of 70% of total toxic waste prevalent in landfills causing heavy metal toxicity of natural resources. Merely 40% of total e-waste produced in India are recycled through disposal and processing and remaining 60% left out at the dumping sites due to lack of efficient assortment and disposal methods (Awasthi et al 2016).

Although no definite official data is available on e-waste generation and its disposal in India, however various independent studies and estimates conducted by NGOs or governmental agencies are available. According to the data released by the Central Pollution Control Board (CPCB), India produces 0.573 million tonnes of e-waste per day. A research conducted by Electronic Industry Association of India at the electronic industry expo –"Componex Nepcon 2009", total e-waste in India was estimated around 4.34 lakh tonnes. Another report by CAG highlighted that around 4 lakh tonnes of electronic wastes were produced in the country annually (Agarwal, 2010). Manufacturers Association for Information Technology (MAIT) revealed through studies that left out / obsolete electronic items will rise drastically in the developing countries with in a decade at the global level, with computer waste in India itself showing growth by 500%. A survey by ASSOCHAM (a trade association of India), predicted that 5.2 Million tonnes of e-waste will be produced annually by the end of 2020 (https://www.downtoearth.org.in/blog/waste/recycling-of-e-waste-in-india-and-its-potential-64034).

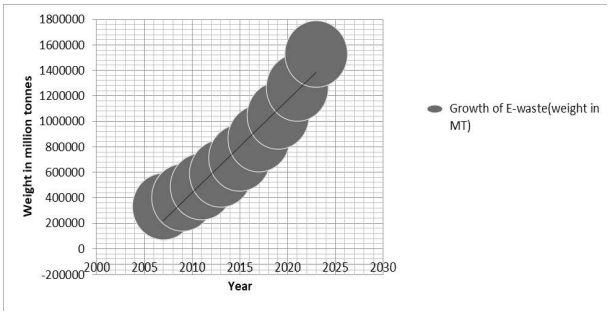

Figure 1. Year wise data of E-Waste generated in India (growth as weight in Million Tonnes)

Source: Department Of Information Technology, India

If the state wise data is taken into consideration, ten states (India) amounts to 70% of total e-waste produced in the country, while 65 cities produced more than 60% of total e-waste in India. Maharashtra tops among the ten states producing major e-waste followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab (**Figure 2)**.(https://telecom.economictimes.indiatimes.com/news/maharashtra-top-e-waste-generating-state-in-india-study/64448215).

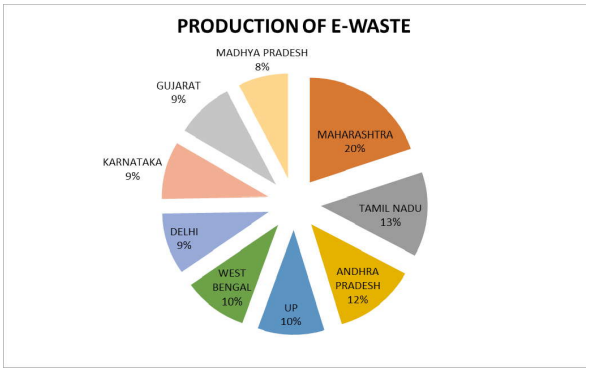

Figure 2. Top ten states generating e-waste in India (value indicated as tonnes/year)

Source: Department of Information Technology, India

The top ten cities producing e-waste are Mumbai followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat & Nagpur (Pradhan, 2013).

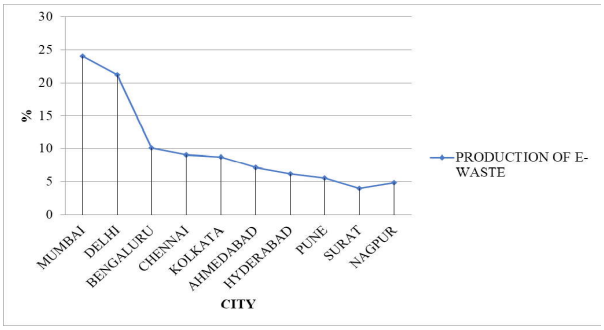

Figure 3. Major cities contributing towards e-waste generation in India

Source: Department Of Information Technology, India

All the government and private industrial sectors contribute to 70% of total e-waste produced in our country. The household e-scrap adds upon 15% of the total waste and the remaining being contributed by electrical equipment manufacturers (Joshi, 2009).

4. Different Approaches to minimize E-waste Accumulation

There are different means by which accumulation of e-wastes can be reduced such as proper disposal, re-use and re-cycling. Although disposal of e-wastes is achieved by land filling, incineration, but none of them are effective in providing complete relief from harmful effects of e-wastes (Awasthi et al 2018). Land Filling is the foremost practiced method for e-waste disposal, in which trenches are formed. Generally, even land surfaces are selected and e-waste is buried in the manmade trenches and covered by another layer of soil to form land base. Recent development in this technique involves the secure landfills, which is provided with various features of impervious liner composed of plastic or leachate collection basin that directs leachate to treatment plants for wastewater processing. But depletion of the pollutants and contaminants in landfills takes long time through a complex process. Along with this, there is a potential risk to the environment that cannot be dodged simply; particularly those caused by leaching of toxic materials into the soil by disposal of e-waste. Hg, Pb and Cd are some of the commonly found leachate in the soil used for landfills. Landfills are also vulnerable to fire resulting in production of poisonous fumes in the atmosphere. Therefore, this method of disposal of e-waste is not environment friendly since contaminants, which are volatile, and non- biodegradable such as Hg, Cd, PCBs, BFRs, etc are not depleted (Chakraborty et al 2018) by this method.

The other method of e-waste disposal is incineration which is a process of complete combustion of e-waste at very high temperature of 900-1000° C in specially designed incinerators. This helps in reduction of total volume of e-waste and utilization of energy released from combustion. This process also aids in recycling of certain metals like iron and conversion of hazardous organic substances into less hazardous chemicals. However, emission of various toxic gases from burning of Hg and Cd escapes out from flue gas cleaning chamber that are released in the atmosphere which contributes enormously to the annual release of volatile toxic substances. Hence, incineration leads to increase in the emission of toxic gases unless proper measures are taken for removal of heavy metals (Li et al 2015).

Re-use of e-waste is the second-hand use of original electronic equipment, either directly or after minor treatment / processing. This method is generally useful in reducing total volume of e-waste generated but is majorly dependent on the condition of the electrical equipment. Large MNCs and various government companies buy the used items back from the consumer, after making necessary alterations, sell it back in the market for its reuse. Apart from this, buying back of old /used electronic equipment should be encouraged in order to avoid unnecessary generation and accumulation of e-wastes. If this practice is followed vigorously it can significantly lower the quantity of e-waste generated and can

surpass the need of e-waste recycling and dumping. Hence, reusing is among the most appropriate way of disposal of e-waste (https://unu.edu/publications/articles/e-waste-challenges-re-use-practices-principles-and-standards.html).

Recycling is another important procedure to reduce the harmful effects of e-wastes. Majority of electronic gadgets, wires and cables can be reprocessed. Recycling mainly employ dismantling i.e. segregation of various e-waste constituents ccomprised of hazardous chemicals such as PCBs, Hg, isolation of plastics, segregation of Iron and non-ferrous metals, CRTs and circuit boards. Recyclers involve use of acids (strong) to retrieve metals such as Cu, Au, Ag and Pb. Since, the availability of dumping sites is very scarce in India and in spite of ever increasing (beyond limitation) generation of e-waste in the developing world; recycling is the most eco-friendly method for e-waste disposal (Kurian, 2007). Recycling may substantially reduce the release of heavy metals in the environment, simultaneously reducing the entry of new metals into e-waste treatment. However, the major challenge is the effective collection of wastes containing heavy metals, which seems to be less feasible because of extravagant quantities of e-waste in today's world. However, recycling of certain heavy metals (such as Nickel, Chromium) are feasible to some extent. (https://www.thebalancesmb.com/introduction-to-electronics-e-waste-recycling-4049386)

When recycling fails to serve the purpose, mineral substitution is the other way out. This ensures that toxic, heavy metals are retrieved back for manmade circulations, thereby preventing the pollution from the source point. Various substitutes of Pb, Hg and Cd have been developed for many applications such as efforts are being made for substitutes of chromium in tanning and wood preservation (Parthsarathy et al 2017).

5. Impact of e-waste on environment and public health

E-waste disposal leads to various challenges faced on a global basis. The electronic wastes if not disposed of properly may cause contamination of air, soil and groundwater and can lead to serious health implications. The toxic metals from e-wastes (such as Hg, Pb), leaches into soil and lowers its pH, thereby, causing soil acidification and also contaminate ground water. Those parts that are not suitable for recycling and extraction process are sometimes burnt in open spaces (Krishnamoorthy et al 2018) and they release toxic fumes, which may lead to severe environmental risks such as depletion of ozone layer causing global warming and may cause various air borne diseases (Awasthi et al 2016). In addition, most of the landfills are left without proper monitoring and is a future threat to environment and human life. Sometimes major accident like the uncontrolled fires in landfills may emit some serious toxic fumes and gases in the atmosphere such as dioxins and furans, volatile metallic Hg and dimethylene Hg (Ramachandra et al 2004). For instance, GUIYU in Hong Kong; China, the world's largest hub of e-waste site of disposal, is witnessing acute shortage of pure resources due to excessive ground water contamination and people are facing serious digestives, pulmonary, neurological, respiratory and bone (Osteoporosis, Osteoarthritis) related ailments and various air borne diseases due to emission of toxic fumes from incineration of e-waste. (https://www.thehindu.com/news/international/battling-e-waste-in-chinas-industrial-hub/article19743155.ece).

It has been extensively studied that the exposure to e-waste toxicants both in direct or indirect way has devastating effects on human body (**Table 1**) (Awasthi et al 2016). High levels of contaminants have been observed in blood samples of workers in the recycling units. Recyclers work under extremely dangerous conditions; workers do their job without gloves and masks and they do not have technical expertise; they work in poorly-ventilated closed spaces, being exposed to toxic gases and chemicals.

Polybrominated diphenyl ethers (PBDEs) in e-waste affect the thyroid gland and its secretions, therefore has been linked to hypothyroidism. Exposure of perfluorooctanoic acid to pregnant females made them deliver premature babies with slow neonatal development. There are reports of miscarriage and stillbirth due to heavy metal toxicity. Moreover, Pb and other heavy metal exposure leads to neurodegenerative diseases in children (Heacock et al 2018).

6. Impact of e-waste on soil health

Soil (pedosphere) is a non-renewable natural resource (for an inch of topsoil, it takes 500 or more years to be replenished), usually referred to as finite natural resources. Soil (made of solid and porous components) contains organic matter, minerals,

atmospheric gases, providing heterogeneous and conducive habitat for wide range of essential microorganisms such as bacteria, protozoa, fungi, nematodes, etc. (Mainguet 1991). This microbial life particularly, bacteria make the environment suitable by contributing significantly to the various bio-geochemical cycles (P, N_2, S, etc.). E-waste deposition in soil also leads to significant depletion of essential organic contents (macro as well as micro nutrients such as such as N_2, K, Ca, P) present in the soil. Leaching of toxic heavy metals affect the fauna as well as flora of the soil; if agricultural fields are contaminated with toxic heavy metals, it can lower the crop yield, and can cause a decline in microbial population in the soil due to exposure to toxic metals (Malhotra et al 2015). The type of bacterial community depicts the soil metabolic processes and help in accessing the soil health trends. Soil microbes play very significant role in maintaining ecological balance by decomposition and degradation of complex inorganic matter into organic ones, which is beneficial for growth of vegetation (Sangwan et al 2012). Once degraded, the recovery of soil is not possible during the entire lifespan of humans. Acidic soils (low pH) affect the soil microorganisms and disrupt the nutrient cycles.

Thus, disposal of e-waste leaches lethal heavy metals, which reasons depletion of essential nutrients in the soil, degrades soil quality, decline in microbial biomass and lowers the pH of soil and contaminates the groundwater resource, leading to abnormal growth of flora and fauna of the concerned area; thereby significantly affecting the agricultural productivity.

7. Conclusion and Future Perspectives

Developing countries like India have a crude manner of handling and disposal of e-waste. E-waste is comprised of perilous contaminants, which pose potential environment risk and has ill effects on public health especially to the people involved in e-waste management. Pregnant female workers, children and population residing around recycling units are more vulnerable. There is an utmost concern of air, water and soil pollution that will ultimately affect the mankind. It is a challenge to reduce the electrical equipment usage. The present laws for e-waste management in India need to be stringently applied for an effective e-waste disposal. It is possible by collective efforts from all the e-waste producing sectors to make a smooth chain flow of e-waste and recycling. Other ways of recycling can be adopted like the bioleaching or green process that involves the use of microorganisms that are capable of degrading or extracting metals from the e-scrap, can be explored and bioengineered.

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WRKY transcription factor super family: Role in plant disease management

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Abstract

Plants face numerous challenges in their natural habitat by various biotic stresses, which in turn trigger their stress-response related machinery. This is achieved by activation or repression of a complex system consisting of key genes coding for miRNAs, siRNAs, and most importantly transcriptional factors (TFs). Among transcriptional factors (TFs), a superfamily of WRKY TFs is considered most important as they regulate maximum number of downstream genes as well as proteins, by both direct (auto and cross-regulation) and indirect mechanisms (physical interactions within themselves or other TFs, proteins and small RNAs) reported hitherto. All the WRKY TF members possess a conserved WRKY domain consisting of nearly 60 amino acids with a specific heptapeptide sequence (WRKYGQK) with a Zn^{++}-finger motif that binds to a specific cis-regulatory element of a defense gene called as W-box (TTGAC[C/T]). This W-box has been reported to be present in the promoter region of genes related to plants' innate immunity including PAMP triggered immunity (PTI), effectors triggered immunity (ETI), basal defense and systemic acquired resistance (SAR). As a result of this specific molecular orchestration primarily in plant immunity, this superfamily has established as a good target in plant disease management. Therefore, in the present review, the focus will be on highlighting the application of the WRKY TFs and plant disease management specifically.

Keywords: W-box, *Pseudomonas*, Classification, *Botrytiscinerea,* Virus.

1. Introduction

Due to the sedentary life and changing climatic conditions, plants have to face various environmental stresses on a regular basis. Among all the stresses, biotic stresses incited by plant pathogens especially affect the growth of various food crops such as rice, barley, sugarcane, lentil, fava bean, chickpea and many more (APS 2020). Upon being challenged by phytopathogens, the plants must change their growth as well as Défense pattern which lead to modification of host-pathogen interaction (Madhusudan *et al.* 2019). Due to continuous changes in climatic conditions, new virulent races or pathovars develop, that can further infect the crops which were resistant to pathogens previously (APS 2020). Therefore, in order to combat these new entities, there is a pressure to enhance the current, as well as to develop new management strategies for phytopathogens.

To improve the strategies, special focus is also given in understanding changes occurring at the genic, transcriptional, protein, metabolic as well as the cellular levels (Chen *et al.* 2019). The converging point of all these changes can be traced back to the transcriptional regulation controlled by transcription factors (TFs). The various TFs related to stress-responsive genes are WRKY "worky", AP2/ ERF, bZIP, MYC, MYB, MADS, NAM, ATAF, CUC and NAC (Chen *et al.* 2019). Each TF consist of a specific polypeptide binding domain which binds to a sequence/stretch of DNA bases together known as *cis*-regulatory

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elements (CREs) in response to specific stress (Mittal *et al.* 2018).

Among all of the TFs reported till date, WRKY TF superfamily is of great importance as they are reported to be involved in a diverse range of plant development, defence (**Figure 1**), metabolism, senescence, wounding, stress response and much more (Chen *et al.* 2019). The WRKY TF superfamily members interact among themselves or with other key TFs, proteins, and small RNAs to regulate the target genes (Chen *et al.* 2019). Our objective in this article is mainly to discuss the WRKYTFs modulation in complex defence gene network, which is a key step for signal transduction pathways related to plant immunity. We have summarised in present article, the structure and classification of WRKY as well as downstream regulation or interaction with same or other TFs, proteins and small RNAs to regulate the defence gene for various plant pathogens such as fungi, bacteria, and viruses.

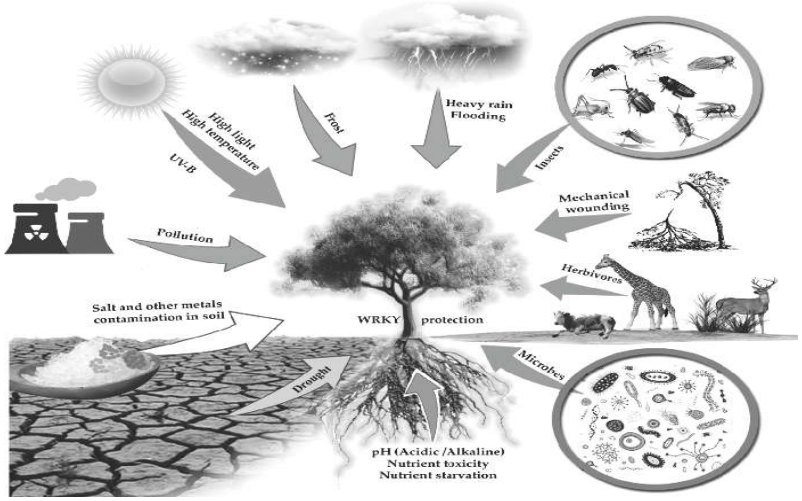

Figure 1. Schematic representation of the WRKY TFs imparted protection in plants against all biological and non-biological stresses.

Sources: Google Scholar (https://scholar.google.co.in/), PubMed (https://www.ncbi.nlm.nih.gov/pubmed) and Web of Science (https://clarivate.com/webofsciencegroup/solutions/web-of-science/) till 10th July, 2020.

2. WRKY TFs: structure

A specific and conserved DNA-binding domain is the distinguishing character of WRKY TFs which is partly protruding region of almost 60 amino acids in plants (Chen *et al.* 2019). In this region, there is an almost invariable sequence at N terminal of protein, WRKYGQK (W; Tryptophan, R; Arginine, K; Lysine, Y; Tyrosine, G; Glycine Q; Glutamine, K; Lysine).WRKY TFs generally binds to a considerably conserved region of DNA identified as the W-box elements having the conserved motif TGACC/T singly or in tandem repeats situated in the promoter region of defense genes (Chen *et al.* 2019). Recently, the WRKY domain structure with W-box as a binding site was identified, and structurally four-stranded β-sheet enters the major grove of DNA in an atypical mode termed the β-wedge, where the sheet is nearly perpendicular to the helical axis of the DNA (Yamasaki *et al.* 2012). Whereas, C-terminal of the protein consist of zinc-finger-like motif $Cx_{4-5}Cx_{22-23}HxH$ or $Cx_7Cx_{23}HXC$ formation (Li *et al.*, 2015).Tryptophan (Y) makes the core of the conserved (WRKYGQK) sequence, whereas rest of the amino acids binds to DNA. Glycine (G) helps in the formation of protrusion to make the grove for binding to W box by hydrophobic interaction with the methyl groups of thymine nitrogenous bases of the DNA. Mutation in the thymine base or Zn^{2+}-binding site drastically reduced the DNA-binding activity due to the destruction in the active structure of DNA binding domain protein (Yamasaki*et al.* 2013). Only in very few crops like *Arabidopsis* (WRIY), soybean (WHQY), potato (WHKC and WRKC), black cottonwood (FRKY), *tomato (*WRKR, WIKY, WSKY, and WQKY*) and* French bean (ARKM, WWKN, and WRMY), WRKY proteins have been reported with changes in the conserved sequence of WRKY (Mohanta *et al.* 2016).

3. Classification of WRKY TFs

In the initial days of researchInitially, WRKY TF was identified for the regulation of sporamin and β-amylase production from sweet potato as SPF1

(Ishiguro and Nakamura 1994). However, later, Rushton and group identified three different WRKY TFs (WRKY1, WRKY2 and WRKY3) from parsley in a stress response against elicitor Pep25 of *Phytophthora parasitica* and given the name of "worky" in 1996 (Rushton *et al.* 1996). This opened a way for identification of stress responsive WRKY TFs which has resulted now in a superfamily. As a result, based on the total number of WRKY domains and presence/absence of Zn^{2+}-finger-like motif, WRKY proteins are classified into three groups*i.e.*, Group I, Group II and Group III (Chen*et al.* 2019). The group I members consist of two WRKY domains, whereas Group II members have one WRKY domain along with Cys2-His2-type of Zn^{2+}-finger motif. Group II members are further divided into five subgroups IIa to IIe based on the presence of additional amino acid motifs in the WRKY domain. Group III members also contain one WRKY domain with Cys2-His/Cysor Cys2-His2 type of zinc-finger motif (Eulgem *et al.* 2000). The criterion of this classification method is exclusively based on protein structure; however, this classification does not includeevolution, origin, and duplications of a gene for WRKY TFs. So, in the year 2005, Zhang and Wang (2005) again reclassified WRKY TFs into five groups *i.e.*, group 1, group 2a + 2b, groups 2c, group 2d + 2e and group 3, based on phylogenetic analysis, domains conservation and intron position in WRKY domain. WRKY TFs were again classified into two groups where Group 1 includes R-type of the intron in the WRKY domain whereas Group 2 members include V-type of an intron (Zhang and Wang 2005).

4. Role of host plant WRKY against viral diseases

As described earlier, the WRKY TFs are one of highly studied regulatory protein family which play both positive and negative roles in plant immunity (Chen *et al.* 2019). One of the major challenges to plant immunity is the onset of viral diseases. There are already many reports in the literature by various research groups for the bolstering support of the role of WRKY TFs against plant viruses. Out of all published articles, the first preliminary report was by Yoda *et al*. (2002). In their pioneer work, they screened a set of defense reaction genes up-regulated during the hypersensitive response (HR) in wild tobacco (Cv. Xanthinc) upon *Tobacco mosaic virus* (TMV) infection using fluorescent differential display (Yoda *et al.* 2002). The full-length deduced TIZZ protein contained a single WRKY domain which showed high similarity to one of WRKY family member namely WIZZ. Their results indicated the presence of a novel type of WRKY protein(s) that might play a critical role in HR signal activation.

Dardick *et al*. (2007)observed significant changes in gene expression concomitant with*Plum pox poty virus* (PPV), *Tomato ringspot virus* (ToRSV) and *Prunus necrotic ring spot ilar virus* (PNRSV) symptoms in *Nicotiana benthamiana* leaves. The number of pathogens associated are? identified including WRKY transcription factors, which were consistent with the severity of the observed symptoms in all the three viruses (Dardick *et al.*2007). In a similar study, McGregor, and colleagues(McGregor *et al.* 2009), focused on one of the most devastating *Ipomoea batatas* disease namely sweet potato virus disease. They used a similar global gene expression approach in two different sweet potato cultivars NASPOT1 (resistant) and Beauregard (susceptible), and found that cell expansion genes, as well as chloroplastic genes, were suppressed while stress-related and various transcription family genes (WRKY, homeodomain proteins, and NAC-like proteins) were induced highly. After virus infection, the protein synthesis-related genes induction was in co-relation with virus accumulation in susceptible plants. This switch in the expression of all these specific host-encoded genes was established as a reason to cause developmental defects in susceptible plants (McGregor *et al.* 2009).

Using *Bean pod mottle virus*-based VIGS technology, the role of WRKY6, as well as WRKY30 in Rsv1-mediated resistance was elucidated in soybean (Zhang *et al.* 2012). Similarly, the over expression of cotton *Gh*WRKY 15 and *Gh* WRKY11 in transgenic tobacco plants activated the expression of several PR, POD, and APX genes, therefore, triggering systemic acquired resistance (SAR) to protect the plant against viral pathogens such as *TMV* and *cucumber mosaic virus* (CMV) as compared with the wild type (Yu *et al.* 2012). Inoculation of *Rice tungro spherical virus* (RTSV) on susceptible rice (Cv. TN1) changed the transcripts levels of multiple stress-related genes including multiple members of the WRKY gene family (*Os*WRKY1, *Os*WRKY5, *Os*WRKY9, *Os*WRKY28, *Os*WRKY29 and *Os*WRKY45) (Satoh *et al.* 2013).

The role of six tomato WRKYs (WRKY41, WRKY42, WRKY53, WRKY54, WRKY 80 and

WRKY81) in *tomato yellow leaf curl virus* (TYLCV) infection were elucidated using subcellular localization analysis, interaction network analysis and TRV-VIGS by Huang *et al.*(2016). Time-course analysis of the effect of *Ugandan cassava brown streak virus* grafting on resistant and susceptible cassava varieties transcriptome revealed the up-regulation of differentially expressed-defence genes response genes including LRR-containing, NBARC-containing, PR, LEA, WRKY, GATA, NAC and HSPs (Amuge *et al.* 2017).

Madronero *et al.* (2018) adopted the global gene expression analysis approach on *Papaya meleira virus* complex induced changes in infected papaya at pre-and post-flowering stages. They reported that at the pre-flowering stage, a total of 633 DEGs was observed including multiple SA-, ethylene (ET)-pathway genes, PR genes, ROS genes, and WRKY TF encoding genes (Madronero *et al.* 2018). Recently, the combinatorial effect of low light intensity/shading and *Soybean mosaic virus* on the transcriptome level of soybean plants was assessed (Zhang *et al.* 2019). Among all the 24 DEGs related to plant-pathogen interaction, a total of two WRKY genes (WRKY33 and WRKY62) were differentially expressed under both light conditions. More recently, Kumar and Dasgupta (2020) studied the effect of infection by both rice tungro viruses (*Rice tungro bacilliform virus* and RTSV) at the rice transcriptomic landscape was deduced by using global gene expression changes using Illumina Hiseq 2500 platform followed by qRT-PCR. About 959 DEGs were related to stress-responsive pathways and hormonal homeostasis. Among all DEGs, the reported WRKY transcription factors were LOC_Os05g25770, LOC_Os08g38990, LOC_Os09g25060, and LOC_Os11g02520 (Kumar and Dasgupta 2020). By summarising all these studies by various authors, we can conclude that the WRKY TFs regulate host defence against viruses at various levels directly or indirectly.

5. Role of host plant WRKY against bacterial diseases

Unlike viruses, the bacteria grow in the spaces between plant cells and cause multiple symptoms including cankers, wilts, soft rots, blights, scabs, galls and leaf spots (APS 2020). Dellagi *et al.* (2000) were the first to report the elicitor-induced nature of WRKYs in response to bacteria where they have isolated an upregulated potato *St* WRKY1 protein using the SSH technique upon inoculation of *Erwiniacarotovora* subsp. *atroseptica* culture filtrate (Dellagi *et al.* 2000). Another evidence of the involvement of WRKY against bacterial diseases in plants was forwarded by Robatzek and Somssich (2002), studied the targets of senescence- and defence-associated *AtWRKY6* factors. Their study revealed the WRKY6 negative regulation on its promoter activity as well as promoters of *At*PR1, *AtSIRK* and other closely related WRKY family members (Robatzek and Somssich 2002). A WRKY gene '*Ca*WRKY' was isolated by using a domain-specific differential display procedure, during the infection of *Xanthomonas campestris*pv. *vesicatoria* (Park *et al.* 2006). Dang *et al.* (2013) clarified the role of pepper *Ca*WRKY40 in imparting resistance against *R. solanacearum* infection and reported that the overexpression of *Ca*WRKY27 enhanced the resistance of tobacco transgenic plants to*Ralstonia solanacearum* (Dang *et al.* 2014).

A positive role of *Os*WRKY51 and *Os* WRKY67 in defence against *X. oryzae* pv. *Oryzae* was established using overexpression study (Hwang *et al.* 2016; Liu *et al.* 2018). By performing temporal transcript profiling, Nemchinov *et al.* (2017) selected and inoculated bacterial stem blight-resistant and susceptible alfalfa (*Medicago sativa* L.) plants. Their analysis revealed that there were plenty of differentially expressed genes (DEGs) in two contrasting genotypes at the molecular level. The reason for resistance appeared to be mediated primarily by 20 WRKY family transcription factors and other function-related genes (Nemchinov*et al.* 2017).

Recently, the constitutive overexpression of wild grapevine *VdWRKY53* in *Arabidopsis* resulted in multi-fold enhancement in resistance to multiple pathogens including *P. syringae* pv. *tomato* (DC3000) (Zhang *et al.* 2019). Gao *et al.* (2020), characterized the role of *SlWRKY8* in the resistance to *P. syringae* pv. *tomato* DC3000 (Pst DC3000) along with other abiotic stresses. The constitutive over expression in the tomato plants (Cv. Ailsa Craig) resulted in increased resistance to Pst DC3000 by enhancing expression levels of PR genes namely *Sl*PR1a as well as *Sl*PR7. Overall, their report suggested the role of *Sl*WRKY8 in plant immunity against bacterial pathogen and other prominent abiotic stresses (Gao *et al.* 2020).Thus, from the above reports by various authors clearly indicates the role of *WRKY* transcription factor superfamily against bacterial diseases in plants. Though enough evidence

is available about the role of WRKY defense against bacterial diseases in plants, but the exact mechanism of signal transduction is not yet clear.

6. Role of host plant WRKY against fungal diseases

Another major challenge to plant immunity apart from bacteria and viruses is the fungal diseases (APS 2020). There are many reports on the role of WRKY against fungal diseases in plants, out of which, the first preliminary report by Rushton *et al*. (1996) needs a special mention, as they used both gain and loss of function experiments in parsley (*Petroselinum crispum*) and identified the presence of WRKY1, WRKY2 and WRKY3 TFs binding W-box in the promoters of PR1-1 and PR1-2 genes (Rushton *et al*. 1996). Furthermore, they confirmed the Pep25 elicitor treatment in parsley cells induced a rapid increase in the mRNA levels of only WRKY1 and WRKY3. Their work suggested that WRKY TFs might play a role in the signal transduction pathway (Rushton *et al*. 1996).

Using suppression subtractive hybridization (SSH), a putative StWRKY1 protein-encoding gene was identified in potato after inoculation of *P. infestans* as well as *E. carotovora* subsp. *atroseptica* filtrate (Dellagi *et al.* 2000). Ryu *et al*. (2006) confirmed the changes in the expression level of a total of 15 host WRKY genes upon inoculation of *M. grisea* (Philippines isolate PO6-6). Their extensive profiling analysis work revealed that the transcript levels of *Os* WRKY7, *Os* WRKY10, *Os* WRKY11, *Os* WRKY30, *Os*WRKY45, *Os* WRKY62, *Os* WRKY76, *Os* WRKY82, and *Os* WRKY85 were significantly increased by 6-48 hours.

The role of the so-called SA activator namely benzothiadiazole is well depicted in the literature. Using the group of techniques like microarray screening, RNAi and transient over-expression system, the role of BTH-inducible WRKY45 was identified in providing resistance against rice blast disease (Shimono *et al.* 2007). The constitutive overexpression of rice blast-induced *Os*WRKY31 in Japanese rice cultivar namely Zhonghua 17 leads to enhanced shoot length, root length and resistance against two blast fungus strain P131 and MS220 of *M. oryzae* (Zhang *et al.* 2008). Yang *et al*. (2009) studied the expression of a total of 46 WRKY TFs encoding genes in the canola infected with two devastating fungal pathogens namely *Sclerotinia sclerotiorum* and *Alternaria brassicae* using quantitative real time-PCR (qRT-PCR). Their study revealed that about 13 BnWRKYs transcript abundance changed significantly following the fungal challenge (Yang *et al*. 2009). Overexpression of nuclear-localized *Os*WRKY30 gene in rice plants depicted the enhanced *Rhizoctonia solani* and *M. grisea* resistance. This occurred due to the activated expression of JA- and PR- synthesis-related genes (Peng *et al*. 2012). The similar role of *Os*WRKY76 (Yokotani *et al.* 2013), *Bo*WRKY6 (Jiang *et al.* 2016), *Ta*WRKY49 (Wang *et al.* 2017), *Vl*WRKY48 (Zhao *et al.* 2018), *Gm*WRKY31 (Xiong *et al.* 2019) and *Ta*WRKY142 (Kuki *et al.* 2020) using gain-of-function and loss-of-function studies were identified. From the above survey of literature we can gain an idea about the identification of various genes associated with WRKY mediated defence in plants against fungal growth and the flowchart is depicted in the **Figure 2**.

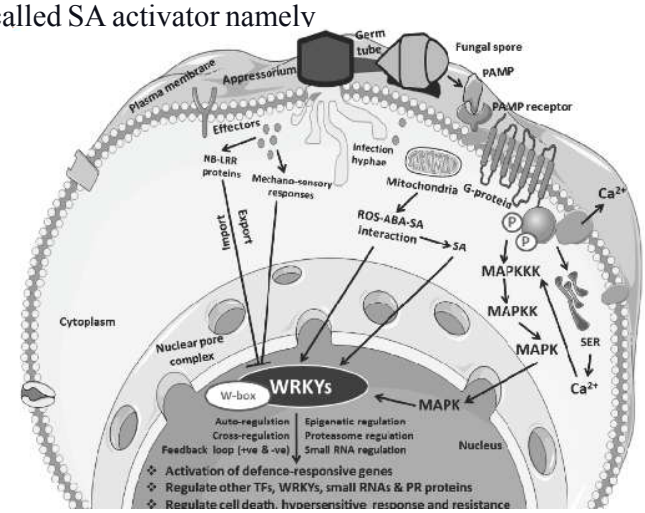

Figure 2.A generalized model depicting the role of WRKYgenes in cellular defense signalling against fungal pathogens.

Under fungal stress, WRKY TFs are regulated by various upstream receptors (RLKs, G-protein) and regulators and impart resistance by controlling expression of defence-related genes as well as PR proteins.

7. Conclusion

Under natural conditions, the plant faces multiple biological and non-biological stresses which creates a complex agronomical environment and corroborates the plant's ability to develop, grow, and reproduce. Within this, biotic stresses are considered as the foremost limiter. The most important aspect is that the major effect is reflected on agriculturally important crop plants *i.e.* the major pillar of food security. As per the data, a 16% share of total yield loss is caused by the microbes annually. Within this, a hefty loss of more than 70% arises due to unavoidable fungal infections. The establishment of proper loss assessment as well as research in this field is important for the process of crop improvement. In this regard, many researchers through their efforts have identified key genes, factors, small RNAs, and epigenetic modifications that control the resistance mechanism. One such key regulator is a superfamily

Table 1. Case studies showing use of transgenic approach (over-expression or downregulation) to modify or manipulate the expression of WRKY TFs for plant defense against microbial diseases.

S. No.	Plant species (Acceptor)	Cultivar/ Line	Pathogen	WRKY name and source	Effect	References
1	*Gossypiumhirsutum* L.	Lumian 22	*Botrytis cinerea*	*Gh*WRKY25 (Cotton)	Enhanced sensitivity to pathogen by reduction in expression levels of SA or ET signaling related genes	Liu *et al.* 2016
2	*Brassica oleracea* var. *italica* L.	Bo112	*Hyaloperonosporaparasitica*	*Bo*WRKY6 (Broccoli)	Increased resistance with enhanced PR1levels	Jiang *et al.* 2016
3	*Nicotianatabacum* L.	Xanthi	*Botrosphaeriadothidea,Gibberellamoniliformis,Colleotrichumgloeosporioides, Fusariumoxysporum*	*Js*WRKY1 (Iron walnut)	Enhanced expression of several defense-related genes (SOD, APX, POD and PR1)	Wang *et al.* 2016
4	*Solanumtuberosum*L.	E-potato 3	*Phytophthorainfestans*	*St*WRKY1 (Potato)	Elevated resistance due to upregulation of PR genes	Shahzad*et al.* 2016
5	*Populustrichocarpa* Torr. & A. Gray, *Populustomentosa* Carr.	Clone 741	*Melampsora sp.*	*Ptr*WRKY18, PtrWRKY35 (Poplar)	Elevated resistance due to upregulation of *PR1.1, PR1.4* and *PR5.1*	Jiang *et al.* 2017
6	*Arabidopsis thaliana* L.	Columbia-0	*B.cinerea, Pseudomonas syringae* pv. *tomato* DC3000, *Golovinomycescichoracearum*	*Vq*WRKY5 (Wild grape)	Overexpressed lines showed enhanced resistance to the biotrophs only	Wang *et al.* 2017
7	*A. thaliana* L.	Columbia-0	*G. cichoracearum, B. cinerea*	*Vl*WRKY3 (Grape)	Increased susceptibility to *B.cinerea* and decreased susceptibility to *G. cichoracearum*	Guo*et al.* 2018
8	*Brassica napus*L.	Westar	*Sclerotiniasclerotiorum*	*Bn*WRKY15, *Bn*WRKY33 (Oilseed rape)	Overexpression lead to modulated expression of both SA and JA-regulated genes	Liu *et al.* 2018
9	*Oryzasativa* L.	Nipponbare,	*Magnaportheoryzae,Xanthomonasor*	*Os*WRKY67	Overexpression lines showed	Liu *et al.* 2018

		BC10	*yzaepv. oryzae*	(Rice)	quantitatively enhanced resistance to leaf blast, panicle blast and bacterial blight. *OsWRKY67*-silencedlines showed increased susceptibility to blast and bacterial blight diseases	
10	*G. hirsutum*L.	Xinluzao 7, Zhongzhimian 2	*Verticilliumdahliae*	*GhWRKY70* (Cotton)	Silencing of *GhWRKY70* increased the resistance whereas *GhWRKY70*overexpression *lines* showed reduction in tolerance	Xiong*et al.* 2019
11	*Arabidopsis suecica*L.	At4, Aa, Allo733	*Pseudomonas syringae*	WRKY18, WRKY40 (Thalecress)	Overexpression lines showed upregulation of several SA pathway□related genes	Abeysinghe*et al.* 2019
12	*G.hirsutum*L.	Williams 82	*Phytophthorasojae*	*GmWRKY40* (Cotton)	Overexpressionhairy root lines showed enhanced resistance whereas silencing lines showed enhanced susceptibility along with ROS accumulation	Cui *et al.* 2019
13	*Cucumissativus* L.	XintaiMiCi	*Pseudoperonosporacubensis*	*Cs*WRKY50 (Cucumber)	Overexpression lines showed enhanced resistance with less ROS accumulationand higher expression levels of antioxidant enzymes.	Luan *et al.* 2019
14	*A. thaliana* L.	Columbia-0, *wrky30*mutant	*Cucumber mosaic virus*	*At*WRKY30(Thalecress)	Overexpression lines showed enhanced resistance whereas silencing lines showed enhanced susceptibility	Zou*et al.* 2019
15	*Solanumlycopersicum* L.	Ailsa Craig	*P.syringae* pv. *tomato* DC3000	*Sl*WRKY8 (Tomato)	Overexpression lines showed enhanced resistance to the pathogen with enhanced *PR1a1* and *PR7*levels	Gao*et al.* 2020
16	*S.tuberosum*L.	E-potato 3	*P.infestans*	StWRKY2 (Potato)	Overexpression lead to enhanced resistance in the potato through the induction of PR proteins	Shahzad*et al.* 2020
17	*Paeonialactiflora*Pall.	Da Fugui	*Alternariatenuissima*	*Pl*WRKY65 (Chinese peony)	Silencing lines showed enhanced susceptibility along with changes in JA and SA content	Wang *et al.* 2020

of WRKY transcription factors that have been reported to control key processes in plants including resistance to biotic stresses (**Figure 1, 2**). Due to the dedicated scientific research more than two decades, the connection of WRKY TFs with plant defense and immunity has been established. Interestingly, it has already been highlighted that WRKY TFs are responsive in many stresses and their modification or manipulation increased the plant tolerance towards specific stresses.

The data in the table also highlights the importance of characterization of the gene in one crop (source) as the same gene can be expressed in acceptor crop for enhancing resistance. For more details, the readers are encouraged to go through the references.

Furthermore, multiple transcriptome studies of treated or challenged samples have provided a list of putative candidate genes in many crop species that will be considered for ensuring food security.

Table 2. Descriptive case studies showing importance of the member of WRKY TF family in plant defense against microbial diseases.

Disease	Pathogen	Plant species	Approach	WRKY gene manipulated	Result	Inference	References
Bacterial diseases	*Xanthomonas oryzae* pv. oryzae	*Oryza sativa*	Differential expression analysis after infection	*Os*WRKY7, *Os*WRKY10, *Os*WRKY11, *Os*WRKY30, *Os*WRKY32, *Os*WRKY67, *Os*WRKY70, *Os*WRKY83 and *Os*WRKY85	Upregulated	Role in plant defense	Ryu*et al.* 2006
	Pseudomonas syringae	*Solanumlyco persicum*	Genome wide analysis	*Sl*WRKY8,*Sl*WRKY23, *Sl*WRKY39, *Sl*WRKY53, *Sl*WRKY80 and *Sl*WRKY81	Upregulated	Role in plant defense from pathogen	Huang *et al.* 2012
	Botrytis cinerea			*Sl*WRKY23, *Sl*WRKY53, *Sl*WRKY33, *Sl*WRKY41, *Sl*WRKY31, *Sl*WRKY8and *Sl*WRKY39	Upregulated		
	Pseudomonas syringaepv. syringae	*Zea mays*(Two near-isogenic lines (NILs) (Resistant (R) and Susceptible (S))	Comparative transcriptome profiling	WRKY25, WRKY33, WRKY5, WRKY62 and WRKY71	Upregulated	Upregulation of WRKY genes in resistant line few days after planting suggest that defense system shows stronger or faster reaction in resistant line to the pathogen	Wu *et al.* 2015
		Medicago sativa (Maverick (S) and ZG9830 (R))	Comparative transcriptome profiling	20 WRKYs	Upregulated	Instant high induction of tracscription factors having WRKY domain shows regulation of genes involved in plant defense	Nemchinov*et al.* 2017
	*Pectobacterium*carotovorum ssp. carotovorum (Pcc)	*Brassica rapa*ssp. *Pekinensis*	EMS mutant inoculation with Pcc and then transcriptome	*Br*WRKY33 and *Br*WRKY25	Upregulated	Putative role in plant regulation for defense	Liu et al. 2019

			analysis				
Fungal diseases	*Phytophthora infestans*	*Solanumtuberosum*	Suppression Subtractive Hybridization (SSH) applied in a search for genes induced during the compatible interaction between *P.infestans* and potato.	S1-9D (WRKY-box transcription factor-like)	Upregulated	WRKY like transcription factor get induced confirming the role in post infection	Beyer *et al.* 2001
	Magnaporthegrisea	*O. sativa* (Variety Nipponbare)	Comparative whole transcriptome analysis between *M.oryzae* and arbuscularmycorrhiza colonized roots	OsAM205 encodes a WRKY TF	Upregulated	Induction of TFs is the general defense mechanism to cope with the colonization of root by the respective fungus	Guimi*et al.* 2005
	M. grisea(Philippines isolate; PO6-6)	*O. sativa*	Comparative whole transcriptome analysis between resistant and susceptible lines	*Os*WRKY7, *Os*WRKY10, *Os*WRKY11, *Os*WRKY30, *Os*WRKY45, *Os*WRKY62, *Os*WRKY76, *Os*WRKY82 and *Os*WRKY85	Upregulated in resistant line	The induction of gene within 6-12 hrof infection highlight their role in defense against fungal pathogen	Ryu*et al.* 2006
	Sclerotiniasclerotioru, Alternariabrassicae	*Brassicanapus*	Genome characterization through the generation of ESTs	10*Bn*WRKY TFsupregulated(*Bn*WRKY6, 25, 28, 33, 40, 45, 53,65, 69and75) and*BnWRKY20*,*Bn*WRKY32	10 *Bn*WRKY TFs were upregulated and 2	Role in defense response	Yang *et al.* 2009

				TFs were downregulated	*Bn*WRKY TFs were downregulated		
	Alternariaalternate (Apple pathotype)	*Malusdomestica*	Genome-wide Exploration of MdWRKYgenes and their phylogenetic analysis	*Md*WRKYTFs differential profile	Some were upregulated and few were downregulated	Role in defense against pathogen like *Md*WRKYN1 and *Md*WRKY26 when targeted by RNAias it impart resistance to the *A. alternata*	Luiet *al.* 2017; Zhang *et al.* 2017
	Moniliophthoraperniciosa	*Theobroma cacao* (TSH1188 (R) and Catongo (S))	*In-silico* and phylogenetic analysis of *TcWRKY* proteins	*Tc*WRKY (Tc04g016130, *Tc*10g016570, *Tc*09g001530, *Tc*06t004420, *Tc*06t013130, *Tc*01t014750 and *Tc*01t018460)	Upregulated and downregulated	There were many WRKY TFs showing role in plant defense	de Almeida *et al.* 2017
	Fusariumoxysporum f. sp. lycopersic (Fol)	*S. lycopersicum*	Genome-wide computational analysis post infection with Fol	*Soly*WRKY14, *Soly*WRKY33, and *Soly*WRKY37	Upregulation	Role in defense response	Amir *et al.* 2018
	Peronosporamanshurica	*Glycine max* (SDM-high resistant (HR) and SDM-high susceptible (HS) genotypes)	Comparative transcriptomeanalysis	*Gm*WRKY2, 26, 36, 37, 66, 73, 82, 83, 114, 166, 180 and17 profile showed changes	11 *Gm*WRKY were upregulated and GmWRKY175 was downregulated	Differentially expressed WRKY genes shows their putative role in plant defense	Dong *et al.* 2019
Viral diseases	*Plum pox virus (PPV)*	*A. thaliana* (Ecotype	Global gene expression after	WRKY TF	Upregulation	WRKY domain containing protein	Babuet *al.* 2008

		Col-0)	infection with PPV			are getting upregulated and providing resistance against the virus	
	Pepper yellow mosaic virus (PepYMV); Potyvirus	*S. lycopersicum* (VarietyMoneymaker)	Genome wide analysis	Homolog of *At*WRKY 22	Upregulated	Over expression of the gene possibly providing plant a defense line to curb or survive the infection.	Alfenas-Zerbini*et al.* 2009
	Sweet potato virus disease (SPVD)	*Ipomoea batatas* Lines (NASPOT1 (R) and Beauregard (S))	Global gene expression after infection with SPVD	WRKY TF	Upregulation	WRKY domain containing protein are getting upregulated and providing resistance against the virus	Mcgeorg*eet al.* 2009
	Tomato spotted wilt virus (TSWV)	*S. lycopersicum*	Global gene expression from root and shoot tissues	16 WRKY TF (shoot; including homolog of WRKY 6 and 7 (eg: *Sl*WRKY 75, *Sl*WRKY46, *Sl*WRKY73, *Sl*WRKY2)	15 upregulated and 1 downregulated (shoot) and all upregulated (root)	Positively regulated WRKY proteins can be overexpressed in the plant for defensive response and negatively regulated WRKY protein can be downregulated for the same	Catoni*et al.* 2009
	Rice dwarf virus (RDV)	*O. sativa*	ComparitiveTranscriptome analysis	*Os*WRKY1, *Os*WRKY5, *Os*WRKY9, *Os*WRKY28, *Os*WRKY29 and *Os*WRKY45	Upregulated	Over expression reduces susceptibility of the plant	Satoh *et al.* 2011
	Tomato	*S.*	Global gene	WRKY TF	16 WRKY	These can be	Chen *et*

	yellow leaf curl virus (TYLCV)	*lycopersicum* (Lines CLN2777A (R) & TMXA48-4-0 (S))	expression after infection with TYLCV		genes downregulated (S) and 7 upregulated (R)	possible candidate for identification and characterization of new gene	*al.* 2013
	Tomato yellow leaf curl virus (TYLCV)	*S. lycopersicum*	Subcellular localization analysis	WRKY41, WRKY42, WRKY53, WRKY54, WRKY80, and WRKY81	Upregulated	Role in plant defense	Huang *et al.* 2016
	Papaya ringspot virus (PRSV)	*Carica papaya*	qRT-PCR of stressed samples	TF12.199, TF807.3, TF21.156 and TF18.51	Upregulated	Over expression reduces susceptibility of the plant	Pan *et al.* 2014
	Ugandan cassava brown streak virus (UCBSV)	*Manihotesculentus* (Lines Namikonga(R) and Albert (S))	Time-course analysis of transcriptome analysis	WRKY	Upregulated	Role in plant defense	Amuge*et al.* 2017
	Cucumber green mottle mosaic virus (CGMMV)	*Citrulluslanatus*	RNASeq	WRKY13, WRKY31, WRKY46, WRKY48, WRKY53, and WRKY70	Upregulated	Plant defense	Li *et al.* 2017
	Soybean mosaic virus	*G. max*	Transcriptome analysis	WRKY genes (WRKY33 and WRKY62)	Upregulated	Plant defense	Zhang *et al.* 2019
	Rice tungro bacilliform virus	*O. sativa*	ComparitiveTranscriptome analysis	*LOC_Os05g25770,LOC_Os08g38990, LOC_Os09g25060, and LOC_Os11g02520*	Upregulated	Over expression reduces susceptibility of the plant	Kumar and Dasgupta 2020

The members of the WRKY TF family expressed under specific stress condition are putative candidates that can be tested for gaining resistance against plant microbial pathogens

In this regard, the science of molecular breeding has the potential to accelerate process of resistant line development for sustainable agricultural practices. To accelerate the research and to screen the putative candidates, CRISPR genome editing can be put to use, as there are many negative regulators of the WRKY family that can be downregulated for achieving resistance in the plant.

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Declarations

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Microbial fuel cell: a potential technology for treatment of waste water and generation of bioelectricity

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ABSTRACT

Rapid urbanisation and industrialization has led to increase in the quantum of waste water generation in the country. Waste water can be generated from domestic, industrial and commercial sources. The municipal waste water contains majorly organic material and coliform bacteria. The waste water needs to be treated in Sewage Treatment Plants (STPs) before it is being released in a receiving water body or land. The principle for waste-water treatment is oxidation of organic matter resulting in reducing organic load,removing solid impurities and diseasecausing bacteria. Under conventional waste water treatment technologies digestion of waste water sludge is being used to generate biogas. A different approach is the use of microbial fuel cell technology for anaerobic digestion of organic matter and production of bio-electricity. This approach directly couples waste water treatment with electricity generation and has high energy efficiency as compared to conventional treatment technologies. Microbial Fuel Cell technology has been actively worked upon to realize its maximum potential. The continuous development of the technology is allowing greater power output. This paper outlines Microbial fuel Cell technology specifically with respect to waste water treatment covering the use, advantages, limitations and future prospects for development of the technology

KEYWORDS: microbial electrochemical technologies, waste conversion, bioenergy, hybrid technologies

1. INTRODUCTION

Release of large volume of untreated or partially treated waste water (sewage)is a major source of pollution of surface water bodies including rivers in the country. The increase in generation of waste water is linked to urbanization and industrial growth. The proportion of population residing in urban areas has increased from 27.8% in 2001 to 31.2 % in 2011. The number of towns has increased from 5,161 in 2001 to 7,935 in 2011 (Central Public Health & Environmental Engineering Organisation, 2013).The uncontrolled growth in urban areas has left many Indian cities deficient in infrastructure services such as water supply, sewerage, storm water drainage and solid waste management(Central Public Health & Environmental Engineering Organisation, 2013). The main source of waste water is from municipal, industrial and commercial sources. There is a gap in the generation and treatment of waste water in India. The total amount of sewage generation is 61754 million litre per day (MLD) of which only 22963 MLD gets treated where as 38791 MLD remains untreated (National status of waste water generation & treatment, 2019). There is also an increase in the generation of industrial wastewater and non-point dischargesdue agricultural activities.

The treatment of waste water is a priority area for reducing water pollution. Accordingly sewage treatment plants (STPs) are being built. These STPs work on the principle of removal of solid impurities and reduction of organic load through microbial digestion. Wastewater treatment consists of a combination of physical, chemical, and biological processes (Henry and Heinke, 2004). The microbial digestion of organic load in waste water is treated through technologies such as Activated Sludge

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Process, Trickling Filters, Rotating Biological Contactors, anaerobic processes, Up-flow Anaerobic Sludge Blanket (UASB) Process. These technologies in association with physical methods for separation and aeration form mainstay of sewage treatments (Kamyotra and Bhardwaj 2011). Tertiary treatment technologies are applied where there are refractory pollutants which need to be removed from waste water and the end use of the treated water.

The conventional technologies are energy intensive and generate large volume of sewage sludge. Sewage treatment is at the interface of civil and chemical process engineering and microbiology. Continued work is being carried out on the waste water technologies for (i) efficient removal of organic load, (ii) removing recalcitrant pollutants, (iii) making technologies energy efficient, (iv) reducing sludge volumes, and (v) generating maximum energy locked in the organic load of waste water. Many new wastewater treatment technologies including hybrid technologies are being developed and tested (Tee et al. 2016). Constructed wetlands using a consortium of plants and microbes for treatment of waste water is also gaining prominence and acceptance. Another technology being actively researched is that of Microbial Fuel cell technology.

The use of microbial fuel cells in waste treatment is developing with increase in current density and waste removal efficiency (Park and Zeikus, 2003; Rabaey et al. 2005a, 2005b). Nevertheless, several bottlenecks still exist, each requiring an appropriate development (Pham et al. 2006). Microbial Fuel Cell has been regarded as a promising technology for waste water treatment despite issues of scalability, low power density and high costs (Pham et al. 2006; Li and Sheng 2012; Li et al. 2017).

2. MICROBIAL FUEL CELL (MFC)

2A. Principle and Construction

Microbial fuel cells were first conceived in the 1900s by Michael Cressé Potter and the progressive development of the technology makes it relevant even today (Santoro et al. 2017). Microbial fuel cell (MFC) technology uses microorganisms to transform chemical energy of organic compounds including those found in waste water into bioelectricity (Angenent et al. 2004; Aelterman et al. 2008; Lovley 2008; Logan 2009).

A typical MFC consists of an anaerobic anode compartment and aerobic cathode compartment, which are separated by a selectively permeable cationic membrane. Microbes form a biofilm over the anode. The oxidation of organic substrate by the microbes present on the anode under anaerobic conditions results in generation of electrons and protons. The electrons move to the anode surfacefrom the biofilm by various means (Cao et al. 2019), Fromthe anode, the electrons move to cathode through the electrical circuit, while the protons migrate through the electrolyte across the selectively permeable cationic membrane to the cathode compartment (Logan and Regan 2006). Electrons and protons are consumed in the cathode by reduction of electron acceptor. The electrical power is harnessed by placing a load between the two electrode compartments.

The microbes are at the core of a MFC. The biofilm covering the anode is generally composed of bacterial species such as *Geobacter* sp., *Shewanella* sp., *Pseudomonas* sp.etc (Gorby et al. 2006; Pham et al. 2006; Nevin et al. 2008; Wang et al. 2013). These bacteria have two important qualities *viz.* (i) ability to digest and degrade organic substrate from variety of sources, and (ii) ability to transfer the electrons produced by the digestion of waste to the anode (Cao et al. 2019).

The bacterial biofilms secrete external intermediary compounds such as humic acids, methylene blue which are called as electron shuttles and transfer electrons generated to the anode surface (Rabaey et al. 2004). These bacterial also develop appendages or pili on the surface known as nanowires (Bond and Lovley 2003). These nanowires assist in carrying electrons to anode surface (Reguera et al. 2006). Sometimes consortium of bacteria isolated from the sewage sludge or waste water are also employed in MFC (Behera and Ghangerkar, 2009; Lu et al. 2009; Cao et al. 2019).

A range of organic substrates can be used for anaerobic digestion by the microbes in bioelectricity production. These range from simple molecules such as glucose, acetate, propionate and butyrate (Ahn and Logan 2010) to complex substrates like waste sludge, fruit and vegetable wastes(Ge et al. 2013; Choi &Ahn 2015). Domestic wastewater can also be used for continuous electricity production (Choi &Ahn 2013).

The microbial fuel cell can be single chamber, double chamber or stacked cells (Aelterman et al. 2006, Chaturvedi and Verma 2016). The architecture of the anode and cathode also influence the current

density (Zhuwei et al. 2007). Current density is the bioelectricity generated per unit area of the electrode. The cationic membrane is an important component of the MFC separating of the anode and cathode chambers. This membrane is called semi permeable because it allows only H^+ ions or the protons to pass through and does not allow any other substance including electrons to pass through it. Several different types of materials such as nylon fibers, glass fibres etc. have been employedin construction of the membrane (Chae et al. 2007).

The level of biofilm formation on anode and the surface area determine the level of electricity generated. The anode material determines effectiveness of bacterial adhesion and efficiency ofelectron transfer to the cathode (Zhuwei et al. 2007). The **c**athode in the MFC reduces oxygen to produce water. Therefore, the cathode material need to have catalytic properties for oxygen reduction. Platinised carbon electrodes are commonly employed as oxygen-reducing cathodes in MFCs. The practical use of Pt-based cathodes in field situations is limited due to their high cost and degradation of the Pt catalytic surface of cathode in field situations. The mechanism of oxidation and reduction in the MFC is not clearly worked out. An example using glucose as the substrate is as follows (Pham et al. 2006):

Anode: $C_6H_{12}O_6 + 6\ H_2O \rightarrow 6\ CO_2 + 24H^+ + 24e^-$

Cathode: $24\ H^+ + 24\ e^- + 6\ O_2 \rightarrow 12\ H_2O$

The total reaction is as follows:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + Electrical energy

2B. Advantages and limitations

Microbial Fuel Cell enables recovery of energy directly on breakdown of organic waste in wastewater, while limiting both the energy input and the excess sludge production (Rabaey and Verstraete 2005). A major limiting factor in microbial fuel cells is the current density, which is affected by the organic substrate used in the microbial fuel, the micro-organisms present, architecture of the anode and cathode, shape of fuel cell. Another important limitation of the technology is scaling-up to commercial level (Chaturvedi and Verma 2016). Research has been undertaken to improve the current density of the microbial fuel and make them scalable to real-life practical applications. Improvements have taken place with respect to increase in current densityand scale.

3. WASTE WATER TREATMENT AND BIOELECTRICITY GENERATION

In the microbial fuel cell, oxidation of organic and in some cases inorganic substrates present in urban sewage, agricultural, dairy, food and industrial wastewaters lead to direct generation of bioelectricity (Gude 2016). This treatment of waste water through microbial fuel cell reduces sludge production and is more energy efficient as compared to conventional waste water treatment systems (Logan 2008; Logan and Rabaey2012; Zhang et al. 2013). The management of sludge is a major concern in conventional waste water treatment while sludge production is less in waste treatment though MFC (Gude, 2016)

MFCs have been not only shown to treat municipal wastewaters which have low Biological Oxygen Demand (BOD) value of less than 300 mg/L but also waste waters with high BOD values of more 2000 mg/L (waste from food processing industry, dairy and distillery waste etc.). Many studies have been carried out on the bioelectricity generation using different types of waste waters. The different types of waste water included agricultural waste water, brewery and bakery waste, dairy waste water, distillery waste water, pulp and paper waste water and sewage sludge. The bioelectricity reported varied from 10 mA/m^2 to 125 mA/m^2 (Nimje et al., 2012;Samsudeen et al. 2015; Velasquez et al. 2011; Yuan et al. 2012), higher bioelectricity generation have also been reported (Cao et al. 2019).

In order to increase the bioelectricity generation output extensive research has been carried out on the electrode material and design. Development of air cathode has shown to improve efficiency of the MFC (Di Lorenzo et al. 2014). The air-cathodes are being developed as alternative to traditional Pt coated cathodes (Tharali et al.2016). Research is also being carried out on the bio-anode in the MFC to enhance the waste degradation and electricity generation. Genetic engineering is also being employed to have microbial strains which lead to enhanced bioelectricity generation at bioanode (Yong et al., 2014). The development of MFC needs to move towards reducing cost, stabilizing energy production and being able to adapt to different categories of wastes with reasonable waste degradation efficiency.

4. MICROBIAL FUEL CELL CENTRED HYBRID TECHNOLOGIES

Microbial Fuel Cell centred hybrid technologies are recently being developed for the treatment of

waste water on sustainable basis (Wen Wei Li et al. 2017). Recently, efforts have been made to integrate MFC with other technologies to create hybrid systems. One such system is constructed wetland-microbial fuel cells (CW-MFC). Constructed wetland has been used for treatment of waste water. The constructed wetland utilizes consortium of plants and microbes for reducing organic load of waste water and has air water-interface and anaerobic zone whereas microbial fuel cell has aerobic and anaerobic chamber for waste water treatment and generation of bioelectricity. Studies have shown that this hybrid technology improves the removal of Chemical Oxygen Demand (Doherty et al 2015) and gives higher power density (Fang et al 2013). Scaling up of such hybrid system can be a way forward for more efficient waste water management.

Another hybrid system includes membrane bioreactor technology (MBR) with microbial fuel cell (MFC)(Wang Yong-Peng et al. 2012). This hybrid system allows higher bioelectricity generation by MFC as well asreduction in membrane fouling with significant increase in efficiency of denitrification in the bioreactor (Liu, W. et al 2018).

The inefficiency of nutrient removal by MFC technology can be overcome by integrating it with an algal system and the effluent from MFC can be treated with algae to remove the residual nutrients and improve water quality (Wen Wei Li et al. 2017). The hybrid system of MFC with algal system has been shown to remove carbon, nitrogen and phosphorus along with higher bioelectricity generation (Zhang et al. 2011).

5. CONCLUSION

Microbial Fuel Cell technology holds promise for sustainable waste water treatment. Research on MFC needs to focus on field level implementation with reduction of cost for development. The use of MFC based hybrid system needs to developed further. MFC is a potential technology for treating the rising quantum of waste water generation in future in a sustainable manner through use of interdisciplinary approaches of microbiology, biotechnology, electrochemistry and engineering.

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Cosmetics: A Dark Fantasy And Their Potential Substitutes

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Abstract

Cosmetics is a term used for substances applied to the human body for cleansing, beautifying, and to enhance the appearance. Various chemicals with potential health hazards such as heavy metals, dyes, preservatives, etc are employed for the formulation of most of the commercially available cosmetic products. These toxic chemicals on exposure may pose adverse effects on human body. Thus, there is an urgent need of some alternatives which can be used to prepare safe and healthy cosmetic products. Herbs does not have any side effects on the human body and these herbal remedies enrich the body with nutrients and other useful minerals. In this review, the harmful aspects of the different commercially available cosmetic products and their remediation have been discussed.

Keywords: Cosmetics, herbal, sunscreen, lipstick, hair colour.

1. Introduction

Cosmetics are scientifically compounded substances employed to cleanse, beautify, and enhance attractiveness of the human body, which have been used since Vedic times. Worldwide, millions of consumers use cosmetic products and their ingredients on daily basis. Various illicit substances are added to the cosmetic products to enhance their short-term effectiveness and to reduce the cost of production (Desmedt, et. al., 2014). Some of the common harmful additives which are added in cosmetic products include antibiotics (e.g., metronidazole), corticosteroids (e.g., clobetasol), sexual hormone (e.g., estrogen), prohibited preservatives (e.g., parabens), whitening agents (e.g., hydroquinone), phthalates (e.g., diethyl phthalate) and nitromusk fragrances (e.g., musk xylene) and methyl-dibromoglutaronitrile (**Figure 1.,** Jin, et. al., 2009; Fiori, et. al., 2014; De, et. al., 2009; Yang, et. al., 2010; Sheliya, et. al., 2014; Pellegrini, et. al, 2011; Sanchez-Prado, et. al., 2011). .Their long-term exposure may cause adverse effects such as skin irritation, allergic reactions, and antibiotic resistance (Ma, et. al., 2016; Nohynek, et. al., 2010). Thus, there is an urgent need of some alternates which can be used to prepare safe cosmetic products.

Recently, the herbal cosmetics have attracted the attention of researchers due to their good activity and comparatively lesser side effects as compared to their synthetic analogues. The natural contents of the herbs enrich the body with nutrients and other useful minerals (Gediya, et. al., 2011). However, scientific research has demonstrated that plants possess a vast and complex arsenal of active constituents which have the ability to calm or smooth the skin. The natural pigments are also widely used in industries such as, dyeing, printing, food, textile, pharmaceutical and cosmetic industries (Mansour, 2018). They possess different biological activities, like antioxidant, antimicrobial and food preserving capability (Singh, et. al., 2013; 2011; 2009; Ambika, et. al., 2014). Therefore the utilization of herbs in cosmetics can provide a safe and effective alternate to the existing commercially available cosmetics. In this review, the harmful aspects of the different commercially available cosmetic products and their remediation have been discussed.

2. Classification of cosmetics

Cosmetics can be classified according to the exposure framework:

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2.1 Rinsed-off product

These are the products which are rinsed-off shortly after application. For example, shampoos, soaps, toothpaste etc.

2.2 Leave on products

These products include which remain in contact with the skin for several hours. For example, body lotion, deodorant, lipsticks etc.

3. Some popular categories of cosmetics products and their harmful effects on the human body

A large number of cosmetic products are available in the market which include skin-care, lip care, nail care, hair care and many other types of products. Cosmetic products may pose harmful effects on human body. Some of the cosmetic products used in daily life have been discussed below:

3.1 Lip care cosmetics

Lip care cosmetics include lip balm, lip stick, lip brilliant, lip volumizer and lip gloss. Lip cosmetic products contain wax, oil, and coloring agents as three main ingredients along with antioxidants, preservatives, and perfumes (Fernandes, et. al., 2013). Lip gloss is employed to highlight the natural color of the lips. Lip balms are most often used to hydrate and protect the lips. Generally lip balm contains beeswax, camphor, cetylalcohol, lanolin, paraffin, dyes, flavor, phenol, salicylic acid, fragrance, sunscreen etc (Fernandes, et. al., 2013). Lipsticks are a group of cosmetic products that have been commonly used for coloring lips. A wide range of lipsticks with different shades of colors, textures, luster are available in the market (Chattopadhyay, 2005). Lipstick consists of different components such as antioxidants, pigments, waxes, oils, and inorganics, heavy metals (Pb, Cu, Cd, Hg, Ni, Sb), etc, which pose severe toxic effects to human beings (**Table 1,** Liu, et.al., 2013; Atz, et.al., 2009; Piccinini, et. al., 2013; Loretz, et. al., 2005; Nourmoradi, et. al., 2013; El-Aziz, et.al., 2017; Nnorom, et.al., 2005). Coal tar is the basic ingredient for the preparation of synthetic dyes which can cause allergy, nausea, dermatitis, drying of the lips and cancer (Deshmukh, et.al., 2013). In addition to colouring agents they may contain some harmful chemicals such as formaldehyde, mineral oils etc..

3.2 Skin Care

Skin is the largest organ and plays an important role and offers a protective barrier against harmful external environment. It regulates temperature, loss of water from the body, protects against harmful radiations of the sun and harmful microorganisms.

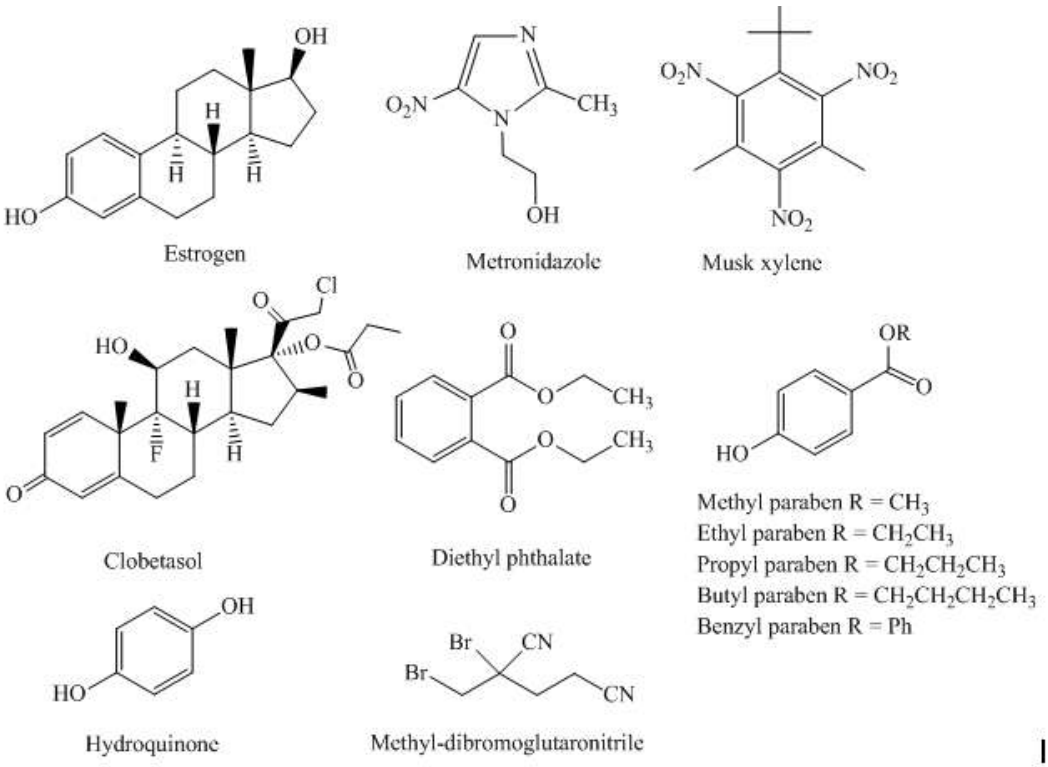

Figure 1. Some of the common harmful additives which are added in cosmetic products.

Table 1. Different types of cosmetic products and their associated health risk.

Type of cosmetic products	Name of the cosmetic product	Chemical ingredients	Role of chemical agent	Health risk
Lip care	Lipstick	Heavy metals, dyes etc.	Coloring agent	Organ damage, allergy, nausea, dermatitis, drying of the lips and cancer (Liu, et.al., 2013; Atz, et.al., 2009; Piccinini, et. al., 2013; Loretz, et. al., 2005; Nourmoradi, et. al., 2013; **El-Aziz, et.al., 2017;** Nnorom, et.al., 2005)
		Parabens	Preservative	Reproductive toxicity, cancer (Darbre, et. al., 2008)
Skin care	Skin whitening products	Hydroquinone	Bleaching agent	Skin irritation, burning sensation and cancer (Ogbechie-Godec, et. al., 2017)
		Mercury	Whitening agent	Liver damage and kidney failure, psychiatric disorders, asthma, liver damage and severe birth defects in children (Peregrino, et. al., 2011)
	Sunscreen	Avobenzone, oxybenzone, octocrylene, octisalate, octinoxate, methoxycinnamate, PABA derivatives	Organic UV-filters	Cancer, neurotoxic effects (Kockler, et. al., 2013; Nafisi, et. al., 2017; Singer, et. al., 2019)
Eye makeup	Eye shadow	Heavy metals	Colouring agents	Brain damage, cancer and respiratory problems (Sainio, et. al., 2000; Jaishankar, et. al., 2014)
		Benzalkonium chloride, parabens	Preservatives	Toxic to the epithelial cells of the eyes, allergy, reproductive toxicity, early puberty and cancer (Darbre, et. al., 2008; Choi, et.al., 2017)
	Kohl	Heavy metal	Coloring agent	Decline in intellectual and learning capacities (Parry, et. al., 1991)
	Mascara	Thiomersal and phenyl mercuric salts	Preservative	Renal, neurologic, and dermal toxicity (Taufikurohmah, et. al., 2014; Graeme, et. al., 1998)
	Eyeliner	Carbon black	Pigment	Cancer (Ramanakumar, et. al., 2008)
Hair care	Shampoo	Surfactants	Sodium lauryl sulfate, ammonium	Skin irritation and allergies (Barel, et. al., 2014)

			lauryl sulfate sodium laureth sulfate, ammonium laureth sulfate etc.	
		Zinc pyrithion	Antidandruff agent	allergic contact dermatitis(Hsieh, et. al., 2010)
	Hair dyes	*p*-phenylenediamine, *p*-toluenediamine 2-naphthylamine, benzidine, 4-aminobiphenyl	Primary intermediates used in permanent hair dye	Eye injury, allergic reactions, cancer (Lewis, et. al., 2013; Baan et al., 2008; IARC, 1993; Nohynek, et. al., 2010)
		m-phenylene-diamines, *m*-aminophenols, resorcinol etc	Couplers used in permanent hair dye	Skin irritation and allergies (Lewis, et. al., 2013; Baan et al., 2008; IARC, 1993; Nohynek, et. al., 2010)
		Ammonia, monoethanolamine	Alkalinizing agents	Respiratory disorders and asthma (Nohynek, et. al., 2010)

Type of cosmetic products Name of the cosmetic product Chemical ingredients Role of chemical agent Health risk

Table 2. Different herbs used in cosmetic formulations and their beneficial aspects

S.No	Type of cosmetic product	Herbs used in cosmetic formulation	Beneficial aspects
1.	Skin care	*Camellia sinensis L., Helianthus annuus, Theobroma cacao, Coriandrum sativum, Allium sativum, Aloe vera*	Enhanced sun protection against UV radiations (Sopyan, et. al., 2009; Banerjee, et. al., 2019; Williams, et. al., 2009; Pazyar, et. al., 2011; Ray, et. al., 2013)
		Coriandrum sativum	Reduction of UVB induced skin photo-aging (Park, et. al., 2012)
		Persea americana	Protects skin from the harmful effect of free radicals (Dreher, et. al., 2013)

		Theobroma cacao	Inhibits skin degradation enzymes (Williams, et. al., 2009)
		Crocus sativus	Skin dipigmentation and lightening agent (Mzabri, et. al., 2019)
		Arctostaphylos uvaursi	Melanin-inhibition (Couteau, et. al., 2016; Migas, et. al., 2015).
2.	Lips care	*Rubia cordifolia* and *Rubia tinctorium*. *Bixa orellana* L. and *Beta vulgaris* L. *Hibiscus rosasinensis* L., *Punica granatum*	Colouring agents (Kapoor, et. al., 2007; Deshmukh, et. al., 2013; Dash, et. al., 2017; Kothari, et. al., 2018; Jain, et. al., 2018)
3.	Hair care	*Lawsonia alba*, *Hibiscus rosasinensis* *Nardostachys jatamansi*, *Saussurea lappa*.	Hair colourants (Singh, et. al., 2015)
		Aegle marmelos, *Emblica officinalis*, *Centella asiatica*, *Arnica montana*, *Hibiscus rosasinensis*	Hair cleansers, tonics, nourishers (Kumar, et. al., 2012)
		Cedrus deodara	Anti-dandruff agents (Sah, et. al., 2018)
		Emblica officinalis, *Hibiscus rosasinensis*, *Centella asiatica*, *Sesamum indicum*; *Indigofera tinctoria*	Darkening of hairs (Sah, et. al., 2018)

Skin care products for the body include cleansers, sunscreen, moisturizers, skin bleach etc. Visible light and near infrared radiation can have harmful effects on our skin, resulting in photo-aging and may induce cancer. Sunscreen are the cosmetic products which can absorb UV rays to protect the skin (Cantrel, et. al., 2001). Most of the conventional sunscreens consist of avobenzone, oxybenzone, octocrylene, octisalate, octinoxate, methoxycinnamate, PABA derivatives etc. that may cause cancer (Kockler, et. al., 2013; Nafisi, et. al., 2017; Singer, et. al., 2019). Various heavy metal ions such as Ni, Pb, Fe, Cr and Cd are also reported to be present in sunscreen agent which possess several toxic effects (Arshad, et. al., 2020).

Skin whitening cosmetics are one of the most popular skin care products all over the World. Skin lightening and skin bleaching is the practice used to lighten the skin color by the application of chemicals which can reduce its melanin content. Some of the most commonly used chemicals includes hydroquinone or its derivatives, kojic acid, tretinoin, á,â hydroxy acids, heavy metals (Hg, Cd, Cr) etc. (Filomeno, 2017; Filomeno, 1998; WHO, 2011; Borowska, 2015; Ogbechie-Godec, et. al., 2017). Mercury (Hg) a toxic heavy metal may cause psychiatric disorders, asthma, liver damage and severe birth defects in children (*Peregrino, et. al., 2011)*. Chemical bleaching may lead to serious skin and health problems such as dermatitis, exogenous ochronosis, steroid acne, Hg poisoning, nephrotic syndrome, neurological, skin cancer etc. (**Table 1**, Benn, et. al., 2016).

3.3 Eye makeup

Eye is a delicate organ in human body. Eye makeup has played an important role in highlighting the eyes. Now a days, a wide variety of eye makeup is available which includes eye shadow, eyeliner, and mascara. Skin around eyes is the most sensitive area of the face and the eye makeup layers may damage the eyes. Eye shadow is a type of makeup employed to enhance the eyes which can be achieved through different colors, shades and blending techniques. Metallic shadows consist of heavy metals such as Cd, Pb, Cr, Co and Ni etc. as the major ingredients which may pose toxicological effects (Sainio, et. al., 2000). The continuous use of these cosmetics can increase the absorption of heavy metals which may cause brain damage, lung cancer and respiratory concerns (Jaishankar, et. al., 2014). Kohl or surma is prepared by utilizing a wide variation in the Pb content. Pb poisoning in childhood may cause long term subtle decline in intellectual and learning capacities (Parry, et. al., 1991). Eyeliner is used to enhance and elongate the size of the eye (Draelos, 1991). Mascara is used to darken, lengthen, thicken, or draw attention to the eyelashes. Regular application of mascara and eyeliner can inhibit the growth of eyelashes and becomes a breeding ground for bacteria which could lead to irritations and infections (Wilson, et.al., 1971). Cosmetic preservatives such as thiomersal and phenyl mercuric salts are employed in eye make-up cleansing products and mascara which on acute or chronic exposure may result in renal, neurologic, and dermal toxicity (Taufikurohmah, et. al., 2014; Graeme, et. al., 1998).

3.4 Hair care cosmetics

Hair care products such as shampoo, conditioner, and hair gels, hair serums, leave-on products, etc. are used for improving the appearance, and hair length, while the dermocosmetic products such as anti-hair loss and antidandruff products focus on the absorption of active compounds into the hair scalp. Extensive use of chemical based hair products may result in dandruff, scalp redness, thinning of hair, and hair loss. Shampoo is an aqueous solution of several surfactants enriched with various substances (Tadros, 2005). Surfactants may result in skin irritations and allergies (Barel, et. al., 2014). Zinc pyrithione is the active ingredient of most of the antidandruff shampoos, which possess antifungal and antidandruff properties. It may led to allergic contact dermatitis (Hsieh, et. al., 2010).

Hair dye ingredients are the most reactive chemicals used in the cosmetic industry. Permanent hair dyes are the most common type of hair dyes used for hair colouration. These type of dyes generally involves two components (primary intermediates, couplers, oxidants) which on mixing undergoes chemical reactions to generate the dye. Few example of primary intermediates such as *p*-phenylenediamine, *p*-toluenediamine 2-naphthylamine, benzidine, 4-aminobiphenyl etc. Some of the common couplers used in hair dyes include *m*-phenylene-diamines, *m*-aminophenols, resorcinol etc. (Lewis, et. al., 2013; Baan et al., 2008; IARC, 1993). These type of hair dyes may cause contact allergy, bladder cancer risk in consumers (**Table 1**, Nohynek, et. al., 2010; Aeby, et. al., 2009). There are reports that exposure to hair dyes and hair straightening cosmetics (HDSC) during pregnancy can be harmful for the fetus (Couto, et. al., 2013).

3.5 Sindoor

Sindoor is a traditional red or orange-red colored cosmetic powder used by Indian women. Modern sindoor consists of vermilion, which is prepared by the purification of cinnabar. It also consist of lead tetroxide (Kapoor, et. al., 2007). Sindoor made from mercury and lead tetroxide salts is toxic **(Table 1)**.

4. Herbal Alternatives

Herbal cosmetics are prepared by utilizing the aqueous or non-aqueous plant extracts, tinctures, fatty acids or essential oils from natural products. A wide variety of plants have been utilized in medicines for the preparation of different cosmetic products such as sunscreen, skin bleach, hair dyes, lip care products etc. (Table 2, Chattopadhyay, 2005). Natural sun-filters have been used in sun-block products, along with natural rehydrants and humectants. Recently, natural extracts based conventional sunscreen formulations have been developed (Table 2). For example, *Camellia sinensis L.* leaves extract has been utilized for the preparation of sunscreen lotion with significantly enhanced sun protection factor (SPF) value (Sopyan, et. al., 2009). Similarly, the herbal oil from *Helianthus annuus* has been employed to formulate sunscreen creams for topical applications which promoted the protection against UV radiations, due to the antioxidant and anti-inflammatory nature of the natural oil constituents (Banerjee, et. al., 2019). Polyphenols derived from *Theobroma cacao* can inhibit the skin degradation enzymes. Moreover *T. cacao* pod extract can be used to protect skin from harmful effect of UV rays, which may be attributed to the presence of antioxidants such as carboxylic acid, fatty acid, phenolic acid, flavonoids and terpenoids (Williams, et. al., 2009). UVB induced skin photo-aging could be reduced by the utilization of ethanolic extract of *Coriandrum sativum* (Park, et. al., 2012). *Allium sativum* possess antioxidant properties and can protect against the harmful effect of UV rays (Pazyar, et. al., 2011). *Aloe vera* leaf extract can be employed for the absorption of UV rays due to the presence of organic compounds possessing conjugated double bonds and phenolic OH groups (Ray, et. al., 2013). The extracts of *Aloe vera*, *Cucumis sativus* and *Daucus carota* have been employed for the formulation of polyherbal cosmetic creams (Aswal, et. al., 2013). *Persea americana* can be used to protect the skin from the harmful effect of free radicals, which could be attributed to the presence of various antioxidants like vitamins and polyphenols (Dreher, et. al., 2013). *Calendula officinalis* extract possesses antioxidant properties due to which it has been utilized for the formulation of hydrophilic creams (Bernatoniene, et. al., 2011).

Natural skin whitening agents have been employed to prepare various cosmetic products (Table 2). For example, *Crocus sativus* has been utilized as skin depigmentation and whitening agents in Ayurvedic preparations. Moreover, it helps in cell formation and repair, works as an antidepressant, minimizes the chance of high blood pressure and heart disease, treats blemishes and acne, and also aids in the production of blood cells (Mzabri, et. al., 2019). Arbutin is a hydroquinone glycoside which can be isolated from the *Arctostaphylos uvaursi* (bearberry plant). Due to the melanin-inhibiting properties of its alpha isomer, it can be used in skin lightening formulations as a safe alternate to the toxic synthetic analogues (Couteau, et. al., 2016; Migas, et. al., 2015). Also, different types of naturally occurring clays such as zeolite, bentonite, montmerollinite, kaolin etc. can be utilized to treat skin problems. These clays are rich in minerals, such as magnesium, phosphorous, calcium, potassium etc. Fuller's earth have unique property of bleaching the skin. These clays can be employed for the removal of toxins, heavy metals and poisonous compounds from the skin (Nilforoushzadeh, et. al., 2018).

Natural products can also be used to produce colouring matter (Table 2). Different red dyes from natural sources has been used for the preparation of sindoor. Sindoor can be prepared from a mixture of turmeric and alum or lime (Kapoor, et. al., 2007). *Rubia cordifolia* and *Rubia tinctorium* have also been used for the preparation of sindoor (Kapoor, et. al., 2007). The roots, bark and seeds of *Bixa orellana* L. and *Beta vulgaris* L. root have been utilized for the preparation of sindoor and lipsticks (Kapoor, et. al., 2007; Deshmukh, et. al., 2013). Various naturally occurring colouring matter from natural sources such as cocoa powder, extracts of the flowers of *Hibiscus rosasinensis* L., mica powder, *Punica granatum* etc. can be used for the preparation of lipsticks (Dash, et. al., 2017; Kothari, et. al., 2018; Jain, et. al., 2018).

Natural hair dyes extracted from plants are of growing economic importance (Table 2).

Lawsonia alba, *Hibiscus rosasinensis, Nardostachys jatamansi*, *Saussurea lappa*, can be used as natural hair colourant (Singh, et. al., 2015). *Lawsonia alba* in combination with other herbal extracts, like *Aegle marmelos*, *Emblica officinalis*, *Centella asiatica*, *Arnica montana, Hibiscus rosasinensis* etc. has been used to formulate hair cleansers, tonics, nourishers (Kumar, et. al., 2012). Herbal hair colours are also used in various disorders such as dandruff, premature greying and head lice etc. *Cedrus deodara*, *Emblica officinalis*, *Hibiscus rosasinensis* have been utilized as anti-dandruff agents (Sah, et. al., 2018). *Centella asiatica*, *Sesamum indicum* and *Indigofera tinctoria*, can be employed for the darkening of hairs (Sah, et. al., 2018).

5. Conclusions

Cosmetics are substances employed to alter the appearance and texture of the body. Most of the commercial brands contain chemicals with potential health hazards. The herbal products offer opportunities to formulate cosmetics with no side effects along with the enrichment of the body with nutrients and other useful minerals. These herbal products can be utilized to prepare various types of safe and healthy cosmetic products such as sun blockers, skin bleach, lip care products, sindoor, eye makeup, hair care products etc. Thus, herbal cosmetics can be an effective and safe alternatives of the synthetic chemical based cosmetics.

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Machine Learning and COVID-19

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Abstract

Human and animal viruses are those formidable pathogens that have the potential to create havoc. We are witness to a grave situation, caused be an animal virus, that acquired the ability to infect humans at an alarming rate. The virus, SARS-CoV-2 has led to an unprecedented loss to the world economy as well as loss of precious human lives. In addition, the virus has led to mental agony for those who survived the onslaught. Scientists from around the world are working hard to develop new drugs and vaccines to tame the virus. In the quest to find a cure against the virus, technology is playing a very crucial role. The machine learning approaches have been instrumental in gaining insights into the COVID-19 pandemic at various stages. In this review, we discuss how machine learning approaches have been used in prevention, diagnosis and drug development against the SARS-CoV-2. We have also discussed how machine learning has identified subtle molecular changes among infected individuals.

Keywords: SARS-CoV-2, COVID-19, Machine Learning, Image Processing

Introduction

Viral infections are one of the major economic health burdens around the world. Currently we are witnessing an unprecedented situation where our world is struggling to fight a pandemic caused by a mighty small organism. This mighty small organism consists of a small stretch of nucleic acid (RNA) and a few proteins and is known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The disease caused by this virus is known as COVID-19: an acronym for Corona virus Disease of 2019. This disease has made our lives miserable and has led to a complete lockdown of the world, an event never witnessed before. We are forced to change the way we socialize, teach, reach out, and travel. With every passing day, infections around the world are increasing by leaps and bounds. This pandemic has refreshed the Bill Gates TED talk of 2015, where he mentioned that anything killing more than 10 million people in the next decade will be an infectious virus and not a war (https://www.ted.com/talks/bill_gates_the_next_outbreak_we_re_not_ready? language=en). Even as we are struggling with health and economic crisis, it seems that the worst is yet to come. A recent prediction by the WHO, that states that some countries still face an uphill task to combat SARS-CoV-2, has catalyzed the efforts to find a drug against this virus (https://tbsnews.net/coronavirus-chronicle/who-warns-some-nations-still-face-long-hard-battle-covid-19-100660). Scientists from around the world are racing against time to develop vaccines and new antivirals in a hope to tame the pandemic. Several candidate vaccines are in the stage of clinical trial and are expected to hit the market in early 2021 providing us with a hope that just like other pathogens, SARS-CoV-2 will also get controlled.

This pandemic has resulted in a section of the society which we proudly and gratefully refer to as the *Corona Warriors*. Foremost among them are the doctors and the nurses who risk their lives every day to fight this pandemic. Along with them, police, sanitisation workers and delivery agents have played a commendable role during this time of crisis. The

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role of yet another community is worth mentioning. This community has aggressively worked from their homes, collaborated with virologists, pathologists, health care workers, administrators, scientists, doctors, radiologists and many more, and charted the patterns of the COVID-19 pandemic. These are the machine learning (ML) warriors. With the access to mountains of COVID-19 related data, this community of developers came forward and developed novel algorithms and machine learning based models to help us gain insights into the patterns of the COVID-19 pandemic.

Since long, machine learning has pervaded the healthcare fabric by extending its help in the early prognosis of many life-threatening conditions, as well as its role in the diagnosis of many diseases. Machine learning has given encouraging results in the field of oncology, radiology, cardiology and cell therapy to name a few. Though the volume of data available is enormous, the relevant information extracted from it needs well trained and tested machine learning algorithms. Since 1960s the process of digitizing the patient data (Baird et al. 1965) came into force which included the storage and retrieval of the patient's data. Based on the health records many artificial intelligence (AI) and ML based systems assist physicians to help make decisions on the prognosis and diagnosis of different diseases. The role of ML techniques for detection of lung cancer (Zhao et al. 2002), skin cancer (Sigurdsson et al. 2004), breast cancer (Fear et al. 2002) and many more has been known for a long time now. The significant role of ML is also realized in the early diagnosis of Parkinson's disease (Pereira et al. 2019), its contribution to detect Alzheimer's disease from circulating non-coding RNAs (Ludwig et al. 2019), and the detection of depression (Swati et al. 2019), to name only a few. Thus, machine learning techniques help the clinicians to handle the patients better,and have made a commendable contribution to enhance the quality of human life. As the world found itself gripped in the relentless clutches of the COVID-19 pandemic, machine learning based approaches were very well suited to understand the various aspects related to the pandemic. In fact, the ML based approaches have been used vastly, right from the prevention of the infection, to the diagnosis, as well as the molecular characterization of the SARS-CoV-2. Some of these areas have been described below.

Machine Learning in COVID-19 Prevention

Prevention is better than Cure. Hence, when the COVID-19was declared a pandemic by the World Health Organization on the 11th March, 2020 (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen), one of the foremost task for every individual was to stay away from the onslaught of this deadly infection. The safest and the most effective way to remain safe from the pathogen is to observe social distancing. Apart from social distancing, contact tracking was one of the approaches that was utilized widely to combat the disease. The *Arogya Setu* application was launched by government of India to sensitize citizens regarding social distancing. This application works on the principle of contact sharing to identify people that might have been in proximity to an infected individual. Although the efficacy of contact sharing applications has yet to be established, a study pointed out that, in order to bring an outbreak under control, around 60% of the population is required to use the application (Fraser et al. 2020). Hence this application could work in cities which have a high smart phone penetration: a prerequisite for contact sharing applications. In fact, the *Arogya Setu* app was successful in predicting around 650 potential COVID-19 clusters which might have been missed out otherwise (https://www.hindustantimes.com/india-news/aarogya-setu-alerted-about-650-clusters/story-1kvGonSkLz77dwH3zMYOQI.html). Similarly, Google used the augmented reality technique in *SODAR* to help people maintain social distancing (https://sodar.withgoogle.com/). Another application worth mentioning is the United Nations Technology Innovation Lab's*1point5,* which builds awareness of the social distancing (https://onepointfive.app).

Machine Learning in COVID-19 Diagnosis

Severe infections of SARS-CoV-2 are frequently associated with pneumonia followed by other complications. Furthermore, the fact that most of the people are asymptomatic or develop disease after a period of time post infection makes things complicated as these people can act as potential spreaders. Hence, identification of disease at the nascent stage becomes extremely important. ML based approaches have been successfully utilized to understand the lung images for possible signs of pneumonia in patients which would otherwise have missed by physicians (https://health.ucsd.edu/news/

releases/Pages/2020-04-07-artificial-intelligence-enables-rapid-covid-19-lung-imaging-analysis.aspx). In this study, authors used more than 2000 chest X-ray images to train their models leading to the identification of pneumonia at a very nascent stage. Similarly, Bayesian Convolutional Neural Network was utilized to predict the cases of COVID-19 from the patient chest X-rays.The method improved the sensitivity from 85.7% to 92.9% leading to better informed decisions (Ghoshal et al. 2020). Similarly, a deep learning method called the VB-NET was utilized on thin section CT images to assess the severity among COVID-19 patients (Shi et al. 2020).

Machine Learning in the COVID-19 Drug Development

With the onset of the COVID-19 pandemic, several groups around the world are trying to identify effective drugs again the virus. Few drugs like Remdesivir and Dexamethasone are being investigatedas potential drugs to cure COVID-19. They have been identified using conventional methods by using the drug and a placebo for clinical trials. Apart from the conventional approaches, ML has been successfully utilized in drug repurposing against SARS-CoV-2. In fact ML based algorithm successfully identified Baricitinib, a drug commonly used in arthritis as the potential candidate against the COVID-19 (https://www.weforum.org/agenda/2020/05/how-ai-and-machine-learning-are-helping-to-fight-covid-19/). Similarly, machine learning approach called Vaxigen-ML was also used to develop a potential vaccine against COVID-19 (Ong et. al. 2020). The approach predicted a combination of structural and non-structural protein to develop as potential vaccine candidate. Though the drugs are now in clinical trials but the speed with which ML identified potential drug againstCOVID-19 from a million of candidates is what make this technique laudable.

Machine Learning in SARS-CoV-2 Characterization

Viral infections inthe host lead to numerous changes at the molecular level. Apart from the host proteome, viral infections lead to rapid changes in the host lipidome and metablome as well. Lipidomic profiling of influenza virus was successfully used to identify novel regulators of inflammation (Tam et. al. 2013). Similar study was performed among the COVID-19 and control patients. However, in this study, all the measurements obtained from the patients were fed to the machine learning model. The model could successfully identify severe COVID-19 patients based on the molecular signatures of serum metabolites with an overall accuracy of 93.5% (Shen et. al. 2020). The approach provides vital clues that can be used to predict whether a patient is prone to more severe COVID-19 manifestation or not, thereby enabling a physician to take timely decision. Another study focused on changes in the upper airway samples of COVID-19 and non-viral acute respiratory illnesses. The researchers successfully utilized machine learning models to differentiate COVID-19 patients based on the host transcriptional response (Mick etal. 2020). Hence, ML based techniques have been successfully utilized to characterize SARS-CoV-2 inducted molecular changes inside the host.

Discussion

COVID-19 has been declared as a pandemic and the disease has resulted in unprecedented loss in terms of mortality and economy. A recent report by United Nations states that the COVID-19 could double the global hunger, further indicates the enormity of the problem. COVID-19 cases around the world are still rising, but the number of deaths due to COVID-19 are decreasing due to better medical interventions. The cure to COVID-19 is urgently required and many groups around the world are using diverse strategies to combat the virus. With the availability of enormous data, machine learning approaches have also been instrumental in gaining insights into the COVID-19 pandemic. The ML techniques have risen to the occasion and helped in containing the alarming situation. The techniques developed in this short period and the insights gained will be instrumental in forming the basis of many future studies. The collaboration between research institutes, technology companies and Pharma industries promise to develop novel, effective and therapeutic approaches based on the vast data that gets generated, thereby expediting the prognosis as well as the diagnosis of the diseases.

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SHARING SECRET WITH PUBLIC KEY CRYPTOGRAPHY

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Abstract

In today's world where Internet has become an inseparable part of our lives, Data security is of utmost importance to us. Every user wants to send his data over a secure channel so that his data can only be accessed by the legitimate user and to make sure that the data has not been tampered while transmission. Public key cryptography is very helpful in achieving a great level of security. In this paper we will talk about different public key cryptography techniques and algorithm. We will analyse RSA (Rivest Shamir and Adleman), Diffie-Hellman, DSA (Digital Signature Algorithm) and ECC (Elliptic curve cryptography). We would also be discussing their strengths and weaknesses. We will analyse their performances. Finally, we will conclude that which algorithm works most efficiently under what circumstances.

Keywords

RSA (Rivest Shamir and Adleman), Diffie-Hellman, DSA (Digital Signature Algorithm), ECC (Elliptic curve cryptography)

1. INTRODUCTION

While communicating through a network everyone wants to transmit his data securely so that no illegitimate user can access the data. Cryptography is used to do a secure data communication through wired and wireless network but what exactly is cryptography? Before knowing about cryptography, it is important to know about cryptology. Cryptology is the study of techniques for ensuring the secrecy and/or authenticity of information. Cryptology classified as cryptography and cryptanalysis. Cryptography is about constructing such techniques; and Cryptanalysis deals with defeating such techniques, to recover information, or forging information that will be accepted as authentic. Cryptography converts readable message into non-readable form. The process of converting from plaintext to ciphertext is known as enciphering or encryption; restoring the plaintext from the ciphertext is deciphering or decryption. Cryptography categorized as Symmetric cryptography and Asymmetric cryptography. In symmetric key cryptography, both parties use the same key. With the help of this key and encryption algorithm, sender encrypts the data; and the receiver decrypts the data by using the same key and the decryption algorithm. In Asymmetric key cryptography, Sender and Receiver uses different keys for encryption and decryption namely PUBLIC and PRIVATE key respectively. Fig. 1.1 shows the basic concept of Public Key Cryptography where the sender encrypts the message using the public key of receiver and sends the encrypted text to the receiver. The receiver receives the enciphered text and decrypt it, using his private key. Note that only the receiver has his private key so only he can decrypt the encrypted text and read the message. Thus in this case, Public key Cryptography has provided confidentiality.

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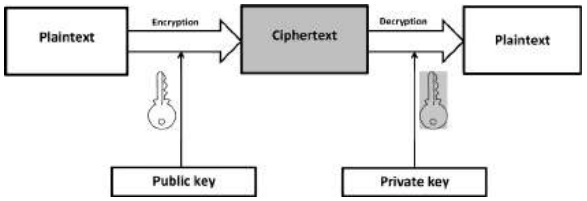

Figure 1.1 Public Key Cryptography Concept

Asymmetric cryptography is also known as Public Key Cryptography. As the name suggests Public key is made public and receiver keeps the private key as a secret. RSA (Rivest Shamir and Adleman), Diffie-Hellman, DSA (Digital Signature Algorithm), ECC (Elliptic curve cryptography) are some of the most frequently used public key cryptography techniques. Among them, the most popular public key cryptography technique is RSA. It is a block cipher i.e. it operates on fixed size of bit groups of plaintext. In this algorithm, plaintext and ciphertext are represented as integer k where, $0 < k < n$ for some n. It offers confidentiality, authenticity, integrity and nondeniability of the data transmitted. It is based on the difficulty of computing the prime factors of product of two large prime numbers. Diffie-Hellman is the simplest public key cryptography technique. It allows two users to exchange a secret key over an insecure channel. It is based on the difficulty of finding discrete logarithms. This technique works fruitfully as long as two parties can mutually authenticate each other. It does not provide authentication. It cannot be used as an encryption/ decryption algorithm. DSA is one of the strongest digital signature technique which is currently being used at many places. It is also based on the difficulty of computing discrete logarithms. It cannot be used to share keys or to perform encryption/decryption. Elliptic curves defined over finite fields are used in developing ECC techniques. It is comparatively a newer member in the family of public key cryptography techniques. It is and has been the "centre of attraction" from past many years for the great level of security it provides, with keys of smaller lengths. We will thoroughly discuss these techniques in this paper. We will also look at the strengths and weaknesses of these techniques with the possible attacks on them.

2. STUDY OF DIFFERENT TECHNIQUES

We will examine the above-mentioned techniques in this paper on the basis of different research paper.

2.1. Rivest Shamir and Adleman (RSA) algorithm

[6] RSA is one of the most popular public key cryptography algorithms. It was introduced by Rivest, Shamir, and Adleman in 1977. It is based on the difficulty of finding large prime factors of integers. To have a better understanding of the need of this algorithm, consider the following problem.

Suppose Ash wishes to communicate with Ben, but they have not previously agreed on a key and they do not wish to send the key in a courier. Thus, all of their messages can be seen by the intruder, Eric. However, they can still communicate with each other in a way that Ben can read all the messages, but Eric cannot.

[4]Let us see how this algorithm works. Two different large prime numbers are chosen by Ben say p and q and then he computes

$n = pq$.

Ben also chooses a number e in such a way that

$gcd((p\text{-}1)(q\text{-}1),e) = 1$.

(n,e) is the public key of Ben. He calculates d such that

$de = 1 \pmod{(p\text{-}1)(q\text{-}1)}$.

(p,q,d) is the private key of Ben. He sends his public key to Ash. Ben does not share his private key with anyone. Ash writes his message in the form of an integer say m. To encrypt the message m, Ash computes

$c = m^e \pmod{n}$

and sends it to Ben. Ben receives the message c. To decrypt c, He calculates

$m = c^d \pmod{n}$.

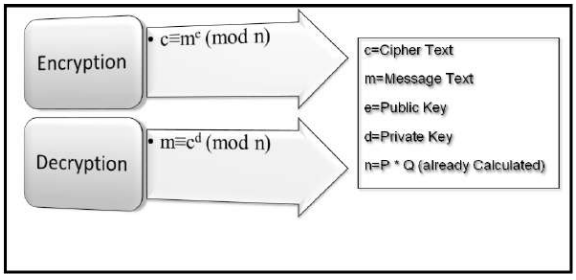

Figure 2.1 The RSA Algorithm

Fig. 2.1 has been taken from the website *https://www.c-sharpcorner.com/UploadFile/75a48f/rsa-algorithm-with-C-Sharp2/*. It gives the brief summary of RSA algorithm. Here, selection of *e* depends on the selection of prime numbers *p* and *q*. If the values of *p* and *q* are chosen to be large enough then it would be very difficult to estimate the encryption. [4]For example- Take $p = 7$, $q = 17$. *e* must not be a factor of $(p-1)(q-1)$

i.e. $(7-1)*(17-1) = 6*16 = 96 = 2*2*2*2*2*3$. So, *e* can take the value 5, 7, 11…

Similarly, we cannot choose a smaller value of *d* as it can increase the probability of a brute force attack.

Attacks on RSA algorithm

Types of attacks possible on RSA are [6]:

- **Brute Force Attack:** In this attack, the intruder tries every possible key with a hope of getting the right key. We can prevent this attack by using a large key space.
- **Mathematical Attack:** It involves finding the prime factors of n which will help the intruder to find $Ö(n) = (p-1)(q-1)$ and thus enable him to determine $d = e^{-1} \pmod{Ö(n)}$.

Users may get attracted to the smaller values of *p* and *q* as it will speed up the process of encryption and decryption but then it will be a cake walk for the force attacker to find out these numbers.

For example, Take $p = 5$, $q = 3$ and $n = pq = 3*5 = 15$. In this case, It can be clearly seen from the value of *n* that the value of *p* and *q* are 3 and 5. So the two prime factors of *n* have to be kept as a secret because if someone obtains these values then he can decrypt all the messages.

We can prevent this attack by choosing large key size for *n.* A key size of around 1024 - 2048 bits seems rational so that an attacker cannot find the prime factors from the value of *n* but factoring an integer *n* is not hard in today's computer days so in addition to this, researchers have suggested that with some extra conditions on the value of *p* and *q* we can prevent this attack.

1. The length of *p* and *q* should differ by a few bit.
2. There should be a large prime factor of $(p-1)$ $(q-1)$.
3. $(p-1)$ and $(q-1)$ should have a small *gcd*.

[2]In the paper presented by Chandra M. Kota et al., It has been shown that if the size of prime factor *p* and *q* is less than or equal to the number of one fourth bits present in *n* then the whole system can be attacked.

- [6]**Timing Attack:** In this attack, an attacker tries to gain information about the plaintext from the computation time of encryption and decryption. We can prevent this attack by making sure that all the computations take same time to be executed.

[4]This algorithm is not viable for wireless communication because the key size is very large. The size of *p* and *q* must be no less than 100 digits. It is a very time-consuming algorithm, involves too many calculations and thus not viable for transmitting large amount of data. However, it is easy to implement this algorithm in any software. It is easy to use and upgrade the algorithm. The advantages of RSA lie in its workability and movability.[6] Unmodifiable signatures can be created using RSA algorithm. It is also useful in providing authenticity. It can be used in sending the key of faster private key cryptography securely.

2.2. Diffie-Hellman Algorithm

Two users can use this algorithm to exchange cryptographic keys securely over an insecure channel. RSA is one solution to this problem. Diffie-Hellman algorithm is another solution of this problem. Consider the following situation :

[4]Suppose Ash and Ben wants to share a secret key of symmetric cipher but the only way to share the key is through an insecure channel. All of their message sent through an insecure channel are monitored by the adversary, Eric then how can Ash and Ben share the key without making it appear to Eric? On first sight, it seems an impossible task but Diffie and Hellman solves this problem by developing this brilliant algorithm. [6]The Diffie-Hellman algorithm is based on the difficulty of finding discrete logarithms. For an integer *b* and a primitive root *a* of a prime number *p*, A unique exponent *i* can be obtained which satisfies

$b = a^i \pmod{p}$ where *0 d" i d" (p-1)*

The exponent *i* is called discrete logarithm of *b* for the base *a*, mod *p*.

Here is how they decide the secret key of the symmetric cipher over an insecure channel. Fig.2.2 has been taken from https://wizardforcel.gitbooks.io/practical-cryptography-for-developers-book/key-exchange/diffie-hellman-key-exchange.html. It gives

a brief summary of Diffie-Hellman key exchange algorithm. [5]At first a large prime p and a primitive root g of prime p is chosen by Ash and Ben mutually. They are made public. Ash selects an integer a which he keeps as a secret, similarly Ben selects an integer b which he does not share with anyone. With the help of their random integers,

Ash calculates $A = g^a \pmod p$ and
Ben calculates $B = g^b \pmod p$.

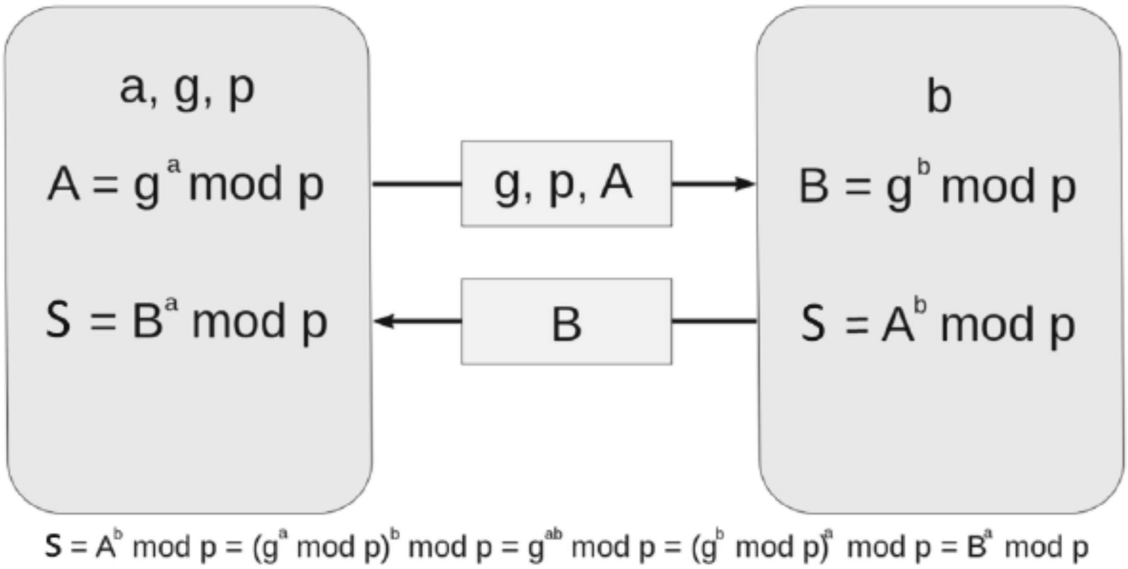

Figure 2.2 The Diffie Hellman Key exchange algorithm

Hereafter Ash sends A to Ben and Ben sends B to Ash. They again use their random integers to calculate the desired secret key.

Ash computes $S = B^a \pmod p$ and
Ben computes $S = A^b \pmod p$

Thus, they have successfully developed the key using an insecure channel.

Suppose that adversary Eric has noted all the messages being transmitted so he has p, g, A, B with him. To find the secret key, he will try to solve $g^a = A \pmod p$ for the value of a then she would have to solve $g^{ab} = (g^a)^b = S$ for the value of b. [7]Solving these equations is equivalent to finding discrete logarithms which is presumed to be very difficult. If he can solve these equations, then he can successfully breach the system.

Attacks on Diffie-Hellman key exchange algorithm

- Brute Force Attack: Longer key lengths make it difficult to find the secret key by the brute force attack.
- [6]Man-in-the-Middle Attack: In this attack, the adversary Eric does the follows4.

1. Eric selects two secret integers x_1 and x_2 and then calculates the corresponding public keys y_1 and y_2 .
2. Ash sends A to Ben.
3. Eric interrupts this message and sends y_1 to Ben. Eric computes $K' = (A)^{x}_{2} \bmod p$
4. Ben receives y_1 and computes $K = (y_1)^b \bmod p$.
5. Ben sends B to Ash.
6. Eric interrupts this message and sends y_2 to Ash. Eric computes $K = (B)^{x}_{1} \bmod p$
7. Ash receives y_2 and computes $K' = (y_2)^a \bmod p$

Now, Ash and Ben think that they have shared the secret key but instead Ash has shared the secret key K' with Eric and Ben has shared the key K with Eric. Hereafter Eric can read all the messages exchanged between Ash and Ben by means of the following manner.

1. Ash transmits an enciphered version of message M i.e. E(K',M).
2. Eric checks this ciphertext, deciphers it and obtains M.

3. If Eric just want to spy the communication between Ash and Ben then he would send E(K,M) to Ash but if he wants to alter the messages being sent to Ben then he would send E(K, N) , where N is the modified message.

It is impossible to detect that such kind of attack has taken place because this key exchange algorithm does not provide authentication to the users. This attack can be prevented by using digital signatures and public key certificates. It is time consuming and involves too many computations. Diffie-Hellman algorithm can not be used to sign digital signatures.[4] It can be used to transmit the key of symmetric encryption. Almost every encryption technology uses Diffie-Hellman algorithm to increase their security, couple of them are Secure Socket Layer (SSL), Secure Shell (SSH), Internet Protocol Security (IPSec), Public Key Infrastructure (PKI), Internet Key Exchange (IKE) and all those other things that relies on these protocols.

2.3 Digital Signature Algorithm

As the world is growing more interest towards internet for its transactions and business activities,it becomes equally important to guard the content from unintended access. A digital signature is a computerized variant of traditional signature. [6]Transporting digital signature is a piece of cake. It cannot be copied easily. Modification of message content is not possible until and unless an illegitimate user has the private key of sender.

Fig. 2.3 has been taken from the website https://www.tutorialspoint.com/index.htm. It shows an approach to obtain the digital signature for a message. Digital signature for a message can be obtained using "Hash Function" and sender's private key. Input to the hash function is the message which is being signed. Hash function compresses the message to a fixed size. Compressed message is given as an input to the signing function and the output of the signing function is the digital signature of the desired message. Sender append this signature with the corresponding message he is going to send so that receiver can make sure that the message has been sent and signed by the intended user. At receiver's side, message is again passed as an input to the hash function and the hash value of the received message is calculated. Receiver verifies the signature using a verification algorithm and the public key of sender which produces a hash value. If the computed hash value matches with this hash value then the signature is assumed to be verified. [6] The difficulty to compute discrete logarithm is the basis of DSA.

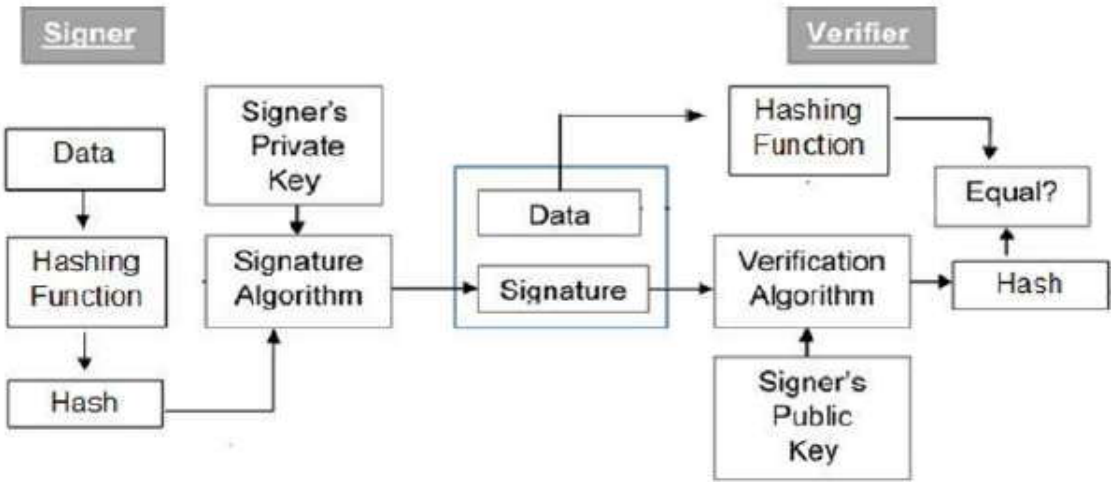

Figure 2.3 Approach to a Digital Signature

Choose a prime number q of length 160-bit. A prime number p of length in between 512 - 1024 bits is chosen in such a manner that $q|(p-1)$. Select $g = h^{(p-1)/q}$ (mod p) where 1 d" h d" $(p-1)$. Note that $g > 1$. These are the global parameters for the members of the group.

Now, each member of the group chooses their private key and develops the public key. A random integer x, where $0 < x < q$, is chosen as the private key. $y = g^x$ (mod p) is the public key. Given the value of x, it is easy to find y but doing the converse is equivalent to solving discrete logarithm which is presumed to be difficult.

To sign a message M, sender follows the following procedure:

1. A randomly or pseudorandomly produced integer k is chosen by the sender. For every time the sender signs a message, he should choose a different value of k.
2. Calculate $r = (g^k \bmod p) \pmod q$.
3. Calculate $s = [k^{-1} (H(M) + xr)] \bmod q$ Where H(M) is the hash value of message M.
4. (r , s) is the sign of sender for the message M. The sender appends his sign with the message M and sends this concatenated text.

To verify the message M, receiver follows the following procedure:

1. Receiver obtains the value of (p, q, y, g) from the public domain.
2. Calculate $u_1 = [H(M) w] \bmod q$ where $w = s^{-1} \bmod q$.
3. Calculate $u_2 = rw \bmod q$.
4. Calculate $v = [(g^{u_1} . y^{u_2}) \bmod p] \bmod q$.
5. The sign is proved to be true if the value of v and r is same.

Let us see how this verification proves that the message has been sent by the intended sender. If we focus at how s was calculated, we will observe that

$H(M) = (ks - xr) \bmod q$

Which hints that,

$s^{-1} H(M) = (k - s^{-1}xr) \bmod q$.

Thus, $k = (s^{-1} H(M) + s^{-1} xr) \bmod q$

i.e. $k = (u_1 + xu_2) \bmod q$.

Therefore, $g^k = g^{u_1 + a u_2} = [(g^{u_1} . y^{u_2}) \bmod p] \bmod$ and we have $v = r$.

For an adversary, it is computationally impossible q to obtain the value of k from r and the value of x from s.

Also note that while creating the signatures, the only exponential computation required is $g^k \bmod p$ and since this value is independent of the message being sent, Sender can precalculate it. [9]It is patent free therefore anyone can use it without charges.

[3]The disadvantage of DSA is that it takes a large amount of time to verify the message because the verification part is a bit computational. We cannot use this algorithm to encrypt the message being sent. Generally, SHA-1 hash function is used in the signing process so any loophole in SHA-1 algorithm will decrease the security of the digital signature.

[6]In fact, he can also compute some values of$r$ in advance which he may use while signing any message. The only heavy computational task remained is the evaluation ofk^{-1} which he can again precalculate for some prechosen values of k. In comparison to the other digital signature, DSA needs less space. It can be used to authenticate the sender. Many encryption technologies like SSL, SSH, TLS , web servers and search engine use DSA for authentication.

2.4 Elliptic Curve Cryptography (ECC)

[6]The majority products and technologies that encrypts using public key cryptography use RSA for digitally signing the document. However, with the growing need of level of security, the key size of RSA is increasing tremendously. It puts a huge burden on the processor of those machines and applications that use RSA. This load on the processors brings unwanted consequences like that on e-business websites. [4]ECC is comparatively a new member in the class of public key encryption algorithms. [6] ECC overcomes this shortcoming of RSA. It would not be wrong if we say that ECC could be the future of public key cryptography. With a key of smaller length, it provides a great level of security as offered by RSA or any other algorithm and thus it requires less processing. [8] It has been found that the security level, offered by any other cryptosystem with a key size of 4096-bit, can be found using 313-bit key in elliptic curve cryptography. [1] Table 2.1 shows the key size ratio and cost ratio of ECC and RSA. It is quicker than any other cryptosystem. [4]Elliptic curve is defined on a particular algebraic structure where some certain operations can be carried out. A one-way function called Elliptic Curve discrete logarithm problem (ECDLP) is given by these operations. The one-way functions, which are the basis of DSA and Diffie-Hellman, is identical to ECDLP. ECDLP is used by ECC to build a cost-effective cryptosystem. [6] Unlike RSA and Diffie-Hellman, ECC is a bit complex and hard to illustrate so we confine ourselves to a rapid review of ECC.

ECC Key Size (bits)	RSA Key Size(bits)	Key Size Ratio	Cost Ratio
160	1024	1:7	1:3
224	2048	1:10	1:6
256	3072	1:12	1:10
384	7680	1:20	1:32
521	15360	1:30	1:64

Table 2.1

Key Size Ratio and Cost ratio for ECC and RSA

An elliptic curve E over the finite field, $\boldsymbol{Z}_p$ is defined as

$E : y^2 \bmod p = (x^3 + ax^2 + bx + c) \bmod p$ Where a, b, c, x and y comes from Z_p .

The set having all the pairs (x,y) satisfying above equation, is denoted by $E_p(a,b)$. It can be proved that $E_p(a,b)$, together with a point at infinity O, forms an abelian group provided that

$(4a^3 + 27b^2) \bmod p$ ‘‘‘ $0 \bmod p$.

An elliptic curve E over the finite field, GF(2^m) is defined as

$E : y^2 + xy = x^3 + ax^2 + b$ Where a, b, x and y belong to GF(2^m) and the computations are carried out in GF(2^m).

The set having all the pairs (x,y) satisfying above equation, is denoted by $E_2^m(a,b)$. It can be proved that $E_2^m(a,b)$, together with a point at infinity O, forms an abelian group if b ‘‘‘ 0.

Just like we have the problem of computing discrete logarithms and finding factorization of product of two large primes, here we have the difficulty to obtain the value of k for the given value of kP Where k is a positive integer and it is less than p.

2.4.1 ECC Diffie-Hellman Key Exchange Algorithm

[6]Ash and Ben need to share a secret key. They can successfully share the secret key by using the procedure given below :

1. They begin with mutually agreeing on a number q which is either a large prime p or has the form 2^m then they choose the value of a and b.
2. Second, they choose the base point $G = (x_1, y_1)$ from the elliptic curve having a large order say n.
3. Ash chooses a number n_A such that $n_A < n$. It is the private key of Ash. He computes his public key using the formula $P_A = n_A . G$.
4. In a similar way, Ben chooses his private key n_B and then calculates his public key P_B.
5. Both sends their public keys to each other.
6. Ash calculates the secret key $k = n_A . P_B$ and Ben calculates the secret key $k = n_B . P_A$.

It is easy to observe that they both have shared the same key. An intruder has to find the value of k for the given values of G and kG which is a very tough task.

2.4.2 Elliptic Curve Encryption/Decryption

[6]We can use the theory of elliptic curve to develop many encryption/decryption techniques. Here we will discuss the simplest one. The plaintext P_m is represented as an ordered pair. Users begin with mutually agreeing on a number q which is either a large prime p or has the form 2^m then they choose the value of a and b. Second, they choose the base point G from the elliptic curve. These are called global parameters. They are declared in public domain and they will be used while performing encryption/ decryption. Every user A chooses his private key n_A and computes the public key $P_A = n_A . G$.

An integer k is chosen by the sender secretly, Ash. He then encrypts P_m and obtains the enciphered text C_m Where

$C_m = [k\text{G}, P_m + k P_B]$

Observe that the public key P_B of receiver, Ben has been used while performing the encryption. To decipher C_m, Ben multiply the first component of C_m with his private key n_B and then subtract the resultant from the second component of the ciphertext. Thus, he obtains the plaintext P_m.

Mathematically,

$P_m + k P_B - (n_B . k\text{G}) = P_m + k P_B - k P_B = P_m$.

[4][7]ECC is used in master cards, mobile phones, internet of things, bitcoins businesses, sensors etc. The security offered by ECC depends on the difficulty faced by the intruder in finding the value of k for the given values of kP and P. ECC encryption/ decryption technology is reasonably secure. No such concrete attacks have been found till now. There are few which can be reduced using different technologies. However, there is nothing like perfection therefore ECC should be carefully enacted.

2.5 [4]***Analysation***

S. No.	Cryptographic Technique	Analysis
1	RSA	RSA can be used in Mobile nodes; because they are vulnerable to many attacks due to their broadcast nature.RSA is not suitable for WSN because it involves too many computations and it is comparitively small.
2	D-H Algorithm	Two users, who have never met, exchange key using D-H algorithm. A proposed for two goals: authenticated key agreement and authenticated key agreement with key confirmation in the asymmetric (public-key) setting. It can be used in internet of things including SSL, SSH, IPSec, PKI.
3	DSA	Sender append this with any kind of message he is going to send so that receiver can make sure that the message has been sent and signed by the intended user. Hash function is used to compress the plaintext to a fixed size. Each byte of compressed message depends on other bytes of the message. Result of Hash function depends on size of data.
4	ECC	Public-key algorithms that can provide shorter key lengths and, depending upon the environment and application in which it is used, improved performance over system based on integer factorization and discrete logarithms. Performance of ECC with other algorithms is, it is 5 to 15, 20 and 60, and sometimes 400 times faster than others depend on ECC bit

2.6 Conclusion

After making thorough analysation of the aforementioned cryptographic techniques, we came to the following conclusions:

· RSA is one of the most popular and strongest algorithms in the family of public key algorithm. It can be used to perform encryption/decryption, to create digital signatures and to share a secret key between two parties. Till now no such concrete attack have been found which can break this algorithm but because of the longer key size, It is a bit slow therefore it might bring burden on the processors of the machines in which they are used.

· Diffie-Hellman algorithm is one of the simplest algorithms in the family of public key algorithm. Almost every encryption technology uses Diffie-Hellman algorithm to increase their security, couple of them are Secure Socket Layer (SSL), Secure Shell (SSH), Internet Protocol Security (IPSec), Public Key Infrastructure (PKI), Internet Key Exchange (IKE) and all those other things that relies on these protocols. It can be used to transmit the keys of symmetric encryption, but It cannot be used to create digital signatures. It cannot be used to perform encryption/decryption as well. It involves too many computations therefore it is time consuming and Since it does not provide authentication, it is prone to Man-in-the-middle-attack. This attack can be overcome by using digital signatures which will authenticate the two parties in front of each other.

· [9]DSA produces the signature of shorter length in contrast to other digital signature standard. When the two communicating parties are not trusted by each other, In that situation DSA can be used. It is quick. It takes lesser storage. It is patent free therefore anyone can use it without charges. Many

encryption technologies like SSL, SSH, TLS , web servers and search engine use DSA for authentication. The disadvantage of DSA is that it takes a large amount of time to verify the message because the verification part is a bit computational. We cannot use this algorithm to encrypt the message being sent. It cannot be used as a key exchange algorithm as well.

· With a key of smaller length, ECC provides a great level of security as offered by RSA or any other algorithm. ECC takes less storage. RSA is slower than ECC as It involves too many calculations. ECC is used in master cards, mobile phones, internet of things, bitcoins businesses, sensors etc. No such concrete attacks have been found till now on ECC but it is a bit complex than RSA and Diffie-Hellman algorithm.

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Viewing Corona Pandemic with Mathematical Glasses: An Overview

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Abstract

The massive spread of the novel Coronavirus pathogen: COVID-19 is certainly one of the gravest situations mankind has faced in centuries. The fact that the virus spreads both, through direct (being in close contact with the patient) and indirect (through droplets that survive on the surfaces that have come in contact with the patient) exposure to an infected person, with an on-going research to confirm if the disease is air-borne as well, makes it all- the- more dangerous to humans. In this article, we aim at identifying some basic factors on which the rate of transmission of the virus depends, and the corresponding measures we can take in order to improve the situation.

Keywords

Corona virus, Exponential growth model, Logistic growth model, Physical distancing, Herd immunity

1. Introduction

With over 12.5 million people who have already been infected worldwide and a recorded 560 thousand deaths, the rate of spread of this disease is appalling. The situation in our own country is no different. Having nearly 800 thousand total cases and registering 22 thousand deaths, hitherto makes India the third worst affected country across the globe, after the USA and Brazil with 3.22 million+ and 1.76 million + cases, respectively.

This disease is supposed to have appeared for the very first time in Wuhan, province of Hubei, China, when a 55-year old man was found infected on November 17, 2019. Lack of knowledge about the symptoms, severity and necessary precautions led to a very rapid spread of COVID-19 in China, and eventually in the rest of the world. The known symptoms resemble that of seasonal flu like: dry cough, cold, fever and even shortness of breath in cases of acute infection. The symptoms get more troublesome as the virus affects the vital organs of the human body. As the general symptoms shown by the person infected with novel coronavirus overlap with common flu, it is difficult to identify the patients and hence the spread cannot be easily controlled *(Huang C. et al, 2020)*.

Dr. Robert Redfield, Director, Center of Disease Control and Prevention (CDC), in an interview with National Public Radio said that as high as 25% (or even a much higher percentage) of the number of people patients of COVID-19 may remain asymptomatic (*Cascella M. et al, 2020)*. That is, they might just be walking around, unaware of the fact that they are actually infected and are spreading the virus. In the US, the fraction of asymptomatic people very quickly rose to 44% of the total cases, making this disease way more dangerous than the SARS-2002 (Severe Acute Respiratory Syndrome) outbreak *(Ksiazek, T. G et al, 2003)*.

Researchers, all across the globe, are working round the clock to know more and more about the new pathogen in the interest of humankind. Administrations are also adopting all possible measures to control the pandemic and create awareness in general public in an effort to contain the transmission at the grass root level.

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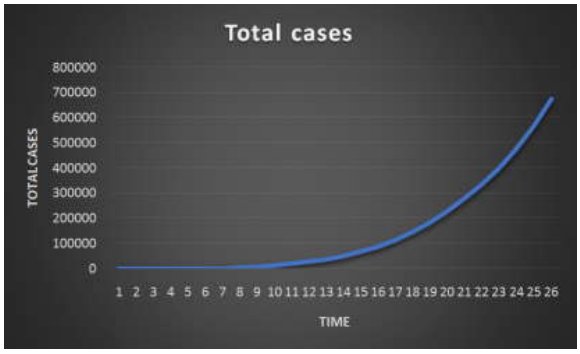
In the present article, we try to analyze the situation with a mathematical bent an. Scrutinizing the spread of COVID-19 from a mathematical point of view, we get to see that mathematical modeling and logistic and exponential growth models help us get to fairly conclusive results about the rate of reproduction, mortality and recovery. This article captures the model in Indian setting and context. The data and figures used would be in the sense of India, which would, in due course, also be valid for the global scenario.

2. Indian Scenario at present

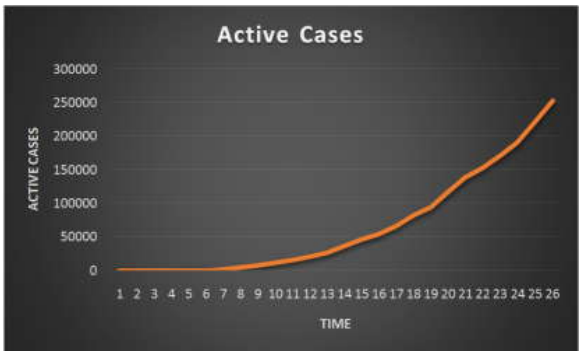
The first case of COVID-19 in India, which originated from China, was reported on January 30th, 2020. As of July 9th, we have a total of 767296 cases including 476377 recoveries and 21129 deaths, confirmed by the Ministry of Health and Family Welfare (MoHFW). The mortality rate due to Coronavirus stands at 2.80%, which is approximately 1.7 times lower than the world average, which is 4.70%. After the first case on 30th January, the 100th case was reported on 15th March, the 500th on 24th March, the 1,000th on 29th March, the 2,000th on 2nd April, the 5,000th on 8th April, the 10,000th on 14th April, the 50,000th on 7th May, the 100,000th on 19th May, the 200,000th on 3rd June, the 500,000th on 27th June and the 700,000th on 7th July, with Mumbai, Delhi, Ahmedabad, Chennai, Pune and Kolkata being the worst affected Indian cities.

Here are some figures concerning the total number of cases, active cases and deaths in India, which will help us plot and judge the behaviour of their respective graphs *(World Health Organization Report on COVID-19,* Aarogya Setu *Statistics, https://www.covid19india.org/, https://www.icmr.nic.in/) , https://mohfw.gov.in/ , https://www.who.int/).*

Day	**Total Cases**	**Active Cases**	**Deaths**
Day 1, 2nd March	5	3	0
Day 6, 7th March	34	31	0
Day 11, 12th March	74	69	1
Day 16, 17th March	137	126	3
Day 21, 22th March	360	365	7
Day 26, 27th March	834	794	19
Day 31, 1st April	1834	1792	41
Day 36, 6th April	4281	4267	111
Day 41, 11th April	7529	7189	242
Day 46, 16th April	12759	11214	420
Day 51, 21th April	18985	15460	603
Day 56, 26th April	26917	20486	826
Day 61, 1st May	35365	26027	1152
Day 66, 6th May	49391	35871	1694
Day 71, 11th May	67152	45925	2206
Day 76, 16th May	85940	53553	2752
Day 81, 21th May	112359	66089	3435
Day 86, 26th May	145380	82172	4167
Day 91, 31st May	182143	93349	5164
Day 96, 5th June	226770	116302	6348
Day 101, 10th June	276583	138069	7745
Day 106, 15th June	332424	152791	9520
Day 111, 20th June	395048	170269	12948
Day 116, 25th June	473105	190191	14894
Day 121, 30th June	566840	220546	16893
Day 126, 5th July	673165	253245	19268



Total Cases



Active Cases

Deaths

The results from these graphs show that the growth in the number of patients follows a fairly consistent pattern. Although initially we had an increase of only some tens of cases that eventually turned into about 20,000 cases per day, which seems to be a very huge difference or a severe deterioration in the condition, but checking the ratios of the corresponding days, we find an interesting result. This table represents the ratio of the cases on every fifth next day, which will help us in reaching certain results.

Day N v/s N+5	Number of cases on day N	Number of cases on day N+5	Corresponding ratio
Day 1 v/s Day 6	5	34	6.80
Day 6 v/s Day 11	34	74	2.18
Day 11 v/s Day 16	74	137	1.85
Day 16 v/s Day 21	137	360	2.63
Day 21 v/s Day 26	360	834	2.
Day 26 v/s Day 31	834	1834	2.20
Day 31 v/s Day 36	1834	4281	2.33
Day 36 v/s Day 41	4281	7529	1.76
Day 41 v/s Day 46	7529	12759	1.70
Day 46 v/s Day 51	12759	18985	1.49
Day 51 v/s Day 56	18985	26917	1.42
Day 56 v/s Day 61	26917	35365	1.31
Day 61 v/s Day 66	35365	49391	1.40
Day 66 v/s Day 71	49391	67152	1.36
Day 71 v/s Day 76	67152	85940	1.28
Day 76 v/s Day 81	85940	112359	1.31
Day 81 v/s Day 86	112359	145380	1.29
Day 86 v/s Day 91	145380	182143	1.25
Day 91 v/s Day 96	182143	226770	1.25
Day 96 v/s Day 101	226770	276583	1.22
Day 101 v/s Day 106	276583	332424	1.20
Day 106 v/s Day 111	332424	395048	1.19
Day 111 v/s Day 116	395048	473105	1.20
Day 116 v/s Day 121	473105	566840	1.20
Day 121 v/s Day 126	566840	673165	1.19

A careful examination of the last column of the table shows that the ratio ultimately attains a nearly constant value, which stabilizes and eventually lies between 1.2 and 1.4 after a certain period of time. This is a prime characteristic of the graph of the exponential growth model in entirety and also of the initial part of the graph of the logistic growth model, as detailed below *(Maier B. F et al ,2020 ; Stevens, H. ,2020).*

1. Exponential Growth Model v/s Logistic Growth Model for Coronavirus

For this discussion the term *birth rate* refers to the 'birth' of coronavirus, that it, from the time when it becomes active or attains the potential to infect humans, and correspondingly, *death rate* refers to the 'death' of coronavirus, that is, when it loses the ability to infect people (for example, when an infected person dies, and the dead body is disposed off completely, coronavirus present in the body can no longer infect any other person).

Exponential Growth Model: Consider a population (of COVID-19 pathogen) growth model. In exponential growth, we assume that the resources required for sustaining the population at any time are unlimited or infinite and will never run out. The growth can be approximated on the following lines:

Let N be the size of the population at the time of study, with α being the rate of birth, and β being the rate of death. Therefore over time T, the rate of change of population, denoted by $\frac{dN}{dT}$, is given by:

$\frac{dN}{dT} = \alpha N - \beta N = (\alpha - \beta)N$

or, $\frac{dN}{dT} = r * N$; where $r = (\alpha - \beta)$ and is commonly termed as *rate of reproduction.*

Depending on whether the value of r is positive or negative, we have a corresponding increase or decrease in the population.

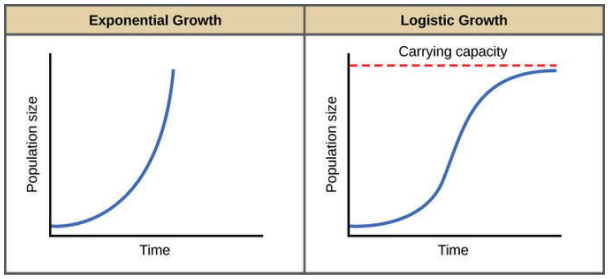
Logistic Growth Model: Exponential growth is a theoretical concept. What we usually find in real world scenarios is the logistic model. Consider a population (of COVID-19 pathogen in this case) growth model. In logistic growth, we assume that the resources required for sustaining the population at any time are limited and will run out eventually. The growth can be approximated on the following lines:

Let N be the size of the population at the time of study, with being the rate of birth, being the rate of death and k being the carrying capacity. Over time T, the rate of change of population, denoted by is given by:

$$\frac{dN}{dT} = (\alpha - \beta) * N * \frac{k - N}{k}$$

or, $$\frac{dN}{dT} = r * N * \frac{k - N}{k}$$

The graphs for the two models look like:



A careful visualization of the two graphs tells us that the exponential growth pattern has no non-

zero equilibrium position for population, whereas the logistic growth pattern attains its equilibrium at a non-zero k, the carrying capacity of population. To know more on these growth patterns, one can refer Belinda Barnes and G. Fulford *(Belinda Barnes et al, 2002)*.

Also, since infinite resources theory for Coronavirus in the real world is impractical, it is safe to believe that this pathogen also follows logistic growth trend, and the curve will ultimately plateau or level off after it reaches the inflation point.

The other thing we notice is that if the effective rate of growth of virus, taking all factors such as: recovery rate, mortality rate, etc., into account is denoted by R, we see that when $R>1$, the number of pathogens increases exponentially, consequently leading to an increase in the number of patients. The situation comes under control when R becomes unity, because that can be treated as a case when a person can spread the virus to only a single other person. In a similar fashion, when the value of R drops to <1, that is when the epidemic starts coming to an end.

Apart from studying the virus population, we can also study the human population by segregating them into three different categories: the susceptible group, the infected group and the removed group. 'Removed group' refers to the people who are either dead because of the disease, or are removed from the system due to the fact that they have recovered from the disease, and the antibodies so formed in them last a lifetime and they can never get infected again. An analysis of a similar kind is done by some researchers. *(Bhola J. et al, 2020)*.

2. Capturing the factors involved

Suppose the total number of infected people on a particular day is . The number of people who are susceptible to the infection is directly proportional to , since more the number of patients in a particular closed environment, more are the chances of the healthy ones acquiring the infection.

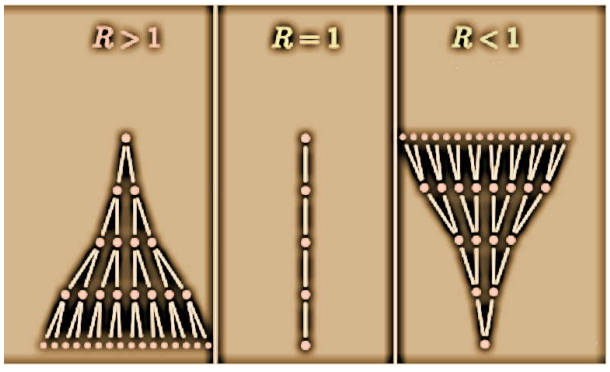
Further, every person who comes in contact with an infected person does not necessarily catch an infection. It is possible that a person with a very short exposure may catch the disease, whereas, possibly a person with a comparatively longer exposure might, as well, not catch it. Therefore, it would be absurd to assume that if a patient comes in contact with 100 people each day, then all 100 of them necessarily develop the disease. This fact leads us to consider an extra factor, called the *probability factor 'p'*, for having a fair approximation of the number of people who can get infected (p lies between 0 and 1). This clearly indicates that more the probability of a person catching an infection, higher would be the number of new people who become infected. Note that this probability would not be the same for all individuals. As the population is large enough, we ignore random differences among individuals and assume it to be constant p for every individual, i.e. every individual will have an equal chance p of getting infected while coming in contact with an infected person.

The last factor on which will probably depend is the amount of exposure an infected person has. That is, if a patient comes into direct or indirect contact with a larger number of people, then he has a chance of spreading the infection amongst a larger community. We consider A to be the average number of people who come in contact with a patient each day. This average A would also be different for different infected persons but for our analysis, we assume it to be a constant for all the infected persons. We, therefore, arrive at the final result that the number of new cases each day () would be directly proportional to the number of existing cases (), the probability of getting infected (p) and the average number of people who come in touch with the patient each day (A). Thus we have the following:

$$\Delta N_0 \propto \begin{cases} f(N_0) \\ g(p) \\ h(A) \end{cases}$$

where f. g, h are increasing functions of their respective variables.

[In essence, we have got that the number of new cases per unit time would be some function of , p and A that varies directly with either of these three. For instance, we could take as or or and so on for capturing the increase in infection, as all of these exhibit direct proportionality to the three variables. To decide the most appropriate proportionality, one needs to have requisite data in terms of the desired variables (which is difficult to be fetched at present) and a deeper analysis of the same. But for all these direct proportion-alities, the further discussion in this article stands valid].



To carry forward the discussion, let us take a particular direct proportionality and analyse the effect as under:

Assume that

$$\Delta N_0 = N_0 * p * A$$

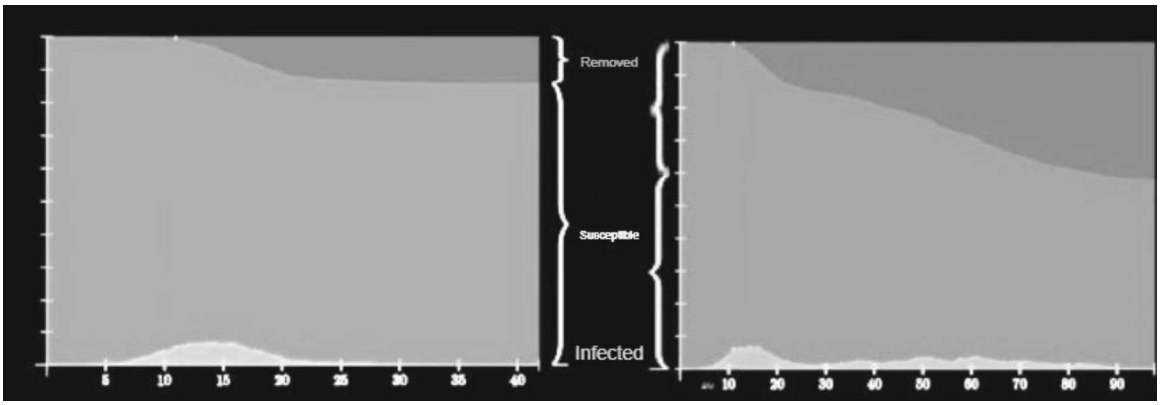
This seems quite alarming as it points that the cases will always be increasing and, in the worst case, the entire human population globally would get infected by the novel Coronavirus disease. However, there are possible way outs to avoid such a situation, and these way-outs lie in reducing the value of the constant as far as possible. Now, this can be achieved by minimizing either of *p* or *A* or possibly both *(https://3blue1brown.com)*.

Minimizing *A* means limiting the number of people who come in touch with the patient, and that is exactly why COVID-19 patients are kept under observation in isolation wards, with even the doctors, medical and para-medical staff members wearing PPE (Personal Protective Equipment) Kits before attending them. Further, lockdowns and curfews are also ways of reducing the value of *A*. So, we are sure about the utility of isolation as a part of the treatment, and lockdowns as effective means of preventing the spread, since the mathematical formula also points towards the same.

The second factor is minimizing *p* or the probability of getting infected. This can be done by maintaining proper hygiene, washing hands, reducing direct/ indirect physical contact with people as far as possible and avoiding crowded places. And we see, that is what exactly lockdowns aim at. Washing hands and sanitizing daily household items is another step towards minimizing *p* and eventually the rate of spread.

3. Physical Distancing and impacts

Talking about the physical distancing (what popularly came to be as *Social Distancing*) factor, as we already saw in the aforementioned formula that the number of new people developing the infection per day is very closely linked with the number of people whom the patient comes in contact with. And thereby, physical distancing plays a key role in deciding the fate of the susceptible population. But we also need to know that 10 out of 100 people following physical distancing and the remaining 90 of them moving ahead with their daily routines as usual, is as good as nobody doing anything. Or, for that matter, 90 people following the norms of distancing and just 10 people escaping it is also only a bit better than doing nothing at all since that will also keep the disease spreading, may be at a slower, but a consistent rate and we would never be able (or at least take considerably longer time) to get the disease eradicated completely. Here are two graphs which show how long does it take to get over the disease when a certain percentage of people start staying away from one another. The curves are plotted between the number of active cases on a particular day (Caution: the graph talks about active cases, and not about total cases) and the number of days it takes for the disease to vanish completely (*Simler, K. , 2020; https://www.3blue1brown.com ; https://www.numberphile.com/)*.



Physical Distance Factor
(100% of Population)
Disease Eradicated in 30 days

Physical Distance Factor
(90% of Population)
Disease Eradicated in 90 days

This is what happens when all the people follow physical distancing and avoid any kind of contact. The disease will get eradicated in close to 30 days, and less than 10% of the total population will be affected by it on any given day.

A little carelessness on the part of 10% of the population, and we see that the disease takes approximately 90 days to go away completely. We also notice that whereas in the first case, the curve representing the number of patients rose only once, till nearly 14 to 15 days after the first case was reported, and then followed a strictly downward trend, but when a few people do not take necessary precautions, then even after following the same trend initially, the graph again rises when we reach 35 days, 50 days, 60 days and 80 days. Apart from taking thrice the time to recover from the disease, the number of people who got infected by it also grew considerably.

We conclude that physical distancing is a powerful way to control the spread, but even a small number of people escaping the process will prolong the duration of the disease to an unimaginable extent.

The other thing we get from this is that if physical distancing is imposed at a very late stage, and a large number of people have already been affected, then it is virtually of no use. Taking a simple example, if a city where this disease spreads has 1,000 families, with an average of 6 members per family, and initially they do not follow any distancing, then say, at least one member of 100 families has already caught the infection. Even if we then start with very strict norms of physical distancing or home quarantine, even then, at least each family member of these 100 infected people is at a very high risk of developing the symptoms of the disease in a very short span of time. Additionally, however hard we try, there might be emergency situations wherein it becomes very essential for a person to travel. The person might spread infection in this process also when he steps out for something important and comes in contact with a certain number of people.

Apart from distancing and all other necessary precautions, there is yet another factor which plays a key role in the entire process. One very essential aspect on which probability of getting infected depends is the number of susceptible people in the given closed setting. When a large number of people have already got infected, their coming in touch with one another does not give rise to new cases. This is what brings us to the concept of '*herd immunity.*'

4. Herd immunity

When most (or a significantly large fraction) of a population has already been infected or is immune to an infectious disease (in case of diseases wherein the antibodies developed last a lifetime, and there is a negligible chance of the person catching the same disease again), there is an indirect protection of the body to the disease. In simpler words, a body that is already infected at present, does not have a possibility of catching an infection again. Therefore the number of susceptible people becomes very less, owing to the fact that most people have already been affected. This is what we call herd immunity (or herd protection) to those who are not immune to the disease (*D' Souza et al, 2020).* Due to herd immunity, the number of susceptible bodies goes down by a considerable amount, and resultantly, the number of new cases arising per day also gets lowered significantly.

As we know, the number of cases in the world are more than 12.5 million, that simply implies that these 12.5 million people (considering no chances of re- infection) or at least a large number of them (considering chances of re- infection or reappearance of symptoms of the same disease in the same person) are no longer susceptible to COVID-19, whether we consider the active cases (a person currently infected cannot get infected again), the recovered ones (considering the antibodies to provide a long term immunity to the person) or the fatalities.

Momentarily, it may strike to us that herd immunity can be the only possible situation for us to wait for in case of diseases like COVID-19, wherein we neither have vaccines for treatment, nor any kind of prior experience of dealing with this. But herd immunity is not achieved until a very large population has already been affected, and this large population may even be as large as 80 to 90% of the total, which in itself would be very alarming and dangerous. By the time we are waiting and relying on herd immunity to play its part and have the situation under control, the peak of the graph is already very high and the existing healthcare resources are already overwhelmed and supremely insufficient for a developing country like ours, excessive population being another constraint, when it comes to such a fatal and life threatening disease. The mortality rate would already have been very high by then. And that is exactly why we cannot wait for such a situation to occur.

5. Conclusion

The data that has been collected over the past few months probably hints that the number of cases will continue to increase, at least for a few more weeks, before we can hope to see a decline in the

number of cases. But, as we come to the end of the article, we clearly understand that physical distancing, avoiding unnecessary travels and proper hygiene are the only possible way outs to protect ourselves from this deadly disease at present. Co-operating with doctors, medical and para- medical staff and following the safety guidelines issued by the government in the interest of public are our prime responsibilities. Mathematicians, chemists and biologists are all striving extremely hard to come up with ways that can save the world. Till the time the situation is not improving, we need to have faith in science, and take all necessary precautions.

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Acousto-optical Characteristics of TeO_3/3C-SiC/$LiNbO_3$ layered structure

Namrata Dewan Soni*

Abstract

In the present work, use of thermally stable multi-layered TeO_3/3C-SiC/128°*Y-X* $LiNbO_3$ surface acoustic wave (SAW) structure, as a potential acousto–optic (AO) device has been proposed. The acoustic properties like figure of merit and diffraction efficiency of the layered structure TeO_3/3C-SiC/128°*Y-X* $LiNbO_3$ is examined using theoretical calculations. It is found that the thermally stable layered structure TeO_3(0.007l)/3C-SiC (0.09 l)/128°*Y-X* $LiNbO_3$ exhibits a high value of acousto optical figure of merit $(8.56 \times 10^{-12} s^3 g^{-1})$ coupled with good overlap between acoustic and optic field. The proposed acousto optic device is based on crystalline silicon carbide (SiC) which is known to withstand harsh environment. Thus the thermally stable TeO_3/3C-SiC/128°*Y-X* $LiNbO_3$ multi-layered SAW structure would be a potential and cost effective device suitable for acousto optic applications in severe environment conditions.

PACS classification numbers: Acoustic properties of thin films (43.35.+d) Thermal stability (68.60 Dv) Silicon carbide (61.80.Jh)

1. Introduction

The field of integrated optics uses a number of acousto optic (AO) devices like modulators, deflectors, tunable optical filters, optical switches, etc (Guofang et al. 2007; Jain et al. 1992; Kakio 2015; Mohammadalizadeh et al. 2010; Tsai et al. 1992). Efficiency of surface acoustic wave (SAW) devices used for AO applications banks upon the acousto-optical properties of the medium in which sound wave and light wave interact. Till now SAW devices based on $LiNbO_3$, $LiTaO_3$ single crystal and various layered structure like TeO_2/ $LiNbO_3$, $LiNbO_3$/Sapphire, ZnO/ Diamond, etc have been investigated (Belovickis et al. 2012; Guofang et al. 2007; Shandilya et al. 2008). Lack of flexibility in tailoring the SAW propagation characteristics like SAW phase velocity and temperature coefficient of delay (TCD) as per the need of the application, is the major limitation for the use of the single crystal based acoustic devices. On the other hand, it has been established that the use layered SAW structure provides more flexibility in tuning the various properties like TCD, phase velocity, coupling coefficient, etc of acoustic devices as per the requirement (Dewan et al.2008; Tsubochi et al. 1982; Tomar et al. 2001).

Recently, a temperature stable TeO_3/3C-SiC/128°*Y-X* $LiNbO_3$ multi-layered SAW structure has been found (Soni 2018), that possess high value of SAW phase velocity (~4390 ms^{-1}) and electromechanical coupling coefficient (~9.8%) at normalized over layer thickness of TeO_3 =0.007λ and 3C-SiC = 0.09λ (Soni 2018). This multi-layered SAW device is based on crystalline 3C-Silicon Carbide (SiC), which is a promising material for high frequency application and could sustain harsh environment (Mehregany et al. 2000). Since 3C SiC is being widely used in photonics and opto-electronics (Yamada et al. 2011; Liu et al. 1993), so in the present work an attempt has been made to investigate the acousto optic properties of the thermally stable TeO_3( )/3C-SiC()/128°*Y-X* $LiNbO_3$ layered SAW device. The SAW propagation characteristics for the layered structure and the field profiles are calculated theoretically using the software developed by (Fahmy et al. 1975). The temperature stable TeO_3( )/3C-SiC() /128°*Y-X* LiNbO3 SAW structure is found to exhibit

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a high value of acousto optical (AO) figure of merit and high diffraction efficiency.

Theoretical Calculations

The possible use of TeO_3( )/3C-SiC() /128° *Y-X* LiNbO3 SAW layered structure in acousto optic devices is examined theoretically by calculating the figure of merit and diffraction efficiency. The IDTs are placed on the top of 128° *Y-X* LiNbO3 piezoelectric crystal. The configuration of TeO_3()/3C-SiC() /128° *Y-X* LiNbO3 SAW layered structure studied for acousto-optic application is shown in figure 1.

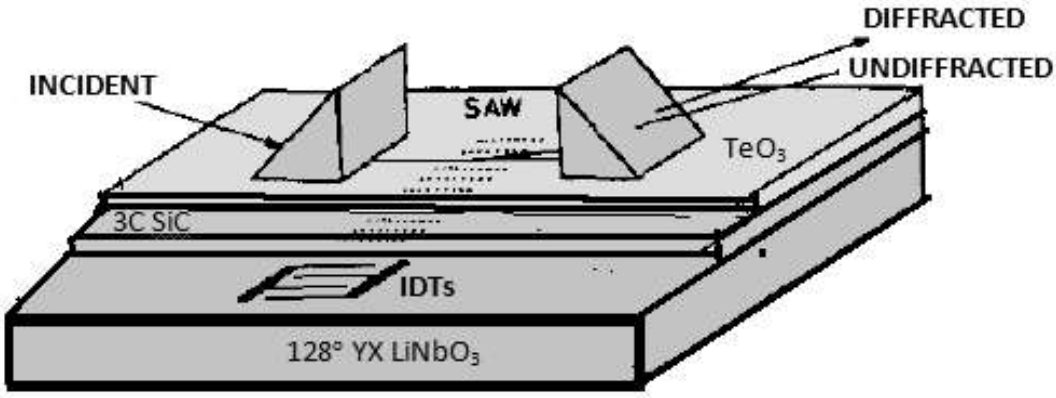

Figure 1: TeO_3( )/3C-SiC() /128° *Y-X* LiNbO3 multilayered acousto optic device configuration with IDTs placed on the top of $LiNbO_3$ crystal.

The required field profile and acoustic wave propagation characteristics of TeO_3( )/3C-SiC()/128° *Y-X* $LiNbO_3$ layered structure has been calculated theoretically using the SAW program developed by Fahmy et al. 1975.The coordinate system used in the current work is given in figure 2. Here x_1 is the direction of propagation of surface wave whose amplitude vanishes as x_3 tends to negative of infinity.

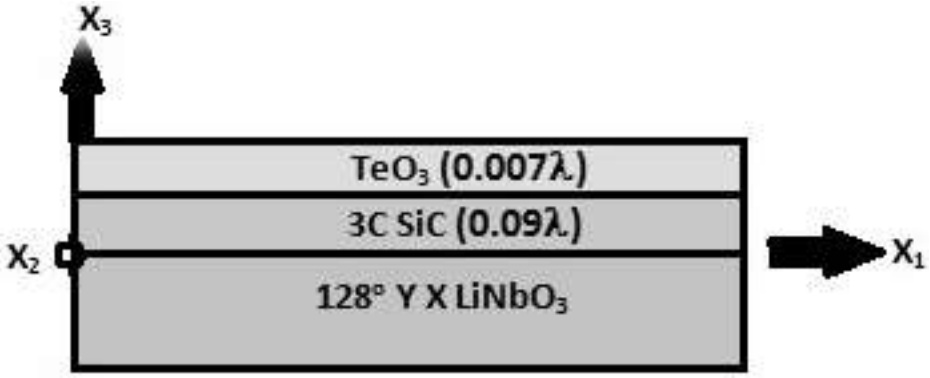

Figure 2: The coordinate system used in the present work.

The material parameters like elastic constants, density, refractive index, dielectric constant, photo elastic constants, etc used in the present study have been taken from the earlier reported work (Soni 2018).

AO Figure of Merit

The vital probe that determines the efficiency of an acousto optic device is its figure of merit. The figure of merit for the layered structure is defined as (Shandilya et al.2008)

$$M = \frac{n^6 p^2}{\rho v_p^3} \qquad (1)$$

Where and are the respective appropriate photo elastic tensor and refractive index of wave guiding layer.

Diffraction Efficiency

Another important parameter for gauging the potential of an acousto optic device is its ability to diffract the optical signal i.e. diffraction efficiency and the latter can be calculated by (Rana et al. 2016):

$$DE = DE(f)_o^2 \left[\frac{\sin \sqrt{DE(f)_o^2 + \left(\frac{K \Delta\Theta L}{2}\right)^2}}{\sqrt{DE(f)_o^2 + \left(\frac{K \Delta\Theta L}{2}\right)^2}} \right]^2 \qquad (2)$$

Where,is the interaction length or acoustic aperture, is the free space optical wavelength, is the momentum vector of SAW and is variation of incident wave from the Bragg angle.

$$DE(f)_o{}^2 = \left(\frac{\pi}{\lambda_o}\right)^2 n_m n_n{}^2 |\Gamma_{mn}(f)|^2 \left(\frac{L}{\cos\Theta_m \cos\Theta_n}\right) \quad (3)$$

The AO diffraction efficiency varies directly with the overlap between the acoustic and optical fields. depends exclusively on the waveguide parameters and the acoustic frequency and is given by:

$$|\Gamma_{mn}(f)|^2 = \frac{\left[\int U_m(x_3) U_n(x_3) U_{ap} dx_3\right]^2}{\int |U_m|^2(x_3) dx_3 \int |U_n|^2(x_3) dx_3} \quad (4)$$

Where represents field distributions of diffracted and un-diffracted modes respectively, p and r are appropriate photo elastic and electro optic tensor respectively. and represent the normalized strain distributions along the waveguide thickness respectively, which have been calculated using the software developed by Fahmy et al. 1975 and a C program is written to calculate the overlap integral and hence the diffraction efficiency using equations (2), (3) and (4).

Results and Discussions

(I) *Figure of merit*

Figure 3 shows the dispersion of AO figure of merit for TeO_3/3C-SiC() /128° *Y-X* $LiNbO_3$ layered structure as a function of the normalized thickness of TeO_3 layer. The value of AO figure of merit increases with an increase in the normalized thickness of TeO_3 and becomes at zero TCD normalized thickness of 0.007l of TeO_3 over layer.

The increase in the value of acousto optic figure of merit with TeO_3 over layer thickness is attributed to the fact that TeO_3 possess lower surface acoustic wave velocity and with the increase in the TeO_3 over layer thickness, SAW energy will be concentrated more into the TeO_3 layer and therefore the SAW velocity of the layered structure decreases (Soni 2018). Since the AO figure of merit as given by equation (1) varies inversely the cube of SAW velocity, therefore with the increase TeO_3 over layer thickness AO figure of merit increases. As reported earlier, with the integration of 0.007 TeO_3 over layer, the SAW layered structure TeO_3/3C-SiC() /128° *Y-X* $LiNbO_3$ becomes thermally stable (Soni 2018) and temperature stability is an important aspect of an efficient SAW device. So the value of AO figure of merit is considered at 0.007 TeO_3 over layer thickness.

(II) *Diffraction Efficiency*

Variation of diffraction efficiency with the optical penetration depth (x_3) for TeO_3(0.007)/3C-

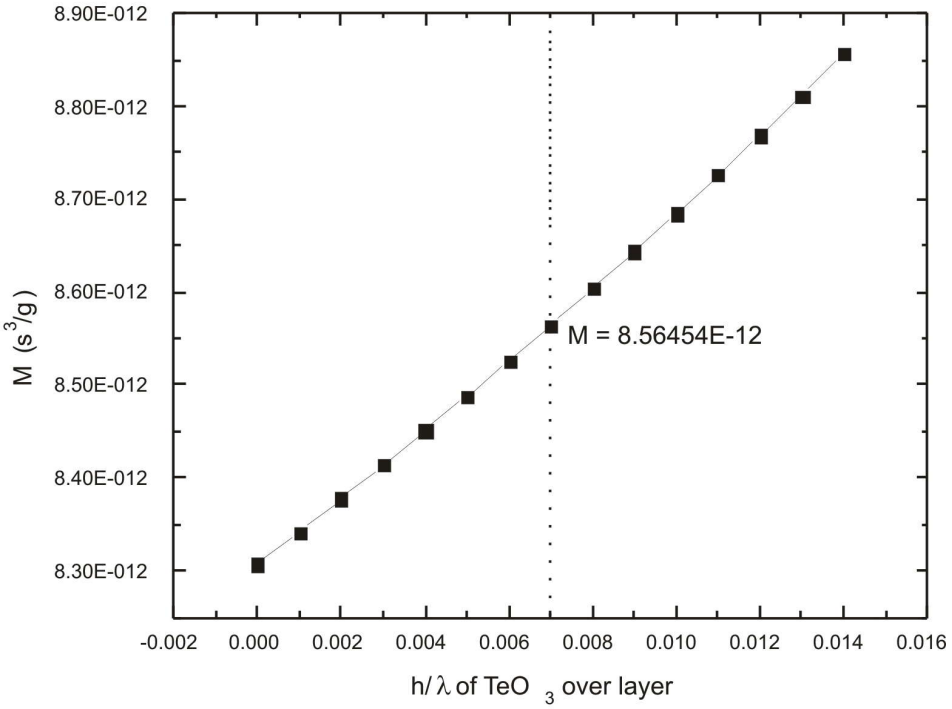

Figure 3: Variation of figure of merit with TeO_3 over layer thickness in TeO_3/3C-SiC() /128° *Y-X* $LiNbO_3$ SAW layered structure.

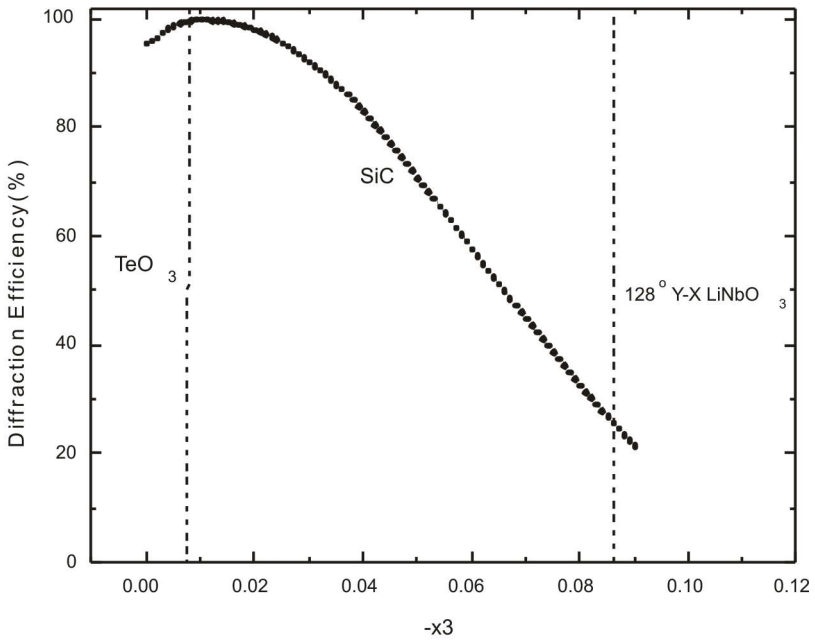

Figure 4: Variation of Diffraction Efficiency with the optical penetration depth for TeO_3(0.007)/3C-SiC() /128° *Y-X* $LiNbO_3$ layered structure

SiC() /128° *Y-X* $LiNbO_3$ layered structure is shown in figure 4. The results show that the maximum overlap (nearly 100%) between acoustic and optical fields exists without TeO_3 over layer. Diffraction efficiency is found to reduce slightly within 4% with the integration of temperature compensated 0.007 TeO_3 over layer. This slight decrease in the value of diffraction efficiency can be compromised for the temperature stability of the considered TeO_3(0.007)/ 3C-SiC()/128° *Y-X* $LiNbO_3$ SAW device. Therefore, it is infer from the figure 4, that the temperature stable TeO_3(0.007)/3C-SiC() /128° *Y-X* $LiNbO_3$ layered structure possess high value of diffraction efficiency (96.1%) indicating it to be boding device to be used in the acousto-optic applications.

Conclusion

In the present work the acousto optic characteristics of thermally stable TeO_3(0.007)/3C-SiC() /128° *Y-X* $LiNbO_3$ layered structure have been examined theoretically. The TeO_3(0.007)/3C-SiC() / 128° *Y-X* $LiNbO_3$ SAW layered structure is found to be optimum for an efficient AO device with high AO figure of merit of coupled with high diffraction efficiency of 96%.

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Nutritional Interventions for a Healthy Life during COVID-19 Outbreak: Prospective Association with Healthy Dietary Pattern

Kaveri Chakrabarty*

Abstract

Coronavirus disease of 2019 is a global pandemic and is a life-threatening public health problem all over the world. In view of the prevalence of this deadly disease caused by severe acute respiratory syndrome coronavirus 2, prevention and prophylactic strategies to prevent or minimize the havoc on mankind are now the topic of growing interest. This review focuses on various measures, as mentioned below, that will help to lead a healthy life, to improve the condition of patients for recovery, and to reduce the risk of deleterious effects. The aim of this review is to present an updated summary of most, although not all, preventive strategies. The adverse ill effects on health can be prevented or minimized by boosting the immune system. The immunomodulatory and anti-inflammatory actions of various micronutrients, particularly vitamin D are highlighted. The role of antioxidant nutrients in the prevention of coronavirus infection is emphasized. Diet plan to improve immunity has been discussed.

Keywords: Coronavirus, Immunity, Nutrients, Antioxidants, Diet plan

1. Introduction

Immune regulators are the first line of defence against the deterioration of health during coronavirus disease of 2019 (COVID-19) pandemic. A number of vitamins (A, D, C, E, B_{12} and folate) and trace elements (zinc and selenium) play a key role in supporting the human immune system. Micronutrients with the strongest evidence for immune support in preventing the risk of inflammation are vitamins (A, D, C) and zinc. Immunomodulatory, anti-inflammatory and anti-fibrotic action of micronutrients will be useful in possible prevention and management of COVID-19. Thus, well-functioning immune system is required for healthy life. Similarly dietary interventions with proper diet plan, is essential for the maintenance of health. Functional foods, such as nutraceuticals provide health benefits beyond the basic nutritional values. Proteins of high biologic value should be provided to enhance immunity function. During COVID-19 pandemic individuals are susceptible to abnormal behavioral problems due to social isolation. The individuals may suffer from depression, aggression, hostility and paranoid behaviour. The COVID-19 patients are more prone to stress, depression and abnormal behavioral problems. It is noteworthy to mention that omega-3-fatty acids [eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and resolvins derived from DHA] may play a crucial role for optimal brain function and thus, can improve mental function (Cardosa et al. 2016). Lack of omega-3-fatty acids may lead to abnormal social and behavioral problem as mentioned above in COVID-19 patients. Oxidative damage due to mitochondrial dysfunction has been correlated with depressive symptoms. Furthermore, oxidative damage due to reactive oxygen species (ROS) may activate pro-inflammatory cytokines, which may aggravate inflammation of the airways and lungs caused by coronavirus. The beneficial effects of probiotics and prebiotics have been discussed in detail in this review.

2. Vitamin D

It is the main immune regulator having direct effect on the function of immune cells. It modulates the function of main immune cells, such as T cells, dendritic cells (DCs) and regulatory T cells (Tregs) (Poole et al, 2018). Tregs can inhibit inflammatory

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responses through the secretion of anti-inflammatory cytokines (Noval et al, 2016). Inhibition of DCs maturity and differentiation is an important immunomodulatory effect of active vitamin D (calcitriol) (Griffin et al. 2004; Barragan et al. 2015) and related D_3 analogs. Vitamin D_3 metabolite calcidiol can promote the development of Tregs (IL-10) by activating DCs (Bakdash et al. 2014). DCs of lymph node and skin are the antigen-producing cells (APCs). APCs are also known as accessory cells. APCs digest and present pieces of the antigen on their surface. In APCs, products of antigen digestion after coupling to protein products of the major histocompatibility complex (MHC) are presented on the cell surface (Ganong 2003). The MHC peptide complex on the surface of APCs binds to T cells. APCs act as messengers between the innate and the adaptive immune system. APCs are the key players in all aspects of T cell responses, including the generation of memory cells.

Vitamin D and inflammatory markers: The expression of inflammatory cytokines, such as IL-6, IL-8 and IL-17 has been found to be reduced by treatment with Vitamin D. Gut dysbiosis caused by COVID-19 is one of the common features. Vitamin D may enhance antimicrobial function in human oral keratinocytes by increasing cathelicidin production (Wang et al. 2013). Cathelicidin can maintain intestinal barrier integrity and also enhances the expression of protective mucin (Otte et al. 2009). Acute respiratory distress syndrome (ARDS) due to COVID-19 is caused by excessive and damaging inflammation of the respiratory tract, termed as "cytokine storm". Negative correlation between vitamin D status and number of COVID-19 cases, and mortality rate was observed (Ilie et al. 2020). Release of pro-inflammatory cytokines (IL-1â and IL-18) by activated macrophages and type 1T helper (TH1) immune cells results in inflammation and fibrosis of the lungs. TH1 helper cells are concerned with exaggerated cell-mediated response, acting against intracellular bacteria. They are activated by cytokines (IL-12, IFN-ä and IL-2). Expression of inflammatory cytokines, such as IL-á, IL-â and tumor necrosis factor-á was found to be inhibited by vitamin D and hypovitaminosis D was caused by overexpression of TH1 cytokines (Hughes et al. 2009). In addition to immunomodulatory action, vitamin D acts as an important antioxidant agent (Ebadi and Montano-Loza 2020).

3. Vitamin A

It was termed as "anti-infective" vitamin at the beginning of the 20th century. It takes part in modulating immune response function, such as activation and proliferation of lymphocytes, T-helper cell differentiation, production of specific antibody isotypes and so on (Mora et al. 2008). It plays an important role in preventing or treating inflammation and autoimmunity. Hypovitaminosis A results in reduced natural killer cell activity, decreased T- and B- lymphocytes and abnormal cytokine function. Vitamin A supplementation decreases child mortality and decreases the severity and duration of diarrhea (Ramakrishnan 2004). Retinoic acid derived from oxidation of retinal (vitamin A aldehyde) takes part in the synthesis of glycoprotein and glycosaminoglycans. Thus, vitamin A takes part in promoting growth and differentiation of tissues, and lubrication between the joints. This function of vitamin A may be hampered by COVID-19. Vitamin A deficiency causes metaplasia, leading to keratinized stratified squamous epithelium in the respiratory passages. This metaplasia of respiratory epithelium may facilitate replication and survival of SARS-CoV-2, which binds to angiotensin converting enzyme 2 receptors in the respiratory tracts of patients. Hypovitaminosis A causes infection of the lungs due to loss of mucociliary epithelium that will aggravate inflammation and fibrosis of the lungs caused by SARS-CoV-2.

4. Additional Immune Regulators with Special Emphasis on Vitamin C

Dysregulation of the immune function increases susceptibility to infection with increased morbidity and mortality. Intestinal infections hamper the absorption of both macronutrients and micronutrients, leading to dysregulation of the immune system, as well as malnutrition/undernutrition (Farhadi and Ovchinnikov 2018). Downregulation of immunity is a cause of malnutrition, which in turn, causes immune dysfunction (bidirectional interaction). This is typically observed in protein energy malnutrition (PEM) which is a disease of infants/children of poor mother. Chronic poverty is the main cause of PEM in developing countries. Lack of micronutrients status may lead to suppressed immunity, which predisposes to malnutrition. The individuals having BMI less than 18kg/m^2 are susceptible to COVID-19 infection. Vitamins (A, D, C, E, B_{12} and folate) and minerals/ trace elements (zinc, iron, copper and selenium) work

in harmony to support the human immune system and play significant synergistic roles to reduce the risk of infection (Gombert et al. 2020). Micronutrients deficiencies or insufficiencies are common in people with eating disorders (for e.g. anorexia nervosa), in smokers, chronic alcoholics and immunocompromised individuals (for e.g. pregnant women and elderly people), which suppresses the immune function (Wintergerst et al. 2007).

Deficiency/insufficiency of micronutrients inhibits immune function by affecting the innate T-cell mediated immune response and adaptive antibody response. COVID-19 patients should have adequate amount of vitamin C as the scorbutic individuals suffer from gum bleeding and subcutaneous hemorrhage in any part of the body due to defective collagen formation and brittle intercellular cement substance. Bone fracture with minimal trauma occurs as the bones are rarified. Deficiency of vitamin C may lead to depletion of muscle carnitine due to defective synthesis of lysine hydroxylase. This may lead to fatigue of the scorbutic individuals. Nitrites, used as preservatives in food can be converted to nitrosamines (Chakrabarty and Chakrabarty 2019). Vitamin C can prevent the formation of nitrosamine, which is a potent carcinogen. The risk for infectious disease is increased with zinc deficiency. Impaired zinc absorption causes acrodermatitis enteropathica characterized by eczematous skin on the hands and feet, impaired immune function, increased susceptibility to infections, diarrhea, poor wound healing, hypogeusia and hemorrhagic dermatitis around the mouth and eyes. Selenium is an anti-inflammatory micromineral. It is essential for immune function. Deficiency of selenium causes cardiomyopathy, resulting in enlargement of heart and ultimately heart failure (Keshan disease) (Gibney et al. 2009). Selenium and zinc are useful in preventing respiratory infections (Jayawardena et al. 2020).

5. Antioxidants

Vitamin C, vitamin E, carotenoids, flavonoids, and selenium are radical-trapping antioxidants, which prevent oxidative damage by inactivating oxygen free radicals. Carotenoids contain beta-carotene, beta-cryptoxanthine, lutein, zeaxanthine and lycopene. Flavonoids are antioxidant nutrients present in a variety of foods (Scalbert and Zamora-ROS 2015). Carotenoids are a variety of carotenes and give rise to retinal aldehyde, which is converted to retinol (vitamin A). Highly toxic ROS causes oxidative stress and damage by modulating various enzymes and transcription factors. Oxidative damage due to ROS activates pro-inflammatory cytokines, resulting in inflammation of the airways and lungs and causes bronchitis and thus, will aggravate the inflammation of the airways and lungs caused by coronavirus. Vitamin E and selenium act synergistically to prevent lipid peroxidation. Zinc/Copper superoxide dismutase (Zn/Cu SOD) prevents oxidative damage by converting superoxide to hydrogen peroxide, which is degraded by catalase. Antioxidants prevent oxidative damage caused by ROS and modulate various enzymes (kinases 1 and 2) and thus, immune function by regulating redox-sensitive transcription factors. Activated transcription factors travel from the cytoplasm of the cell into the nucleus and cause alteration of the gene expression, resulting in cell senescence. Antioxidant sources in the diet are shown in Table 1.

Table 1 Antioxidant sources in the diet

	Antioxidants	Main sources
1.	Carotenoids	Yellow vegetables, carrots and fruits
2.	Vitamin D_3	Cod liver oil, liver, egg yolk, meat, butter,fortified milk and edible mushrooms
3.	Vitamin D_2	Fortified food and mushrooms
4.	Vitamin E	Vegetable oils, wheat germ, tomatoes, nuts,green leafy vegetables and seeds
5.	Vitamin C	Orange, lemon, guava, amla (Indian gooseberry),tomatoes, broccoli and green leafy vegetables
6.	Zinc	Meat, liver, cheese, nuts, beans, wheat bran andoat meal
7.	Selenium	Garlic, cereal grains (jowar and bajra), Bengalgram, meat, shellfish, chicken and egg yolk
8.	Flavonoids	Onions, berries, apples and green tea containingcatechin
9.	Melatonin	Vegetables, fruits, flowers, seeds and a variety of herbs

6. Dietary Interventions/Diet Plan

(a) Nutraceuticals are functional foods with health benefits beyond the basic nutritional values for e.g. diets rich in fruits, vegetables, fish, cereal grains and olive oil.

(b) Omega-3-fatty acids (EPA and DHA) are found in fish oils. EPA can be converted to prostaglandins and leukotrienes that are essential for fluidity and renewal of the membrane. COVID-19 patients are not able to face minor stress. Isolation syndrome of Covid patients aggravates stress due to increased glucocorticoids. Social isolation, helplessness, dejection and loss of interest in daily activities may lead to aggressive behavior and domestic violence. Suicide is common due to extreme depression. Brain cells require EPA and DHA in order to stabilize mood and emotion (Cardosa et al. 2016).

(c) Probiotics are live microorganisms, the good bacteria that increase resistance to pathogen invasion by forming a physical barrier. Probiotics have many important functions including enhancing the immune function and also helping in the treatment and prevention of diarrhea, colitis, irritable bowel syndrome, diverticular disease etc. Yoghurt is a very good source of probiotics. Beneficial effects of probiotics is shown in Table 2.

Table 2 Beneficial effects of Probiotics

Facilitation	Inhibition
Formation of B vitamin (folic acid)	Gastrointestinal infections
Overall immunomodulatory response	Protein expression of pathogenic bacteria
IgA formation	Toxic compounds like ammonia
IgG formation (allergen specific)	IgE formation (allergen specific)
Th1 cytokine production	Th2 cytokine production
Treg formation and function	Cholesterol levels
Antiinflammatory mechanisms	Superoxide radicals
SCFAs formation	
Lactose tolerance	
Growth of intestinal beneficial flora	

(d) Prebiotic fibers are nondigestible food ingredients and include galacto-oligosaccharides, fructose-oligosaccharides (fructosans) and lactulose. Some dietary fibers are major sources of prebiotics. Fermentable fiber is present in prebiotic supplements which induce growth of beneficial bacteria (Lactobacillus and Bifidobacteria). Prebiotics increase the formation of important vitamins. They stimulate the activity and growth of intestinal bacteria. Colonic flora ferments carbohydrates and releases short-chain fatty acids (SCFAs). SCFAs are acetate, propionate and butyrate. They maintain the integrity of colonocyte DNA. SCFAs increase the secretion of bile. Propionic acid decreases cholesterol synthesis in the liver, leading to hypocholesterolemia. SCFAs result from fermentation of fibers by the gut microbiota and reduce the risk of type 2 diabetes mellitus (T2DM), metabolic syndrome, obesity and inflammatory diseases. Beneficial effects of prebiotics is shown in Table 3.

Table 3. Beneficial effects of Prebiotics

Facilitation	Inhibition
Growth of intestinal beneficial flora	Pathogenic bacteria
Formation of B vitamin (folic acid)	Risk of colonic cancer
Immune function	Triglyceride and cholesterol levels
Peristalsis	Risk of intestinal infection
Mineral absorption like calcium	
Bowel movement	

(e) During COVID-19 pandemic, the non-infective individuals or the patients suffering from coronavirus should take anti-inflammatory food (fruits, vegetables, dietary fibers, etc) and avoid pro-

inflammatory inducing diets (for e.g. processed and junk food), preventing inflammation. Intake of minimum 400g/day of fruits and vegetables is desirable. Diets rich in PUFA and MUFA should be preferred.

Effects of Various Factors on COVID-19 are summarized in Figure 1.

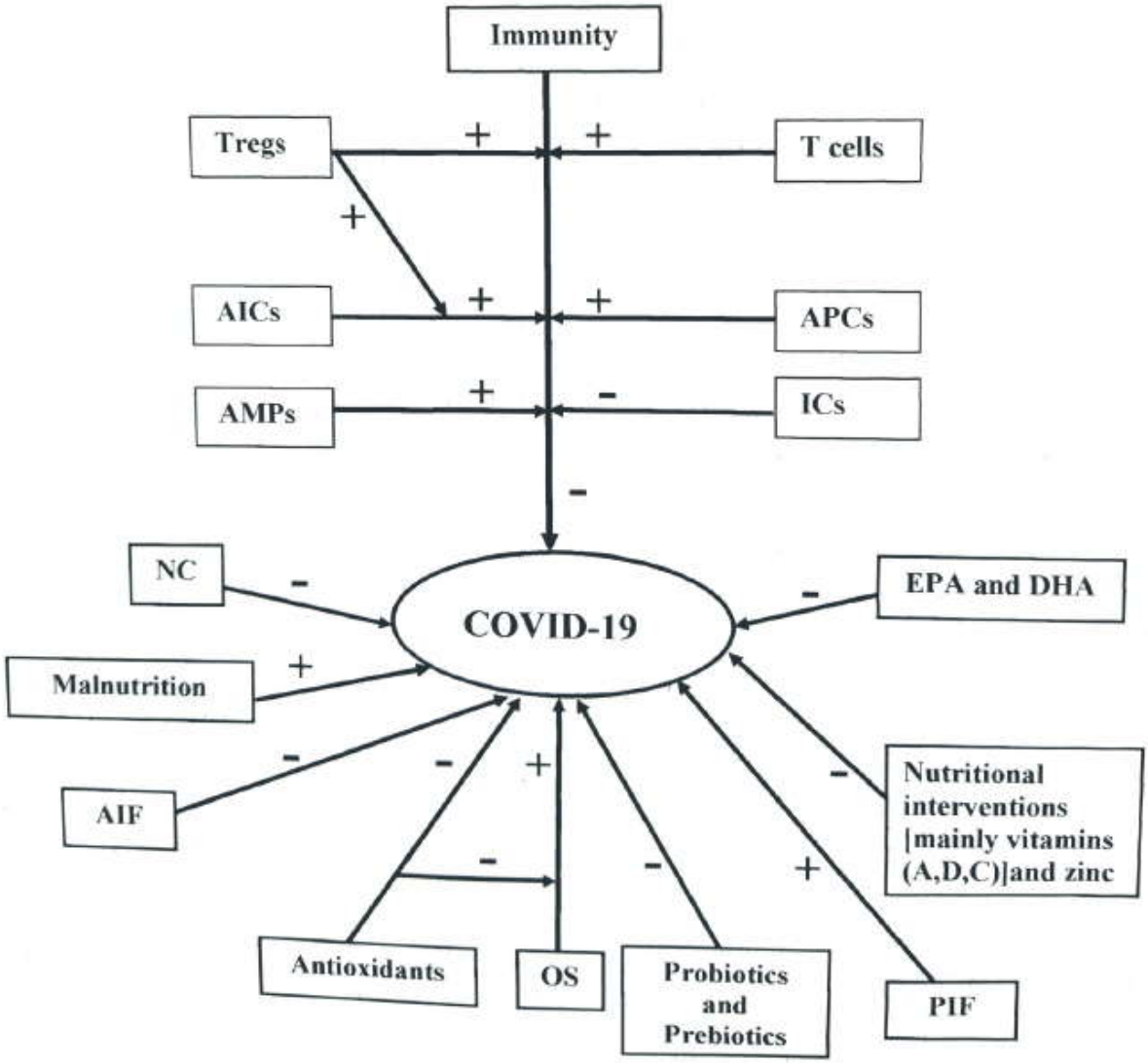

Figure 1 Effects of various factors on COVID-19. + indicates facilitation and - indicates inhibition; Tregs=Regulatory T cells; AICs=Anti-inflammatory cytokines; AMPs= Antimicrobial peptides; APCs=Antigen presenting cells; ICs=Inflammatory cytokines; NC=Nutraceuticals; EPA=Eicosapentaenoic acid; DHA=Docosahexaenoic acid; OS=Oxidative stress; AIF=Antiinflammatory food; PIF= Proinflammatory food

7. Summary

Possible benefits of vitamins, trace elements and functional foods including nutraceuticals in Covid-19 patients are summarized. The role of probiotic and prebiotic fibers, omega-3-fatty acids, pro-inflammatory and pre-inflammatory diets in ameliorating immunity in non-infective individuals as well as in patients suffering from SARS-CoV-2 disease has been emphasized. Balanced diet should be followed. Daily supplementation of nutrients should be higher than the RDA to support immune function. In conclusion, nutritional interventions may prevent cytokine storm in COVID-19 patients.

8. Future Directions

During COVID-19 pandemic, endogenous cutaneous production of vitamin D_3 (cholecalciferol)

from 7-Dehydrocholesterol is negligible due to limited exposure to sunlight in indoor population, especially immunocompromised individuals (for e.g. pregnant women and elderly persons). Dietary sources of vitamin D are not adequate to maintain vitamin D levels in the body. Vegans are very much susceptible to vitamin D deficiency as they do not consume any animal products including eggs and dairy products. Similarly obese people suffer from vitamin D deficiency as vitamin D, a fat soluble vitamin, is mainly stored into greater volume of adipose tissue because of its lipophilic properties. As a result, bioavailability of vitamin D is negligible due to volumetric dilution effect, as well as due to less endogenous cutaneous production. UV radiation falls in the autumn and becomes very less in the winters. Vitamin D status may be extremely low in vegans and obese individuals, especially in autumn and winter. To my knowledge, no study till date has measured serum vitamin D level in indoor vegans and obese individuals (both coronavirus infected and non-infected) during COVID-19 pandemic. It may be interesting to investigate the same at different seasons and different duration of sun exposure (from <1h/day to >2h/day). Different doses of vitamin D should be administered to find out the optimal vitamin D status. High dose of vitamin D should be avoided because of calcinosis. Well-designed randomized clinical trials may be warranted to evaluate or determine nutritional interventions with special emphasis of diet plan in preventing/minimizing the risk of deleterious effects of COVID-19.

Conflict of Interest: The author declares that there is no conflict of interest.

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Unmasking host cell responses in severe Dengue pathogenesis

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Abstract:

Dengue virus infection, which is the cause of mortality across various regions of the globe, can be caused by any of the four recognized serotypes (DENV 1-4). The infection can range from dengue fever to severe and life-threatening dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS). There has been a great deal of research to understand the pathogenesis of dengue and its severe forms. Multiple findings have revealed the role of various host's factors in abnormal homeostasis and increased vascular permeability. In order to control, cure and prevent the disease, it is vital to have a complete understanding of the entire mechanism of pathogenesis. In this review, we have attempted to elucidate the various roles of the host's immune system in pathogenesis of severe forms of dengue in a host.

Key words: dengue, hemorrhagic fever, pathogenesis, immune system

Introduction:

Dengue viral infection is regarded as the most prevalent and rapidly spreading mosquito-borne viral disease of human beings, spreading rapidly within countries and across the world (Guzman & Harris, 2015). The World Health Organization (WHO) report of 2017 estimates that 3.9 billion people in a total of 128 countries are at risk of dengue virus (DENV) infection per year (*Dengue and Severe Dengue*, n.d.). It is an arthropod-borne disease transmitted by *Aedes* mosquito and caused by the four dengue virus serotypes (DENV 1–4) which are genetically related and biologically similar.(Guzman & Harris, 2015)

Symptomatic dengue virus infection has been classified into dengue fever (DF), dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) ("WHO | Dengue Haemorrhagic Fever: Diagnosis, Treatment, Prevention and Control. 2nd Edition. Geneva/: World Health Organization.," 2015) (Fig. 1). Dengue fever is characterized by the rapid onset of fever along with severe headache, retro-orbital pain, muscular pain (myalgia), joint pain (arthralgia), gastrointestinal discomfort, rash and possible minor hemorrhagic manifestations in the form of petechiae, epistaxis, and gingival bleeding whereas dengue haemorrhagic fever (DHF) is characterized by all the symptoms of dengue fever, in combination with hemorrhagic manifestations (positive tourniquet test or spontaneous bleeding), thrombocytopenia, and evidence of increased vascular permeability (Martina et al., 2009). On the other hand, dengue shock syndrome (DSS) is usually characterized by a rapid, weak pulse with narrowing of the pulse pressure or hypotension with cold, clammy skin and restlessness (*Dengue Haemorrhagic Fever*, n.d.). Dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS) initially observed in Southeast Asia when children were found dying of an acute febrile disease accompanied by a complex of physiologic abnormalities affecting multiple organ systems has now spread throughout the world(Scott B. Halstead & Cohen, 2015).

According to an epidemiological and statistical study, the dengue incidence in India has sharply increased from 1998 to 2001 from 0.72 to 3.21 per million population. Over the period 1998–2009, 82 327 dengue cases (incidence: 6.34 per million population) were reported whereas during a more recent period

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(2010–2014), 213 607 cases (incidence: 34.81 per million population) of dengue fever were observed. Since 2010, a dengue incidence of greater than 15 per million population has been reported annually (Mutheneni et al., 2017). Of the 50 million cases of dengue reported annually, it is estimated that almost 500,000 correspond to severe dengue, of which, over 20 000 individuals die because of the infection with this virus (Murray et al., 2013).

From the various studies made to understand the pathogenesis of dengue, it is clear that the interaction between the host immune system and virus replication plays an important role in the progression to severe disease such as DHF or DSS. Dengue Viral (DENV) proteins interact with the host cells to mediate viral replication and pathogenesis.

Various epidemiological and experimental evidences support the association between the severity of dengue illness and a previous dengue infection in consequence of preexisting enhancing antibodies (Tirado & Yoon, 2003). The activation of cells of both lymphoid (B and T cells) and myeloid origin (such as Monocytes, Macrophages) in response to the DENV infection can also lead to overproduction of pro-inflammatory cytokines which consequently cause the uncontrolled inflammatory response and the disruption of vascular epithelium integrity (Srikiatkhachorn et al., 2017b). The understanding of the pathogenesis of dengue severe forms is crucial clinically, immunologically and even epidemiologically. In this review, we aim to outline the role of host immune system in the progression of dengue to its severe forms such as dengue hemorrhagic fever in the host body.

Role of immune cells:

Monocytes: Monocytes are circulating blood leukocytes which play a crucial role in providing innate immunity against the pathogen through inflammatory response. These mononuclear phagocytic cells show plasticity to develop into macrophages or dendritic cells (Karlmark et al., 2012). Peripheral blood monocytes are a heterogeneous population of circulating leukocytes including CD14++ CD16" (classical), CD14++ CD16+ (intermediate), and CD14+ CD16++ (non-classical) monocytes, divided on the basis of expression of CD14 (membrane receptor for lipopolysaccharide) and CD16 receptors. These monocytes are further characterized and differentiated on the basis of expression of the chemokine receptors CCR2, CCR5 and CX3CR1 (Geissmann et al., 2003; Wong et al., 2012).

Monocytes have long been considered as the primary target of DENV infection and have been proven via several *in vitro* studies. The dramatic increase of DENV replication in monocytes and other Fc receptor bearing cells in the presence of specific antibodies against the virus is known as antibody dependent enhancement (ADE) of specific virus infection (Tirado & Yoon, 2003). Antibody Dependent Enhancement (ADE) of a virus infection occurs when preexisting antibodies against primary DENV infection binds to a DENV particle with a different serotype during subsequent infection. This complex is unable to neutralize the virus and gets attached to the Fcã receptors present on circulating Monocytes (and other Fcã receptors bearing cells) instead which, in turn, mediates the entry of DENV into the cell and leads to increase in the overall replication and production of the virus. According to a study analyzing infection and activation of human peripheral blood Monocytes by DENV through the mechanism of antibody-dependent enhancement, a >14 fold enhancement in secondary infection was observed with a heterotypic serotype while only a 6.6 fold increase in a homotypic serotype of DENV(Sun et al., 2011). Moreover, it was also observed that expression of CD86, CD32, CD14, CD11c, and DEN prM was significantly increased in peripheral blood mononuclear cells (PBMCs) from DHF patients as compared with DF patients corresponding to the implications for antibody dependent enhancement and immunopathogenesis of DHF (Durbin et al., 2008).

In response to the DENV infection, monocytes are triggered for the production of various chemokines and cytokines which are associated with severe dengue because of their role in increasing vascular leak and endothelial permeability (Castillo et al., 2019). These include high levels of TNF-á (Espina et al., 2003), IL-10 (Torrentes-Carvalho et al., 2009), IL-8, MCP-1, interferon ã-induced protein, (IP)-10, IL-6, IL-8, IL-10 and IL-1â (Green & Harris, 2014) (Fig. 2). The monocytes derived cells have also been shown to be responsible for the production of such cytokines and chemokines. The mode of action of these chemical factors has been discussed and illustrated shortly in the review.

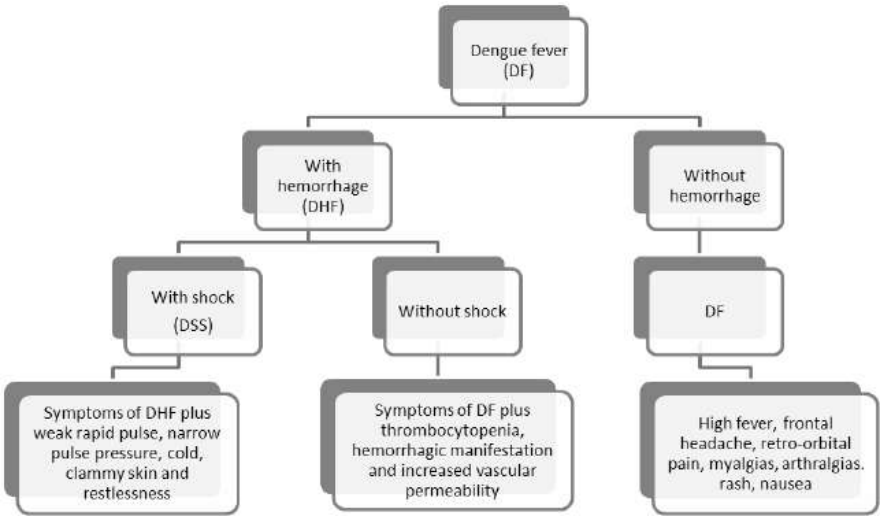

Figure 1: Classification of dengue fever on the basis of severity and clinical symptoms associated with them.

Macrophages: Macrophages are a diverse phenotype of professional phagocytic cells derived from bone-marrow precursors and parent monocytes in the peripheral blood. They are essential for the maintenance and defense of host tissues, doing so by sensing and engulfing particulate matter and, when necessary, initiating a pro-inflammatory response (Verschoor et al., 2012). Macrophages, along with monocytes are the prime targets of DENV and like monocytes, macrophages are also comprised of wide variety of subpopulations (Verschoor et al., 2012). It was observed that the *in vitro* DENV infected-macrophages secreted multiple innate cytokines and chemokines, including tumor necrosis factor alpha, alpha interferon (IFN-á), interleukin-1â (IL-1â), IL-8, IL-12, MIP-1á, and RANTES (Chen & Wang, 2002) (Fig. 2). A study has shown human primary splenic macrophages to be the principal dengue-permissive cells in spleen instead of T and B cells contributing in the initial steps of immune enhancements that ultimately lead to severe forms of dengue in some individuals (Blackley et al., 2007). The mannose receptors of macrophages have been shown to bind to envelope glycoprotein of all the four serotypes of DENV and thus aiding in viral entry (Miller et al., 2008). A C-type lectin on macrophages named CLEC5A activates NLRP3 inflammasomes which are essential for IL-1â and IL-18 secretion (Wu et al., 2013).

The levels of interleukin-6, interleukin-8, interleukin-10, interleukin-18, tumour necrosis factor-á, transforming growth factor-â, and cytotoxic factor-2, released by macrophages, have been observed to markedly increase in the case of DHF grade IV patients and are thus correlated with the severity of the disease (Chaturvedi et al., 2006). The cytotoxic factors, produced by CD4+ T cells and cytotoxic factor-2 by H-2A+ macrophages increase capillary permeability and damage the blood-brain barrier indicating their role in pathogenicity of DHF. Cytotoxic factor/cytotoxic factor-2 induce macrophages to produce free radicals, nitrite, reactive oxygen and peroxynitrite. The free radicals, besides killing the target cells by apoptosis also directly upregulate production of proinflammatory cytokines by macrophages (Chaturvedi et al., 1987; Gulati et al., 1983).

Interaction of dengue virus with macrophages and endothelial cell can lead to hemorrhage development. The virus infects several cell types including endothelial cells and also induces production of chemokines that attract macrophages. Along with the stimulation of endothelial cells by DENV NS2B/3, the chemical factors cause the endothelium damage and increased vascular permeability which ultimately results in hemorrhage development (Lin et al., 2014; Wan et al., 2018).

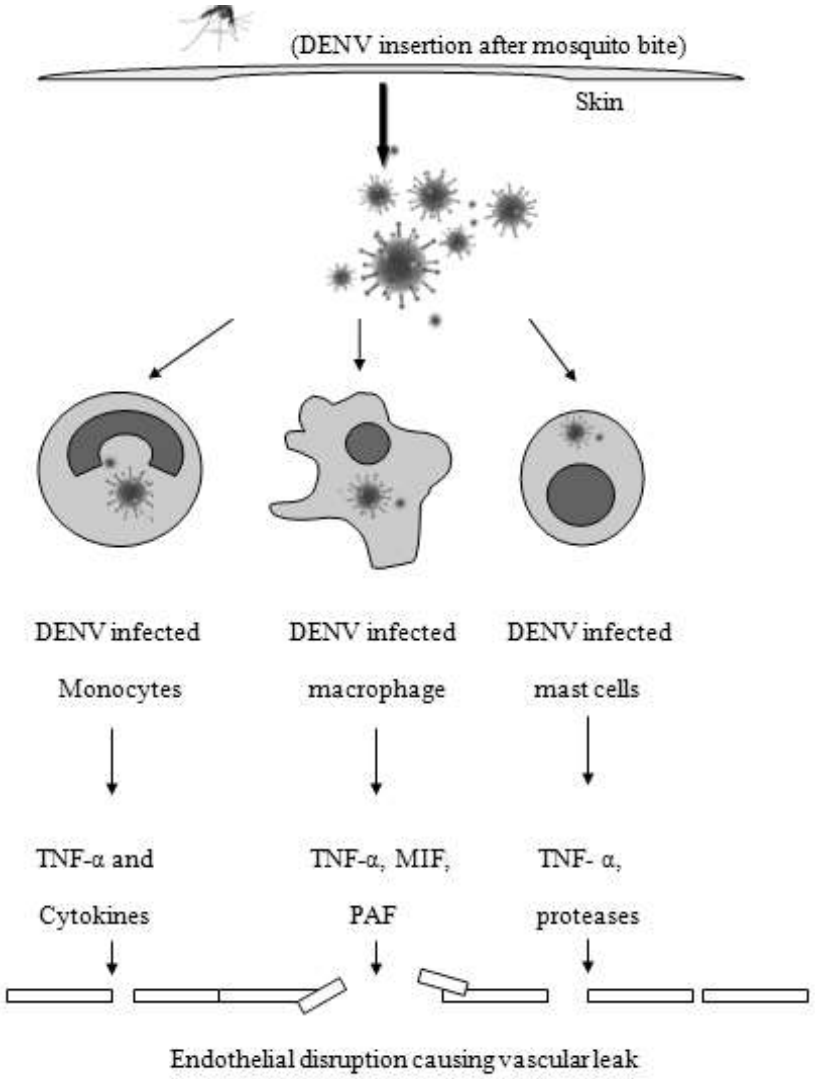

Figure 2: Role of monocytes, macrophages and mast cells in endothelial disruption causing vascular leak leading to severe forms of dengue infection.

Mast cells: In humans, mast cells develop from $CD34^{+}/CD117^{+}$ pluripotent progenitor cells originating in the bone marrow and are well known for their inflammatory roles during allergy (Gilfillan et al., 2011). Mast cells are the important cells of the immune system and are found in mucosal and epithelial tissues throughout the body. Two phenotypes of human mast cells are known: mucosal mast cells that produce only tryptase and connective tissue mast cells that produce chymase, tryptase, and carboxypeptidases (Irani et al., 1986; Krystel-Whittemore et al., 2016a). Similar to monocytes and macrophages, mast cells have also been reported to have a contribution to severe forms of dengue.

Human mast cells can express FCãRI and FCãRII receptors and are permissive to antibody-enhanced dengue virus infection, occurring in an FcãRII-dependent manner (Brown et al., 2006; Wan et al., 2018). ADE enhanced infection of mast cell results in infectious virus production and the induction of significant levels of cytokines, such as interleukin-1â (IL-1â), IL-6 and TNF-á, as well as chemokines CCL3, CCL4, and CCL5 (King et al., 2002).

DENV has been shown to accumulate in subcellular granules in mast cells after the infection and when these granules are released, infectious virus can be found inside and could be transported through the lymph system to other organs. After the activation of mast cells, there is a release of some potent immune mediators stored in granules which also include proteases such as chymase, tryptase, histamine, heparin along with various cytokines and chemokines.

The inflammatory stimuli released from mast cells such as VEGF (vascular endothelial growth factor), tryptase, histamine, chymase and TNF-á are known to be responsible for vascular leakage by disrupting the cell-cell junction (Fig. 2). The mast cells derived platelet activation factor is also associated with increased vascular permeability during the course of developing DHF (Avirutnan et al., 2013; Krystel-Whittemore et al., 2016b).

T-Lymphocytes: Besides the role of antibodies in the development of severe dengue, other adaptive immune components, such as T cells, have also been implicated in the pathogenesis. Without ignoring the role of the polyfunctional dengue-specific T cell response in the protection against DENV infection (Elong Ngono et al., 2016), it has been noted in some patients with secondary dengue infections, that when memory CD8+ T lymphocyte clones specific of previous infecting serotypes are activated, they have a low affinity for the new infecting serotype (S. B. Halstead et al., 1983). A study corresponding to virus-specific T cells in Thai children demonstrated that many dengue-specific T-cell cells showed higher affinity for previously encountered strains but were of low affinity for the infective virus; contributing to delayed viral elimination and systemic disturbances leading to severe forms of dengue (Mongkolsapaya et al., 2003).

In a secondary DENV infection, T cells are highly activated and produce multiple kinds of lymphokines whose levels are found to be significantly higher in DHF than DF. IFN-ã, IL-2 and TNF-á are mainly produced by DENV-specific T-cells upon activation and play a key role in pathogenesis of dengue and disease severity (Kurane et al., 2011).

Soluble factors:

Elevated levels of cytokines have been detected in DHF/DSS patients and may play a causal role in the vascular leak and coagulopathy syndromes characteristic of severe dengue (Bethell et al., 1998; Meena et al., 2019; Mustafa et al., 2001; Srikiatkhachorn et al., 2017a; Suharti et al., 2002; Tauseef et al., 2016).

· **TNF-á: I**t is a pro inflammatory cytokine produced by monocytes/macrophages, endothelial cells or adaptive immune cells namely CD4+ or CD8+ T cells. It is toxic to vascular endothelial cells and responsible for increased permeability (Espina et al., 2003; Yamaoka et al., 2002). It is known to induce reactive oxygen and nitrogen intermediates and signal for apoptotic cell death, increasing vascular permeability and ultimately leading to hemorrhage (Masood et al., 2018; Vitarana et al., 1991). A recent study by Meena et al. has found that an increase of one unit of TNF-*á* was associated with a decrease of 160 units of blood platelets; suggesting the role in pathogenesis of dengue (Meena et al., 2019). TNF-á works synergistically with IFN-ã and is known to mediate activation-induced death of T cells (Yamaoka et al., 2002). On the other hand, studies have also shown that TNF-á is responsible for induction of IL-6, the high levels of which have also been associated with dengue severity (Juffrie et al., 2001).

· **Vascular endothelial growth factor A (VEGF-A):** VEGF-A, is a 38 kDa heparin-binding, dimeric, disulfide-bonded glycoprotein (Senger et al., 1993). Tseng et al. have demonstrated elevated levels of VEGF in patients with dengue hemorrhagic fever and correlated it with D dimer level (Tseng et al., 2005). A study revealed that dengue virus can lower the production of soluble VEGF2 receptors by endothelial cells while increasing the expression of membrane-bound VEGF2. This combination will lead to increased biologically active free VEGF and increased VEGF2 receptor responsiveness that result in increased vascular permeability and plasma leakage (Srikiatkhachorn et al., 2007). VEGF is also associated with facilitation of coagulation–fibrinolysis pathway by induction of tissue factor (TF) expression in mononuclear and endothelial cells (Martina et al., 2009).

· **Platelet-activating factor (PAF):** Studies have shown significantly elevated levels of Platelet-activating factor (PAF) in patients with DHF (Jeewandara et al., 2015). DENV infected cells activate nuclear factor-8 b which further leads to production of PAF. On the other hand, PAF is also known to activate NF-*ê*B, which, in turn, regulates the production of several inflammatory cytokines such as TNF-á and IL-1â, ultimately leading to more PAF production (Im et al., 1997). Activation of platelet-activating factor receptor (PAFR) on endothelial cells and leukocytes induces increased vascular permeability, hypotension, and production of cytokines (Souza et al., 2009). Endothelial permeability is known to be disrupted by reduction in the expression of tight junction protein ZO-1 (Tornavaca et al., 2015). LPS present in blood is also known to amplify the production of PAF. Sphingosine-1-phosphate, a signaling phospholipid, is known to oppose the effects

of VEGF and a study has found significantly lower levels of S1P in blood of patients with DHF (Gomes et al., 2014). Various phospholipases have also been shown to act on the phospholipids to release PAF from cells such as monocytes, macrophages, mast cells, etc (Jeewandara et al., 2016). A recent investigation has shown that the mast cell activation leads to an elevated levels of secretory phospholipase A2s and thus increased range of PAF in DHF patients (Jeewandara et al., 2016).

· **Interleukins:** Higher plasma levels of IL-1â, IL-1Ra (Suharti et al., 2002), IL-6 (Juffrie et al., 2001), IL-13, IL-18 (Mustafa et al., 2001), IL-8 (Raghupathy et al., 1998), and IL-10 (Tauseef et al., 2016) have been found in patients with severe DENV infections. IL-2, IL-6 and IL-8 are known to be potent vascular permeability enhancing cytokines (Her et al., 2017). Platelets are known to form platelet–monocyte aggregates and interactions within them lead to production of cytokines such as IL-1*â*, IL-8 and IL-10 by Monocytes and thus this aggregate is, correlated with the presence of thrombocytopenia, and vascular leak (Jeewandara et al., 2015). Mildly higher IL-1*â* has been demonstrated in patients with severe dengue and is thought to associate with activation of fibrinolysis (Suharti et al., 2002) and increase in vascular permeability (Castro et al., 2011). A recent study indicated that IL-33, a pleiotropic pro-inflammatory cytokine, plays a 'disease-exacerbating' role in dengue infection and is probably driven by CXCR2-expressing cells (Marques et al., 2018).

· Angiopoietin-1 (Ang-1) and angiopoietin-2 (Ang-2) and their endothelial tyrosine kinase receptor Tie-2 form a central signaling system in endothelial permeability (Gavin Thurston & Daly, 2012). Angiopoietin-1–mediated Tie2 activation maintains the quiescent state of the endothelium by stabilizing endothelial cell-cell junctions and by countering the permeabilizing effects of VEGF (G. Thurston et al., 2000). On the other hand, Angiopoietin-2 antagonizes the effects of Ang-1; it destabilizes the endothelium by disrupting cell-cell adhesion and primes the endothelial cells to the effects of pro-inflammatory cytokines and VEGF (Fiedler et al., 2006) . A study shows that DHF/DSS is associated with reduced Ang-1 plasma levels and increased Ang-2 levels. The two angiopoietins were shown to induce PAF very rapidly in bovine endothelial cell lines in a bi-phasic manner (Michels et al., 2012).

· Apart from these, interleukin 1 receptor antagonist, interferon ã –" lü "inducible protein 10, hepatocyte growth factor, soluble p75 tumor necrosis factor á receptor, vascular cell adhesion molecule 1, and matrix metalloproteinase 2 have also been significantly associated with significant plasma leakage (Her et al., 2017). Extremely high expression levels of monocyte chemoattractant protein-1 (MCP-1) were found in the plasma of DHF patients in a study by Lee et. al. their partial contribution to increased permeability and disrupted tight junctions of human vascular endothelium was also signified (Lee et al., 2006). On the other hand, DENV-triggered macrophage migration inhibitory factor (MIF) secretion can not only facilitate DENV replication through the regulation of autophagy but also worsen the severity of vascular leak by enhancing endothelial permeability (Lai et al., 2020).

Conclusion:

Endothelial dysfunction, increased vascular permeability and coagulopathy along with plasma leakage are the fundamental attributes in severe form of dengue DHF/DSS. Various studies have indicated the role of host immune system in pathogenesis of different forms of dengue infection. Both innate and adaptive immune responses lead to a cytokine storm which eventually causes alteration in the endothelial permeability. The interplay of immune cells such as monocytes, macrophages, mast cells, T cells and that of various soluble factors in pathogenesis of severe forms of dengue have been elucidated in this review. It is extremely crucial to have an integrated understanding of the mechanisms underlying the pathology of the disease and the contribution of immune system of host itself in its severity; in order to evaluate their role to develop therapeutics for treatment of disease.

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Principles and aspects of molecular docking: A bird's eye view

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Abstract

Molecular docking is an evolving and expanding *in-silico* structure-based method with multiple applications. It performs a search algorithm to create an optimum number of configurations and evaluates until the minimum energy convergence is reached. The docking strategy can vary according to the ligand/target flexibility. Various robust and dynamic molecular tools based on different algorithms are freely available. These tools exhibit a wide variety of applications including drug design, vaccine development, drug repositioning, and bioremediation. The results of molecular docking can be evaluated on the basis of scoring functions and root mean square deviation values and can be visualized using various software. Despite enormous advances in the field of computational biology over decades and the widespread applications of docking methods, several pitfalls still exist. This review presents a collaborative view of molecular docking where we have focussed on its algorithms and functions along with the applications and challenges. It also provides insights into the process of docking through an elaboration of AutoDock server and into various visualising software used for analyzing the results.

Keywords: Molecular docking, docking algorithms, docked structure visualisation, Auto Dock, applications of docking

Abbreviations: RMSD- Root mean square deviation; LGA- Lamarckian genetic algorithm; GA- Genetic algorithm; LS- Local search; PDB- Protein data bank

1. Introduction

In modern times as the need for better therapeutics is growing by leaps and bounds, molecular docking has emerged as an important tool in drug discovery and vaccine development. This is evident by the increasing level of sophistication of different docking aspects and growing number of users from both academia and pharmaceutical industry. Molecular docking is the *in-silico* method that anticipates the favoured orientation of ligand against receptor to make a stable complex and uses electrostatic, Van der waals, coulombic interactions and hydrogen bonds to quantify it (Chaudhary & Mishra, 2016). The sum of all these interactions is approximated by a docking score, which represents the potentiality of binding. Docking servers/tools are assisted by a search algorithm which inspects the various conformations of the ligands until the confluence to the minimum potential energy is reached and an affinity binding function is obtained which is meant to rank the various binding conformations as the sum of electrostatic and Vander waals energies (Pagadala et al., 2017). Three key ingredients of the docking are representation of the system, conformational space search and ranking of the potential solutions.

Docking essentially simulates the interaction of the protein surface. The surface can be described by mathematical models, for example by geometrical shape descriptors or by a grid, which is basically an experimentally appropriate site where the ligand is supposed to bind. Alternatively, it can involve static

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or dynamic treatment of the protein frame/receptor. Various algorithms like Monte Carlo, Fragment-based, Genetic algorithms, Systematic searches, distance geometry and many more are applied for analysis of the potential solutions (Halperin et al., 2002).

In this review we have tried to shed some light upon the various components of molecular docking, result visualisation and analysis, applications and challenges along with the elucidation of a highly used tool- AutoDock.

2. General aspects of molecular docking

2.1 Search Algorithms

Docking is a computationally difficult task because there are many ways of putting two molecules together owing to the three translational and three rotational degrees of freedom (degree of freedom signifies various ways in which a molecule can move or rotate). The number of possibilities grows exponentially with the size of the components (Halperin et al., 2002). A search algorithm is a means to create an optimum number of configurations on the basis of experimental methods of determining binding mode (Chaudhary & Mishra, 2016). The search for candidate solutions in the molecular docking is addressed in two essentially different approaches: (1) a full three-dimensional space search and, (2) a gradual guided progression through solution space. The former scans the entire solution space in a pre-defined systematic manner. In contrast, the latter either scans only a part of the solution space in a partially random and partially criteria-guided manner, or generates fitting solutions (Audie& Swanson, 2012).

2.2 Scoring function

A search algorithm may produce a large number of solutions inconceivable for any practical need. Here the scoring function comes into play which discriminates between the "correct" native solutions with low Root Mean Square Deviation (RMSD) within a reasonable computation time. RMSD is used to compare the docked conformation with the reference mode or with other docked complexes (Halperin et al., 2002). RMSD between the experimentally observed heavy-atom positions (subset of atoms for which RMSD is calculated) of the ligand and those predicted by the docking program is used as a scoring function when the experimentally known structure of the complex exists (Mih °an, 2012; Pedotti et al., 2011). Complexes with RMSD values <2 Å are considered a success, while RMSD values between 2 - 3 Å are only partially acceptable (Cole et al., 2005; Mih °an, 2012).

Over the years, different scoring functions have been developed and grouped into three main categories: force field based, empirical function and knowledge based scoring function. There are three main applications of these scoring functions in docking (Bielska et al., 2011): a) identification of most favourable binding modes, b) accurate prediction of binding affinities and c) identification of potential binders from a ligand library. All three applications are related to each other and an ideal scoring function performs well for each of the applications (Huang et al., 2010).

2.3 Types of Molecular Docking

2.3.1 Lock and key/rigid docking: It is used to find complexes with high degree of shape complementarities between ligand and the receptor. In this approach the ligand and receptor remain as stiff structures and search space is very limited. In this case, ligand flexibility could be addressed by using a pre-computed set of ligand conformations, or by allowing for a degree of atom–atom overlap between the protein and ligand (Meng et al., 2011). The first docking program developed by Kuntz group named 'DOCK' was based on this mechanism. Other programs such as Patchdock and SymmDock also use similar mechanics.

2.3.2 Flexible ligand and rigid receptor docking: This method is based on induced-fit mechanics and considers the flexibilities of both the ligand and receptor as both change their conformations to form a minimum energy and perfect-fit complex. However, for better accuracy and computational time management the receptor is kept fixed while keeping the ligand flexible. Majority of the docking programmes like AutoDock and FlexXuse this mechanism (Meng et al., 2011).

2.3.3 Flexible ligand flexible receptor docking: This method is also based on induced fit mechanics but here the side chain flexibility plays a crucial role in the formation of the ligand-receptor complexes. These changes allow the receptor to alter its binding site according to the orientation of the ligand. This method has the advantage of computational efficiency as the receptor coordinates remain fixed and interactions are executed by adjusting Van der

waals parameters. GOLD and AutoDock3.0 involve this type of docking mechanism (Meng et al., 2011).

2.4 Approaches to molecular docking

2.4.1 Simulation approach: Here the ligand and target/receptor remain stable at some feasible physical distance and the ligand is allowed to bind in the groove of receptor after performing some definite movements in its conformational space. With every move in the conformational limit, ligand releases some of its potential energy. This approach is advantageous when docking is performed with the ligand of high flexibility. At present many grid-based tools like AutoDock utilizes this approach (Dar & Mir, 2017).

2.4.2 Shape complementarity approach: It emphasizes on surface structural features like lipophilicity and hydrophilicity of the ligand and receptor because of which Van der waals interactions play a major role. Here the surface of target is shown with respect to its solvent-accessible surface area and ligand's molecular surface is showed in terms of matching surface illustration with respect to receptor. For example, in protein target molecules, hydrophobicity is estimated by employing number of turns in the main-chain atoms. This approach is quick and involves scanning of numerous ligands for the binding possibilities to the target (Dar & Mir, 2017).

3. Steps involved in docking

Docking is basically the *in-silico* study of interaction between a macromolecule (receptor) and a micro molecule (ligand). For this purpose, both the molecules should undergo some pre docking preparatory phases before final analysis.

3.1 Preparation of receptor: The 3-D structure of the protein is retrieved from protein data bank (PDB) using online servers by providing entry code or by text search. After this as per the requirement, removal of water molecules, stabilization of charges, filling of the missing residues and side chain generation is performed.

3.2 Binding site prediction: Receptor protein may have many binding sites hence prediction of appropriate binding cavity is essential for a good docking outcome which is done by using the co-ordinates of a co-crystallized receptor-ligand structure.

3.3 Preparation of ligand: Ligands can be obtained from several databases like ZINC, PubChem or it can be designed using tools like Chem sketch. The ligand can be saved in several file formats like .mol, .pdband. and pdbqt for future references.

3.4 Docking: After the selection of receptor and ligand they are subjected to docking with some adjustments in the parameters like number of runs and number of cycles. This can be done by employment of several tools including AutoDock Vina, Hex and, many others (Table 1). At this stage interaction between ligand and receptor is analysed and the scoring function gives energy scores for the formed complexes on the basis of binding compatibility.

4. AutoDock: A promising docking tool

Auto Dock is open source software for computational based docking and virtual screening of small molecule to macromolecular receptors developed by Morris et. al. at the Scripps Research Institute (Morris et al., 2009; Huey, et al., 2009) It is based on Lamarckian genetic algorithm (LGA) which is a hybrid of genetic algorithm (GA) and local search (LS) (Fu et al., 2018). Due to its free-availability for academic users, high accuracy, efficient performance and easy usage, AutoDock has become a very popular choice as docking software which is well indicated by its high number of citations in recent years. It is a suite of several complementary tools, namely, AutoDock Vina, AutoDock 4, Raccoon, AutoDockTools, and AutoLigand, for computational docking and virtual screening (Forli et al., 2016). AutoDock 4 and AutoDock Vina are the two generations of the molecular docking software which differ on the grounds of automated grid map calculation, speed and accuracy (Morris et al., 2009; Huey, et al., 2009; Trott & Olson, 2009). AutoDockTools, a graphical user interface, has been developed to facilitate formatting of input molecule files to identify active sites and determine volume of search space, and to cluster, display and analyse the docking results (Morris et al., 2009; Huey, et al., 2009). On the other hand, Raccoon is a graphical interface used to virtually screen a library of ligands with a single receptor and also to process ligand libraries in different formats, automatically (Forli et al., 2016). As the docking of ligands to the entire protein surface is generally not practically feasible, it is essential to identify the optimal binding sites on receptors. This task can be performed in AutoDock using a program from the suite that is AutoLigand which predicts the binding sites on the basis of the free-energy force field (Harris et al., 2008).

Table 1: Description of some most-cited docking programs and servers.

Program/ Server	Developer /Creators	Licence terms	Docking features (Sousa et al., 2013)
Autodock (Morris, Ruth, et al., 2009; Trott & Olson, 2009)	Morris & co-workers, The Scripps Research Institute	Free availability to academic users	-Offers a variety of search algorithms -Can be used with a visual interface called autodocktools (ADT) for efficient analysis of the docking results
–GOLD (Jones et al., 1997)	Cambridge Crystallographic Data Centre (CCDC)	Commercially available	-Interactive docking set-up via Hermes -Genetic algorithm (GA) based search method
DOCK (Allen et al., 2015)	Irwin Kuntz University of California, San Francisco	Available free of charge for academic institutions	-AMBER molecular mechanics scoring function with implicit solvent, conjugate gradient minimization, and molecular dynamics simulation capabilities

FlexX (Rarey et al., 1996)	T.Lengauer and M.Rarey Biosolveit	Commercially available	-Robust incremental construction algorithm through which the ligand is decomposed into pieces and then flexibly built up in the
			-Allows both rigid body and flexible ligand docking
Glide (Friesner et al., 2004)	Schrodinger LLC	Commercially available	-Approximates a complete systematic search of the conformational, orientational and positional space of the docked ligand -Offers the full range of speed vs. Accuracy options

Patchdock (Schneidman-Duhovny et al., 2005)	Dina Schneidman-Duhovny, Yuval Inbar, Ruth Nussinov and Haim J. Wolfson	Freely available web server	-Input consists of two molecules: proteins, DNA, drugs, peptides -Geometry-based /rigid docking algorithm
CABS-dock (Kurcinski et al., 2015)	Mateusz Kurcinski, Michal Jamroz, MaciejBlaszczyk, Andrzej Kolinski, Sebastian Kmiecik	Freely available web server	-Does not require pre-defined knowledge of binding site -Uses highly efficient protocol for flexible docking of peptides to proteins

4.1 Work flow of docking experiment with Auto Dock Suite

A general docking experiment with AutoDock requires various steps including preparation of coordinate file, docking simulation, and analysis:

i. **Preparation of coordinate file:** Coordinate files for receptor and ligand are required for a successful docking and are prepared using AutoDockTools in a variety of common formats. AutoDockTools defines docking parameters and specifies PDBQT (Protein Data Bank, partial Charge Q and atom type T) files for ligand and receptor (Seeliger & de Groot, 2010) PDBQT is extended PDB format, used for coordinate files, which includes atomic partial charge, atom type, and polar hydrogen atom along with the information of torsional degree of freedom (Morris et al., 2009; Forli et al., 2016).

ii. **Docking simulation:** After preparation of the coordinate files, the user can go for various docking simulation such as single docking with AutoDock/AutoDock Vina, docking with explicit water and virtual screening with Raccoon and Vina, depending on the requirements. Initially, the center and size of the search space are defined using a grid whose coordinates are mentioned in the configuration file. Finally, the AutoDock/AutoDock Vina is run at the command line with the path of directory containing the coordinates and configuration files (Forli et al., 2016; Goodsell et al., 1996; Morris et al., 2009; Huey, et al., 2009).

iii. **Analysis:** The final analysis of the result is performed using AutoDockTools to visualize the coordinates of docked results and the interactions between the receptor and the ligand (Morris et al., 2009; Forli et al., 2016)

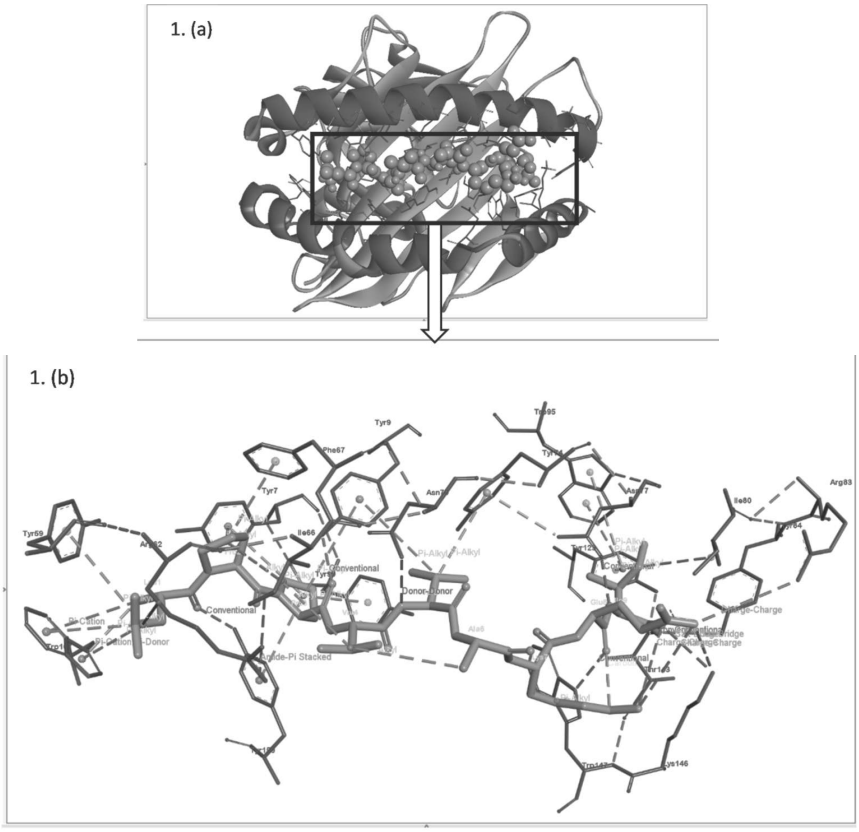

Figure 1: Docking result of HLA B*5101 with its control peptide. The receptor structure was obtained using the PDB database (PDB ID: 1E27). HEX server was used for docking and the figure was generated using Discovery Studio Visualizer. (a) Control peptide "LPPVVAKEI" in yellow colour docked into the peptide binding groove of HLA B*5101. (b) A zoomed in figure showing the different non-covalent interactions between the peptide (in yellow colour) and the HLA molecule (in blue colour).

5. Evaluation and visualization of docking results

The evaluation of the docking results relies mainly on a scoring function that ranks the different binding modes on the basis of calculated binding energies/affinities and other criteria, and usually only a small number of top-ranked complexes are chosen as candidates for further studies such as experimental assays (Cheng et al., 2012). Despite a number of scoring functions that have been developed, none of them are perfect in terms of accuracy and the compounds can exhibit poses with imperfect hydrogen-bonding, poor interactions with the binding pocket, poses based purely on hydrophobic interactions and shape complementarity or generation of poses outside the binding pocket (Bielska et al., 2011). Thus, selection of most favourable ligand solely based on binding affinities scores is not sufficient and visual inspection is often necessary for a thorough understanding of the structural principles that determine the strength and interactions of a protein-ligand complex. Protein–protein interactions play a central role in many biological processes, such as ligand mediated signal transmission making the understanding of protein–ligand recognition and binding of great importance for the discovery and design of new drugs (Dunn, 2010). Interactions are generally categorised into 5 types: a) hydrogen bond with ligand acceptor, b) hydrogen bond with ligand donor, c) ionic interactions, d) hydrophobic interactions and e) Pi stacking. These weak non-covalent interactions are key players in stabilizing a ligand energetically at the interface of a protein structure (Patil et al., 2010) .

Several software are available specifically for the structural analysis and for studying interactions between proteins and ligands. Protein-ligand complexes can be visualized and inspected using the tools such as Pymol, Discovery Studio, UCSF ChimeraX, Ligplot+ etc.

Pymol (Delano, 2002) is an open source molecular visualization system created by Warren

Lyford Delano and currently developed and maintained by Schrödinger Inc (Chan et al., 2017). Presently, Pymol is one of the most widely used macromolecular visualization tools that can produce high-quality movies and images of macromolecules in different representations including ribbons, cartoons, dots, surfaces, spheres, sticks, and lines. Pymol is particularly widely used since it is written in Python and can be extended to Python plugins easily (Chan et al., 2017). The Autodock/Vina-plugin for Pymol represents an interface between these programs and allows to carry out molecular docking, virtual screening and binding site analysis with Pymol (Seeliger& De Groot, 2010).

Discovery Studio (Biovia, 2017)is a suite of software developed and distributed by Dassault SystemesBiovia for analyzing and modelling molecular structures, sequences, and other data of relevance to researchers. The Discovery Studio Visualizer is a free viewer with features such as advanced molecular visualizations, displaying and editing ligand binding sites, display of a range of molecular surface properties including H-bonds, charge, ionizability, lipophilicity, aromaticity and solvent accessibility, monitoring non-bond interactions including favourable, unfavourable and unsatisfied interactions (Biovia, 2017). It also provides a rich set of viewers for displaying plots and other graphical representations of data. The application runs on Windows and Linux and is a fully integrated desktop environment that provides access to standard operating system features such as the file system, clipboard, and printing services. Figure 1 shows the result of a docking experiment performed using Hex program and visualized in Discovery Studio Visualizer.

Ligplot+ (Laskowski & Swindells, 2011) is a

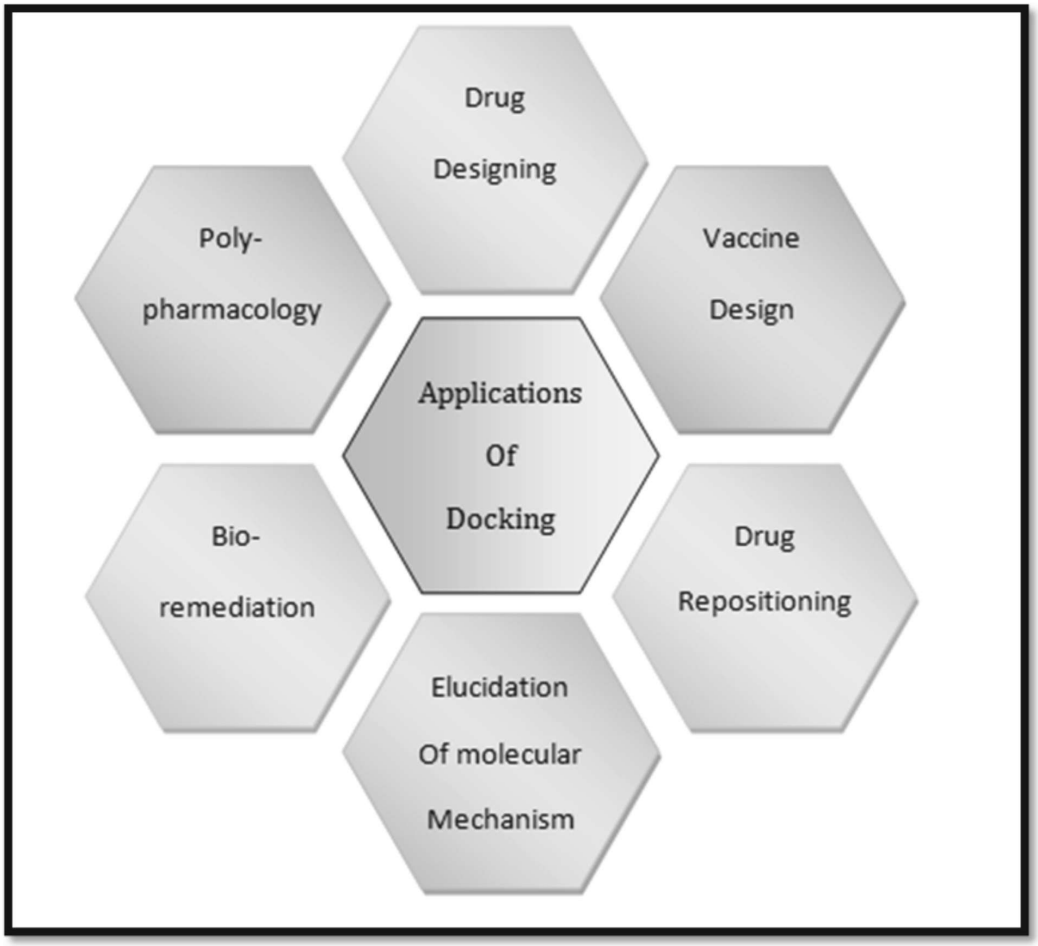

Figure 2: Applications of molecular docking: Various applications of molecular docking includes drug designing, vaccine design through the immunoinformatics approach, drug repositioning of the already approved drugs, elucidation of molecular mechanisms to have deeper understanding of the life processes, bioremediation to combat pollution, and polypharmacology to identify ligands which can bind to variety of therapeutic targets.

successor to the original Ligplot program developed by European Bioinformatics Institute. The Ligplot+ program automatically generates schematic 2-D representations of protein-ligand complexes from standard Protein Data Bank file input (Laskowski & Swindells, 2011). It runs from an intuitive java interface which allows on-screen editing of the plots via mouse click-and-drag operations. It provides an alternative to visualization of 3-D structures which is often difficult to quickly investigate with (Laskowski & Swindells, 2011). The 2-D representation diagrams portray the hydrogen-bond interaction patterns and hydrophobic contacts between the ligand and the main-chain or side-chain elements of the protein.

UCSF Chimerax (Goddard et al., 2018) is one of the most powerful 3D molecular visualization program developed by the Resource for Biocomputing, Visualization and Informatics . UCSF Chimerax is built over the original UCSF Chimera visualization system with the main goal to provide an integrated multiscale modelling environment that enables researchers to interactively access, visualize, and analyze structural data (Goddard et al., 2018).

6. Applications of molecular docking

Molecular docking exhibits a wide array of applications in today's world where bioinformatics is strengthening its grip onto the research based literature. An ever increasing computational power coupled with improvised algorithms has added to the list of molecular docking applications which includes drug discovery, prediction of toxicity and side effect targets, epitope prediction for epitope-based vaccine, drug repositioning, biological mechanism elucidation, bioremediation, and library building among many other (Figure 2) (Bielska et al., 2011; Dar & Mir, 2017; Goodsell et al., 1996).

There are numerous compounds in nature which exhibit biological effects on humans which can be a result of a long-term co-evolution (Ji et al., 2009). The computational screening of large libraries of natural compounds against the molecular targets reduces time, effort and cost for finding the desired drug target. Molecular docking is one of the most successful and popular *in-silico* methods which helps in predicting interactions between the molecules and biological target. Along with structure-based virtual screening, it is also employed to identify targets for which the ligands exhibit good complementarity, also known as target fishing and profiling. Moreover, it is also utilized to identify ligands that show simultaneous binding with a variety of therapeutic relevant targets of interest; a process known as polypharmocology (Pinzi& Rastelli, 2019). Given the extensive evaluation and safety measures required for a new molecule to be approved as a drug, it is always preferable to repurpose an established and approved drug towards novel therapeutic targets. For example, a docking-based study has discovered that mebendazole, which is an anti-parasitic drug, is also found to be an anti-angiogenic inhibitor (vascular endothelial growth factor receptor 2) (Dakshanamurthy et al., 2012). This strategy of drug repositioning using the computational approach of molecular docking also involves the screening of structural complementarity. Several computational approaches including molecular docking are also used to identify or indicate side effects of drugs by analyzing the existing databases of drug-adverse drug reaction (drug-ADR)pairs (Xu et al., 2018). For instance, Ma. et. al, in an *in-silico* study using a docking based program predicted the toxicity related target protein for melamine and its metabolite, cyanuric acid (Ma et al., 2011). Along with the extensive use of molecular docking in drug designing and its related aspects, it is also being used worldwide as a part of immunoinformatic approach to find a probable epitope-based vaccine candidate. In these studies, epitopes selected after numerous screening methods are docked with various HLA molecules in order to validate their ability to be presented by antigen presenting cells to cytotoxic T-cell or helper T-cell (De Groot et al., 2002). Recently, there has been a spike in the utilization of molecular docking tools for the immunoinformatics and drug design approaches in an attempt to recognize vaccigenic epitopes and inhibitory molecules against SARS-CoV-2 (Sarkar et al., 2020). A docking strategy with novel methods of analysis also makes it possible to understand the deeper insights of various delicate molecular mechanisms (Bartuzi et al., 2017). Apart from the wide array of applications of molecular docking in life science and pharmacology, it has also been successfully employed in environmental remediation. In this case, active sites of various enzymes are analysed for their biodegradative properties and ability to accommodate the pollutant molecules (Liu et al., 2018).

7. Challenges in docking

It is evident from docking literature that it is in a mature stage of development but significant challenges still remain. Though important advances are being made in all aspects of docking programs, flexibility and successful scoring are still far from perfect (Huang & Zou, 2010). Opting for a docking program that will suit best according to the needs

and will give the best results is also not simple and straight forward (Akhter, 2016). Along with this, unlike the ligand flexibility, the protein flexibility is still in infancy and requires improvement (Huang & Zou, 2010). Various studies have also reported that due to major biochemical and physical differences in charges, binding pockets, and solvation, existing docking programs which have been developed for proteins, face difficulties when employed directly for nucleic acids (Luo et al., 2019). Despite all these challenges the *in-silico* docking procedures offer a great deal of insights into protein interactions.

8. Conclusion

In the present study, we have reviewed the basic aspects of molecular docking by explaining the workflow using the key docking tools and the various modern-day applications of docking. Molecular docking method has seen increased usage and is currently seen as a key player in early stage drug-discovery and vaccine development. Many protein-ligand docking programs and web-based servers are currently available and new alternatives are being developed every year. Despite such advances, docking studies are far from being perfect and involve a number of drawbacks. Treatment of receptor flexibility and lack of a perfect current scoring function appear as major hurdles in docking. Nevertheless, despite the drawbacks of each docking strategy, docking based virtual screening remains a useful and promising *in-silico* tool for developing new therapeutics. This is especially evident from the number of studies using molecular docking approaches to screen for both natural and synthetic medications to treat COVID-19.

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Alternate Approaches to Animal-Models

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Use of animals as models to mimic human systems is fairly common. Technological progress, especially in medical research and development, has seen an increase in the number of animals used in research. It is estimated that every year, millions of animals are used in experiments across the world (Rusche, 2003). Mice, rats, hamsters, birds, fishes, amphibians, guinea pigs, rabbits, dogs and monkeys are widely used for drug and vaccine discovery and testing, toxicology screening and even in the cosmetic industry for testing beauty products. Animal models are also the basis of many biomedical experiments ranging from studying brain circuits (Del et al. 2018) to disease progression in tissues (Basaraba, 2017) and even cellular ageing (Yousefzadeh et al, 2019).

The Issue:

The main issue with using animals as models during scientific experiments is the pain, suffering and death experienced by the animals during the process. Animals are kept in small cramped cages, often in isolation while they are injected with drugs, vaccines and chemicals. The effects of these compounds are studied on the whole body, or the animal is euthanized and tissues or organs are harvested and examined. Animals that survive the experiment are often euthanized after the test to avoid further pain and suffering. Besides these major ethical concerns, there are few more disadvantages in using animal models like high cost, time consuming protocols, low efficiency and necessity of trained manpower. Another important concern is that, in certain types of research, animals differ too much from humans thereby making experiments conducted on them irrelevant.

The 3R Concept:

To overcome the problems associated with animal experiments, and in order to avoid unethical practices, the following 3R concept of animal use in research and testing was first introduced in 1959 (Russell et al, 1959)

- **Replacing:** Substitute animal models with non-animal systems such as computer models, biochemical or cell-based assays.
- **Reducing:** Decrease the number of animals required for testing to a minimum while still satisfying and achieving the testing goals.
- **Refining:** Eliminate pain or distress in animals, or enhance animal well-being by providing better facilities, care and treatment.

The Non-Animal Alternative Approach:

Test methods that incorporate the 3Rs are referred to as alternative methods (Doke et al, 2015). With rapid advances being made in Science and Technology, scientists have developed various non-animal alternatives. These include

1. The Algorithmic (Computational-Model) approach: Computer generated simulations are widely used to predict activity and toxic effects of a chemical or potential drug without the need for animal models. Computational models can process huge volumes of research data to predict the effects of chemicals or molecules on an organism. High-speed algorithms, like the Structure Activity Relationship (SARs) program, use structural information from online chemical databases and compares untested compounds against thousands of tested chemical compounds. Thus, toxicity of tested compounds can be used to make predictions about the toxicity of the untested new compounds having a similar structure (Russo et al, 2019). Other tools like the Computer Aided Drug Design (CADD) program can identify probable binding sites for potential drug molecules, and can eliminate molecules having no binding sites. Only the best molecules obtained from this primary

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screening are used for animal testing, thereby greatly reducing the number of animals required. These software programs can also help design a new drug for specific binding sites and also predict their efficacy, so that animal testing is only necessary for final confirmatory trials (Vedani, 1991). Other widely used computer programs like Structure Activity Relationship (SARs) and Quantitative Structure Activity Relationship (QSAR) help in predicting biological activity of a potential drug and predict possible negative effects like carcinogenicity and mutagenicity (Abdolmaleki et al, 2017). The advantages of computer models are that they are faster and comparatively cheaper. In fact, computational methods have been so successful that some researchers conclude that algorithms could even be *better* than animal tests at predicting toxicity in certain compounds (Luechtefeld et al, 2018).

2. Lab-Grown Organ (Cell and Tissue Culture) approach: Another approach that is fast gaining recognition as an important alternative for animal testing is the use of *in vitro* cell and tissue cultures, involving growth of cells outside the body in laboratory environments. Cells and tissues from organs like liver, kidney, brain, skin etc. are obtained from humans and animals, and are cultured in suitable growth media. These lab-maintained cultures can survive for a few days to months and even for years. These cultures can be used for the preliminary screening of chemicals or potential drug molecules (Shay et al, 2000). These cultures can be used to test cosmetics, drugs and chemicals for their toxicity and efficacy eliminating the necessity of using animals. An exciting development in this field is the**organs-on-a-chip**. This technique involves growing cultured human cells on a scaffold, like hydrogel or electrospun fibres, embedded on plastic chips to form tiny structures that mimic the functioning of various human organs. These organ-cultures can then be used to test the effects of new compounds or drugs on human cells and have the advantage of providing more human-relevant results than animal experiments. More importantly they can also replace the use of whole animals in screening processes. The development of bovine corneal organ cultures to screen for chemical irritancy is fast replacing the painful Draize test requiring rabbits*(*Xu et al, 2000). In addition to lungs, livers and hearts, researchers also are developing artificial 3D structures that mimic the human skin. This is of great importance in toxicology, where they can replace the common animal skin tests (Dellambra et al, 2019). Benefits of tissue or organ cultures are that they are easy to maintain and process, less time-consuming and are cost-effective (De Vries et al, 2015).

3. Human Models: An idea that is currently gaining popularity is that since it is humans that get the benefit of new drugs and research, it is humans who should be the test subjects. There are carefully controlled forms of human testing like ***microdosing***, where human test subjects receive a new drug in very tiny quantities where it doesn't have adverse health impacts, but there is just enough drug in the system to study its impact on cells (Burt et al, 2017). This approach could help eliminate non-working drugs at an early stage. In turn it reduces the unnecessary usage of thousands of animals in studies that only prove that a drug doesn't work. Many pharmaceutical companies now use microdosing to streamline drug development, as this approach has proved to be safe, efficient and cheap.

The Future

Can these alternative methods replace animal testing in the future? In some areas of research like cosmetic testing and toxicology screening, animal testing is increasingly being replaced by alternate methods. But in some other areas where the questions being researched are more complex, animal models still remain the only way we have of fully understanding the varied and long-term effects of a molecule, drug, vaccine or disease. Alternate models still cannot replicate a physiological human body, with its complex neural circuitry and multi-organ complexity. Scientists are working to overcome these issues by integrating computer models, bioinformatics tools, tissue and organ cultures with enzymatic screens, modern analytical techniques and statistical procedures to provide highly dependable results. Such an integrated approach could have the desired result of minimizing and maybe even ending the usage of animal models.

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उत्तर प्रदेश का प्रचलित लोक गीत 'कजरी' - विषय वैविध्य एवं समकालीन प्रभाव

(मिर्जापुरी, बनारसी व अवधी के विशेष संदर्भ में)

अपराजिता

"लोकगीत किसी संस्कृति के मुँह बोलते चित्र हैं" - डॉ. वासुदेव शरण अग्रवाल सृष्टि के आरम्भ से ही मानव प्रकृति की सुकुमारता और लावण्य पर मुग्ध हो तद्नुरूप भावाभिव्यक्ति करता आ रहा है। लोकजीवन और प्रकृति का प्रारम्भ से ही घनिष्ठ सम्बन्ध रहा है, प्रकृति के आँगन में लोक का स्वच्छंद विचरण होता है। ग्रीष्म ऋतु में सूर्य का प्रचंड आतप जहाँ सबको व्याकुल कर देता है, वहीं शिशिर की शीतल मंद बयार सम्पूर्ण वातावरण में उल्लास तथा वसंत ऋतु का सुधामयी चन्दा मानव की कल्पनाओं में माधुर्य बिखेर देता है।

भारत में विभिन्न प्रकार की ऋतुओं का संगम है। यह संगम यहाँ के लोकगीतों में ही नहीं अपितु लोककलाओं, लोकनृत्यों, आदि सभी में देखने को मिलता है। प्रकृति के दिए इस वरदान को उल्लासपूर्वक मनाने की परम्परा भारत में प्राचीन काल से ही रही है। भारत में ऋतु के अनुसार न केवल गीत के कथ्य बदलते हैं, बल्कि उनके शिल्प में भी परिवर्तन आता है। डॉ. कृष्णदेव उपाध्याय इस बात को विस्तार देते हुए कहते हैं- यदि वर्षा के दिनों में किसान आल्हा गाकर अपना मनोरंजन करता है तो सावन में कजरी गाकर अपने दर्द को दूर करता है, यदि फागुन के महीने में होली या फागुन के गीतों द्वारा वह अपने हृदयगत उल्लास को प्रकट करता है तो चैत में चैता या घांटों गाकर वह आत्म विभोर हो जाता है।

ऋतु वर्णन की लिखित परम्परा वैदिक साहित्य में ऋतुओं और महीनों की गणना तथा ऋतु विशेष के स्वामी के वर्णन से प्रारम्भ होती है। इतना ही नहीं हिन्दी साहित्य के आदिकालीन ग्रन्थों में भी ऋतु वर्णन की यह परंपरा दृष्टिगत होती है। भक्तिकालीन साहित्य की दोनों धाराओं (निर्गुण सगुण) में भी ऋतु वर्णन की यह परम्परा विद्यमान है। रीतिकालीन साहित्य में भी श्रृंगार रस के उद्दीपन भाव हेतु ऋतु वर्णन किया गया।[1]

ऋतुगीतों की यह परम्परा लोकभाषाओं में अधिक मुखर हुई है। अवध ब्रज एवं भोजपुरी भाषी क्षेत्रों में ऋतुओं की मनोहारी सुषमा तथा मानव मन पर पड़ने वाले विविध प्रभावों का चित्रण ऋतुगीतों में प्राप्त है। उपलब्ध ऋतुगीतों को दो भागों - वर्षा ऋतु के गीत व वसंत ऋतु के गीत में वर्गीकृत किया जा सकता है। प्रथम प्रकार के गीतों में कजरी, बारहमासा, छःमासा, चौमासा, मल्हार, झूला, हिंडोला, सावन, चौहट, आल्हा, चाँचर और रोपाई गीतों की गणना की जाती है। दूसरे प्रकार के गीत वसंत ऋतु में गाये जाते हैं। जिनमें कोयल की कूक, वृक्षों में पुष्पागमन, होली का उल्लास, कामाधिक्य आदि का वर्णन होता है। होली, धमार, कबीर, जोगिया, फाग, चैता या चैती वसंत कालीन ऋतु गीत है।[2] अर्थात कजरी को हम ऋतुगीत की संज्ञा दे सकते हैं। ऋतुगीत इसलिए क्योंकि यह प्रमुख रूप से सावन महीने में गाया जाने वाला लोकगीत है। हालांकि विषय की विविधता की दृष्टि से यह कई रूपों में सम्पन्न है परन्तु सावन और उससे जुड़े विषयों का मनमोहक और यथार्थ चित्रण इसमें देखने को मिलता है।

ऋतु गीतों ही नहीं बल्कि समस्त लोकगीत में ''कजरी'' गीतों का विशेष स्थान है। लोकप्रियता एवं चारुता के आधार पर 'कजरी' गीतों को ''वर्षाकालीन गीतों की रानी'' कहा जा सकता है।[3] वर्षा ऋतु के विभिन्न उपादानों बादलों का उमड़ना, गर्जना, विद्युत की चमक, वर्षा की झड़ी, झंझावातों का चलना, दादुर, मोर, पपीहा, आदि का उल्लासमय ध्वनियों का बहुविधि वर्णन इसके अंतर्गत होता है। ऐसे ही मनोरम वातावरण में कजरी गीतों का गायन किया जाता है।

कजरी गीतों की उत्पत्ति कब और कैसे हुई इस सम्बन्ध में कोई ठोक तथ्य तो प्राप्त नहीं हैं, परन्तु इस उत्पत्ति से अलग-अलग क्षेत्रों में भिन्न-भिन्न किंवदंतियाँ अवश्य जुड़ी हुई हैं। ''लोक साहित्य के कुछ विद्वान कजरी के जन्म का सम्बन्ध मिर्जापुर व बनारस में प्रचलित शक्तिपूजा या गौरीपूजा तथा

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वैष्णव इसे विशेष रूप से कृष्णोपासना या लावणी से जोड़ते हैं। मिर्जापुर के कुछ गायक कजरी को अष्टभुजी विंध्याचल की देन मानते हैं। उनके अनुसार काली कज्जली के चार रूपों, काली, दुर्गा, विंध्याचल की अष्टभुजी और मैहर की मनियादेवी के द्वारा व्यक्त भाव कजली द्वारा गाये गए, अत: 'कजली' के नाम से प्रसिद्ध हुए।[4] पंडित बलदेव उपाध्याय के अनुसार-''आज कल की कजली प्राचीन लावणी की ही प्रतिनिधि है।''[5]

'कजरी' पूर्वी उत्तर प्रदेश और भोजपुरी से जुड़े हुए कुछ क्षेत्रों का सावन के महीने में गाया जाने वाला प्रसिद्ध लोकगायन है। उत्तर प्रदेश में मुख्य रूप से कजरी की शैली दो प्रकार की मानी जा सकती है। एक को गजल की शक्ल में कजरी दंगलों में सुना जा सकता है। दूसरी और दूनमुनिया कजरी, जिसे औरतें वृत्त बनाकर ताल देती हुई झुक-झुक कर गाती हैं।[6] चूंकि लय लोकगीतों की आत्मा होती है अत: लय के आधार पर इसे चार भागों में देखा जा सकता है 'ठहकी लय, ठुनठुनिया लय, चलती लय, रामाहरी लय। कजरी के विषय प्रमुखत: परम्परागत होते हैं और अपने समकालीन लोकजीवन का दर्शन कराने वाले भी। अधिकतर कजरियों में शृंगार रस की प्रधानता होती है। कजरी के वर्ण्य विषय ने जहाँ एक ओर भोजपुरी के संत कवि लक्ष्मीसखी, रसिक किशोरी, आदि को प्रभावित किया वहीं अमीर सुखरो, बहादुरशाह जफर, सुप्रसिद्ध शायर सैय्यद अली मुहम्मद 'शाद', हिन्दी के कवि अंबिका दत्त व्यास, श्रीधर पाठक, द्विज बलदेव, बदरीनारायण उपाध्याय 'प्रेमघन' आदि भी कजरी के आकर्षण से मुक्त नहीं रह सके।[7] यहाँ तक कि भारतेन्दु हरिश्चंद्र ने भी अनेक कजरियों की रचना कर लोक विधा से हिन्दी साहित्य को सुसज्जित किया। भारतेन्दु हरिश्चंद्र जी का समय कजरी का 'स्वर्ण युग' था। 19वीं शताब्दी के उत्तरार्द्ध में भारतेन्दु हरिश्चंद्र ने कजरी के गिरते हुए स्तर को संवर्धित करते हुए संगीत और लोकजीवन में सर्वोच्च स्थान दिलाते हुए उसका पुनर्प्रतिष्ठापन किया।[8]

कजरी गीत का एक प्राचीन उदाहरण तेरहवीं शताब्दी का, आज भी न केवल उपलब्ध है बल्कि गायक कलाकार इसको अपनी प्रस्तुतियों में प्रमुख स्थान भी देते हैं। यह कजरी, अमीर खुसरो की बहुप्रचलित रचना है, जिसकी पंक्तियाँ हैं[9] -

''अम्मा मेरे बाबा को भेजो री कि सावन आया''

भारत में अंतिम मुगल बादशाह बहादुरशाह जफर की एक रचना- ''झूला किन डारों रे अमरइयाँ''..... भी बेहद प्रचलित है। जैसा कि उपरोक्त प्रारम्भिक उदाहरणों से यह प्रतीत होता है कि कजरी की विषय यात्रा का आरम्भ प्रमुखत: सावन ऋतु से होता है परन्तु इस लोकगीत की दीर्घ यात्रा में इसके कई रूपों में दर्शन हमें होते हैं। सावन के ऋतु शृंगार से सजी नायिका के प्रेम, उल्लास, विरह, दु:ख एवं चंचलता का मनोहारी वर्णन करते हुए यह सामाजिक रिश्तों, धार्मिक आस्थाओं को सहेजती अपने समकालीन विषयों को भी प्रतिबिम्बित करती है। यहाँ पारंपरिक शृंगार रस के भाव का उद्दीपन करती अवधी कजरी का एक उदाहरण निम्नवत है जहाँ एक कजरी गीत में नायक द्वारा नायिका के साज ओ शृंगार की प्रशंसा करते हुए समागम हेतु उससे स्वयं आकर मिलने की प्रार्थना की गई है[10] -

"अरे रामा बरसत रिमझिम पनिया चली तो आवो जनिया एहारी।

तुम्हरे सिर के बार हैं कारे बीच मोतियाँ मांग सँवारे हो रामा।

अरे रामा चोटी में लगी झुनझुनिया चली तो आवो जनिया ए हारी।

कड़ा छड़ा पाजेब बिराजै बिछुवन कै झनकारी हो रामा।

अरे रामा कमर परी करधनिया चली तो आवो जनिया ए हारी।"

आमतौर पर कजरियाँ - 'जैतसार', 'ठुनठुनियाँ', 'खेमटा', 'बनारसी', और मिर्जापुरी धुनों के नाम से पहचानी जाती हैं। कजरियों की पहचान उनके टेक के शब्दों से भी होती है पारंपरिक कजरियों की धुनें व टेक निर्धारित होते हैं। मुख्यत: कजरियों में टेक इस प्रकार होते हैं - 'रामा', 'बलमू', 'सांवर गोरिया', 'ललना', 'ननदी', 'ए हारी', आदि। बनारसी कजरी गीत का एक उदाहरण यहाँ प्रस्तुत है जिसमें नायिका द्वारा मेहंदी लाने के लिए नायक से आग्रह करना तथा ननद से उसे पिसवा कर प्रियतम से ही लगा देने का अनुरोध किया गया है -

पिया मेहंदी लियाय दा मोतीझील ते, जाके सायकील ते न।
पिया मेहंदी ले आऊ, छोटकी ननद से पिसाऊ
अपने हथवा से लगावा काटा कील से, जाके सायकील ते ना।
ई ह सावनी बहार, बात कही न हमार
कौनो फाइदा न निकली दलील ते, जाके सायकील ते ना

वहीं एक अन्य कजरी गीत के उदाहरण में पति के विदेश से सौतन लाने की आशंका प्रकट करती है जिससे स्त्रियों की मध्यकालीन दुर्दशा व बहुपत्नी प्रथा के प्रचलन का ज्ञान होता है। नायक द्वारा रोजगार की तलाश में विदेश जाने और उसकी व्यथा के विषय को भी कजरी गीतों में स्थान दिया गया है, सम्बन्धित गीत इस प्रकार है -

धनी हो खोला न केंवरिया हम बीदेसवा जईबे ना।
जऊ मोरे सइयाँ तुम जईहों बिदेसवा तानी तू एतना कर देऊ ना।

की हमरे भैया को बुलवाय देऊ हम नैहरवा रहबे ना।

गए बिऊ बिदेसवा ए धनिया, कैसे होई गुजारा न रानी।

रुपैया कमाके आऊबे तोहका झुलनी नीक गढ़ऊबे, हम बीदेसवा....।

जईहों तू बिदेसवा कऊनिउ सवतिनिया लइ अइहो ए सइया

अब हम कुछ ना सुनबै बतिया हमरा भैया के बुलवाय देऊ, हम नैहरवा..।

हम तऊ तोहरे खातिर जनिया, जाऊ बिदेसवा ओ धनिया।

अब हम घर ही रहबै ना, तू जईहौ नैहरवा ना हम बिदेसवा जईबे ना।

नायक की व्यथा, नायिका का प्रेम, सावन ऋतु में श्रृंगार तथा विरह का अद्‌भुत संगम पारिवारिक रिश्तों में नोकझोक के सुन्दर चित्रण के साथ सामाजिक, धार्मिक आर्थिक स्थितियों का भी यथार्थ और प्रभावी चित्रण लोकभाषाओं से सजे इन लोकगीतों में देखने को मिलता है। उपरोक्त कजरी गीत जिसमें देश में रोजगार दयनीय दशा और कमाई हेतु विदेश गमन का संकेत मिलता है, जो अत्यंत प्रभावपूर्ण है।

विभिन्न क्षेत्र की कजरियों के इस क्रम में अवधी कजरी की अपनी अलग ही विशेषता होती है। कजरी का प्रधान विषय प्रेम है। इसमें श्रृंगार रस के दोनों पक्षों की झांकी देखने को मिलती है, परन्तु संयोग श्रृंगार की प्रधानता होती है। लोक संस्कृति में कई प्रकार के रीति-रिवाजों को मनाने का प्रचलन होता है। अवध में वर्षा ऋतु के दिनों में नव-विवाहिता वधु कजली खेलने के लिए अपने मायके जाती है, परन्तु यहाँ पत्नी द्वारा मायके न जाकर ससुराल में ही पति संग रहने का नायिका का सुन्दर आग्रह दिखता है जो कि अवधी कजरी की विषयगत सुंदरता है। गीत इस प्रकार है -

चाहे भैया रूठें चाहे जाएँ, सावना में नाहि जईबे ननदी।

मगही पतईया के बिड़वा मंगौली, चाहे भैया राचें चाहे जाएँ.....सावनवा में...।

अरे गिन चुन कलियन सेज बिछाया, चाहे भैया सोवें चाहे जाएँ...सावनवा में।

इसके अन्यत्र कजरी में अनेक समकालीन विषयों का भी बहुत गहरा प्रभाव दृष्टिगत होता है। समकालीन कजरी एक उदाहरण हमें ब्रिटिश काल में देखने को मिलता है। ब्रिटिश शासनकाल में अनेक लोकगीतकारों ने ऐसी राष्ट्रवादी कजरियों की रचना की जिनसे तत्कालीन ब्रिटिश सरकार ने कठोर यातनाएँ भी दीं। परन्तु प्रतिबंध के बावजूद लोकपरम्पराएँ जन-जन तक पहुँचती रहीं। इन विषयों पर रची गई अनेक कजरियों में बलिदानियों को नमन और महात्मा गाँधी के सिद्धान्तों को रेखांकित किया गया। ऐसी ही एक कजरी की पंक्तियाँ इस प्रकार हैं -

"चरखा कातो मानो गांधी जी की बतियाँ, बिपतिया कटि जइहें ननदी"[11]

वहीं कुछ अन्य कजरियों में अंग्रेजों की दमनकारी नीतियों पर भी प्रहार किया गया।

"कइसे खेले जाइबू सावन में कजरिया बदरिया घेरी आइल ननदी"।

इन पंक्तियों में काले बादलों का घिरना गुलाम के प्रतीक के रूप में चित्रित हुआ है। इसके अंतरे की पंक्तियाँ कुछ इस प्रकार से हैं -

"केतनों लाठी गोली खाइलें, केतनों डामन (अंडमान का अपभ्रंश) फांसी चढ़िले केतनों पीसत होइहें जेहल में चकरिया, बदरिया घेरि आइल ननदी।"

आजादी के बाद कजरी गायकों ने इस अंतरे को परिवर्तित कर दिया। 1857 की क्रांति के पश्चात् जिन जीवित लोगों से अंग्रेजी हुकूमत को ज्यादा खतरा महसूस हुआ, उन्हें काला पानी की सजा दे दी गयी। इस व्यथा को भी लोकगीतों में व्यक्त किया गया और कजरी में यह समकालीन विषय के प्रभाव के रूप में दिखाई देता है -

"अरे रामा नागर नैया जाला काले पनिया रे हारी
सबकर नैया जाला कासी हो बिसेसर रामा
नागर नैया जाला काले पनियाँ रे हारी
घरवा में रोवै नागर, माई बहिनियाँ रामा।
'सेजिया पै रोवे बारी धनिया रे हारी।"[12]

लोकगीत निश्चित ही एक सशक्त विधा है समय को सहेजने, संस्कृतियों को समेटने की। परन्तु समय के साथ हो रहे त्वरित परिवर्तनों ने हमारी लोककलाओं को भी प्रभावित किया है। चाहे वह लोकगीत हो, कला हो या अन्य कोई लोकविधा सामाजिक सरोकारों की श्रेणी में पिछड़ते जा रहे हैं। पूर्व में संयुक्त परिवारों के नेतृत्व में हमारी परम्पराएँ मौखिक रूप में ही बड़े बुजुर्गों से नई पीढ़ी में सहज ही अग्रसारित हो जाते थे परन्तु अब एकल परिवारों की बढ़ती सभ्यता के फलस्वरूप भी यह परम्परा क्षीण होती जा रही है। वहीं बढ़ती शहरी संस्कृति में और सभ्य व संभ्रांत होने की लालसा ने हमने अवश्य ही तकनीक और विज्ञान से और समृद्धता प्रदान की है परन्तु अपनी जड़ों को छोड़कर कोई विशाल वृक्ष भी पल्लवित और पुष्पित नहीं हो सकता। यदि लोक संस्कृतियों को हम अपनी संस्कृति की बुनियाद

कहें तो अतिशयोक्ति नहीं होगी। अत: बुनियाद के अभाव में किसी भी भवन का निर्माण व्यर्थ है, ऐसे निर्माण का कोई भविष्य नहीं। कजरी लोकगीतों का स्वरूप वर्तमान में काफी बदला है या यूँ कहें कि बदलते हुए परिवेश से हमारी कजरी भी प्रभावित हुई है।

ऋतु प्रधान लोकगायन की शैली कजरी का फिल्मों में भी प्रयोग किया जाने लगा है। हालाँकि हिन्दी फिल्मों में कजरी का मौलिक रूप कम मिलता है, किन्तु 1963 में प्रदर्शित भोजपुरी फिल्म 'बिदेसिया' में इस शैली का अत्यंत मौलिक रूप में प्रयोग किया गया। इस कजरी गीत की रचना अपने समय के जाने माने लोकगीतकार राममूर्ति चतुर्वेदी ने की थी और इसे संगीत बद्ध किया एस0एन0 त्रिपाठी ने। यह गीत महिलाओं द्वारा समूह में गाई जाने वाली टूनमुनिया कजरी की शैली में मौलिकता को बरकरार रखते हुए प्रस्तुत किया गया। इस कजरी गीत को गायिका गीता दत्त और कौमुदी मजूमदार ने अपने स्वरों से फिल्मों में कजरी के प्रयोग को मौलिक स्वरूप प्रदान किया था। इसके अतिरिक्त फिल्मी गीतों में कजरी शैली से प्रभावित होकर कई गीतों की रचना की गई।

देसी वाद्य यंत्रों के साथ गाई जाने वाली कजरी अब आधुनिक वाद्य यंत्रों के साथ गाई जा रही है। परन्तु हमारी इस लोकसंस्कृति की मौलिकता को बरकरार रखते हुए नए प्रयोग करने की आवश्यकता है ताकि आने वाली पीढ़ी इनके प्रति जागृत हो और अपनी संस्कृति और लोक परम्पराओं को अपनाए जिससे ये लोक परम्पराएँ युगों-युगों तक जीवित रह सकें।

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स्वामी विवेकानन्द की दृष्टि में मूल्य आधारित शिक्षा की उपादेयता : एक समीक्षात्मक विश्लेषण

डॉ. सत्येन्द्र श्रीवास्तव

"आप की दृष्टि में एक शिक्षित व्यक्ति वह है जो केवल कुछ परीक्षाएं पास कर अच्छे व्याख्यान देता हो। ऐसी शिक्षा जो जीवन के संघर्षों से जूझने हेतु जन-साधारण को सशक्त बनाने में मदद न करे, जो उनके चरित्र को मजबूत न बनाए, परोपकार की भावना न विकसित करे, सिंह जैसा साहस न पैदा करे क्या उसका कोई मूल्य है?" *स्वामी विवेकानन्द*, बेलूर मठ, 1898

"ऐसी शिक्षा जो अच्छे और बुरे में भेद करना न सिखाए, अच्छे को अपनाने और बुरे से दूर रहना न सिखाए, वह एक मिथ्या- शिक्षा (मिसनोमर) है।" *गाँधी*

19 वीं सदी के उत्तरार्द्ध में जिस विचारक के क्रांतिकारी विचारों ने पूरी दुनिया को प्रभावित किया और यह क्रम अभी भी जारी है, उनमें स्वामी विवेकानन्द सर्वप्रमुख हैं। उनके सरल किन्तु सारगर्भित विचार केवल मानव मस्तिष्क को ही प्रभावित नहीं करते बल्कि उसके हृदय पर भी अमिट छाप छोड़ते हैं। यद्यपि विवेकानन्द ने शिक्षा के ऊपर अलग से कोई पुस्तक नहीं लिखी लेकिन अपने जीवन के गहरे अनुभव के आधार पर उन्होंने विभिन्न व्याख्यानों में शिक्षा से संबन्धित जिन मुद्दों को उठाया, वे बेहद समीचीन हैं। सिस्टर निवेदिता अक्सर कहा करती थीं कि विवेकानन्द जो भी कहते या लिखते थे, वे पहले स्वयं उसका अनुभव करते थे। यही बात मूल्य-आधारित शिक्षा के सम्बंध में उनके विचारों पर भी लागू होती है।

'मूल्य' एक बहु-आयामी शब्द है, जिसके भीतर बहुत सारे नैतिक संप्रत्यय समाहित हैं जैसे ईमानदारी, सत्यनिष्ठा, कर्तव्य, आत्म-सम्मान, सभी के प्रति करुणा, मनुष्यता का उत्थान, महिलाओं और वंचितों के प्रति विशेष आदर-भाव इत्यादि। एक मूल्य-आधारित शिक्षा में ये सारे तत्व समाहित होते हैं, इनके अभाव में वह केवल कुछ सूचनाओं का संग्रहण, शुष्क विचार मात्र रह जाएगी। इसलिए, शुरू में ही यह जानना जरूरी है कि शिक्षा 'क्या नहीं है' उसके बाद ही हम 'शिक्षा क्या है' समझ पाएंगे। शिकागो, धर्म-संसद से वापस भारत लौटने के बाद अपने एक व्याख्यान 'द फ्युचर ऑफ इंडिया' में वे कहते हैं-

"शिक्षा सूचनाओं का संग्रहण मात्र नहीं, जो आपके मस्तिष्क में ठूँस दी जाती है और जहाँ वह जीवन पर्यत अपच रूप में पड़ी रहती है। .....यदि आपने पाँच विचारों को पढ़कर अपने जीवन-चरित्र में उतार लिया तो आप उस व्यक्ति से ज्यादा शिक्षित हैं, जिसने पूरी लाइब्रेरी रट रखी हो यथा खरश्चन्दन भारवाही भारस्य वेत्ता न तु चन्दनस्य। चन्दन के बोझ से लदे गधे को केवल उसका भार पता होता है, न कि मूल्य। यदि शिक्षा सूचनाओं का संग्रहण है तो पुस्तकालय दुनिया के सबसे बड़े मनीषी होते और विश्वकोश सबसे बड़े ऋषि।"[1]

इसी तरह का मत वे 23 दिसम्बर1898 को देवघर (वैद्यनाथ) से मृणालिनी बोस को लिखे पत्र 'आवर प्रेजेंट सोशल प्रॉब्लम्स' में व्यक्त करते हैं

"शिक्षा क्या है? क्या यह किताब याद करना है? नहीं। क्या यह ज्ञान की विविधता है? यह भी नहीं। एक ऐसा अभ्यास जिसके द्वारा संकल्प के आवेग और अभिव्यक्ति को नियंत्रित कर उन्हें उपयोगी बनाया जा सके, वह शिक्षा है। अब तक की शिक्षा में, पीढ़ियों से संकल्प को बलपूर्वक खत्म किया गया .. .... और मनुष्य धीरे धीरे मशीन बनता चला गया।"[2]

ये दोनों अभिव्यक्तियाँ बताती हैं कि 'शिक्षा क्या नहीं है'। दुर्भाग्य से इन्हें ही शिक्षा का असली अर्थ मान लिया गया। ऐसे में हमारे लिए शिक्षा का सही अर्थ जानना बेहद जरूरी है और यह भी कि हमें 'किस प्रकार की शिक्षा की जरूरत है'। शिक्षा के वास्तविक लक्ष्य की व्याख्या करते हुए 24 जनवरी 1898 को एक प्रश्न-उत्तर के दौरान विवेकानन्द कहते हैं

"हमें ऐसी शिक्षा चाहिए, जिससे चरित्र का निर्माण हो, मस्तिष्क की शक्ति में वृद्धि हो, बुद्धि का विस्तार हो और जिससे व्यक्ति अपने पैरों पर खड़ा हो सके।"[3]

विवेकानन्द की दृष्टि में मस्तिष्क का सशक्तीकरण और चारित्रिक दृढ़ता शिक्षा की अपरिहार्य विशेषताएँ हैं। इनके अभाव

डॉ. सत्येन्द्र श्रीवास्तव, सहायक प्रोफेसर, दर्शनशास्त्र विभाग, हंस राज कॉलेज।

में शिक्षा केवल किताबी ज्ञान और निजी स्वार्थ की पूर्ति तक सिमटकर रह जाएगी। उनकी इस सोच के बारे में उपन्यासकार प्रेमचंद ने मई 1908 में पत्रिका 'जमाना' में लिखा था

"स्वामी जी की शिक्षा का आधार प्रेम और शक्ति है। निर्भीकता उसका प्राण है और आत्म-विश्वास उसका धर्म है। उनकी शिक्षा में अनुनय-विनय के लिए तनिक भी स्थान नहीं है।"[4]

इस लक्ष्य की प्राप्ति के लिए विवेकानन्द शिक्षकों की भूमिका पर बहुत जोर देते हैं क्योंकि शिक्षक के कार्य-व्यवहार युवा मस्तिष्क पर बहुत गहरा असर डालते हैं। यह शिक्षक ही हैं जो विद्यार्थियों को किताबी और अकादेमिक ज्ञान के अलावा जीवन के कुछ बेहतरीन मूल्य बहुत सहज तरीके से सिखा सकते हैं, जो उन्हें जीवन-पर्यंत याद रहते हैं,न कि केवल परीक्षा के समय तक। इसके लिए शिक्षक का चरित्र भी उतना ही महत्त्वपूर्ण है, जितनी कि उसकी बौद्धिक प्रवीणता। जैसा कि भक्ति-योग में वे 'क्वॉलिफिकेशन्स ऑफ द ऐसपिरन्ट ऐंड द टीचर' के अंतर्गत लिखते हैं

"अक्सर यह सवाल पूछा जाता है 'हम शिक्षक के चरित्र और व्यक्तित्व को क्यों देखते हैं? हमें तो केवल यह देखना चाहिए कि वह क्या कहता है।' यह दृष्टिकोण सही नहीं है .... एक शिक्षक को पूर्णत: शुद्ध होना चाहिए, तभी उसके शब्दों का कोई मूल्य होगा।"[5]

फरवरी 1897 को 'मद्रास टाइम्स' में दिये एक साक्षात्कार में वे कहते हैं कि मूल्य आधारित शिक्षा के लिए शिक्षक की चारित्रिक उत्कृष्टता बहुत जरूरी है। उनका मत है

"शिक्षा की मेरी अवधारणा शिक्षक के साथ व्यक्तिगत संपर्क रखना है ..... शिक्षक की व्यक्तिगत सत्यनिष्ठा के बिना कोई शिक्षा नहीं हो सकती। अपने विश्वविद्यालयों को देखिये। अपने पचास साल के जीवन में उन्होंने क्या किया? वे केवल परीक्षण करने वाले यंत्र बन गए। आम आदमी के दुख के लिए त्याग की भावना अभी भी हमारे देश में विकसित नहीं हो पायी है।"[6]

इसी बात का समर्थन करते हुए महात्मा गांधी ने भी कहा था कि एक शिक्षक का शिक्षण-कार्य उसके नैतिक आचरण से अनिवार्यत: जुड़ा होता है। एक कायर शिक्षक अपने विद्यार्थियों को साहस का और एक अनियमित शिक्षक कभी भी समयबद्धता का महत्व नहीं सिखा पाएगा। अपनी आत्मकथा में वे लिखते हैं

"मेरे विचार में बच्चों को कभी भी साधारण शिक्षकों के हवाले नहीं करना चाहिए। उनका पुस्तकीय ज्ञान उनके नैतिक मूल्य जितना महत्वपूर्ण नहीं है।"[7]

22 अक्तूबर 1925 को 'यंग इंडिया' में गाँधी ने जिन सात सामाजिक पापों की चर्चा की थी, उसमें एक पाप 'चरित्र के बिना ज्ञान' भी है। इसी से हम समझ सकते हैं कि गाँधी के लिए चरित्र की क्या महत्ता थी। अपनी आत्म-कथा के खंड 'ऐज स्कूल मास्टर' में वे लिखते हैं—"मैंने हृदय के स्वभाव या चरित्र-निर्माण को सदैव पहला स्थान दिया है .....मैं चरित्र-निर्माण को शिक्षा की बुनियाद मानता हूँ और यदि बुनियाद पक्की रख दी जाए तो अन्य बातें या तो बच्चे खुद या फिर अपने मित्रों से सीख लेंगे।"[8]

शिक्षा का स्वरूप विस्तृत होना चाहिए, तभी वह जन-सामान्य की उन्नति में महत्वपूर्ण कारक सिद्ध होगी। यही कारण है कि विवेकानन्द शिक्षा के लोकतंत्रीकरण के बहुत बड़े हिमायती थे। उनके अनुसार शिक्षा केवल कुछ समृद्ध लोगों के अपने ही स्वार्थ की पूर्ति का साधन न बने अपितु इसका एक सामाजिक सरोकार होना चाहिए, जिसमें वंचित वर्ग का विकास जरूर शामिल हो। इसका उद्देश्य बिना किसी भेदभाव के समूची मानव-जाति का उत्थान हो। जैसा कि 1896 में लंदन के एक साक्षात्कार में वे कहते हैं—

"बौद्धिकता केवल कुछ सुसंस्कृत लोगों का एकाधिकार नहीं होना चाहिए, इसका प्रसार ऊपर से नीचे की ओर जरूर होना चाहिए।"[9]

इस पवित्र उद्देश्य की पूर्ति के लिए विवेकानन्द शिक्षित-वर्ग की जवाबदेही निर्धारित करना चाहते हैं। उनके अनुसार ये शिक्षित लोग, अशिक्षित और वंचित वर्ग के कल्याण के लिए कार्य करें, उनके पिछड़ेपन को दूर करके उन्हें समाज की मुख्य धारा में शामिल करें अन्यथा शिक्षा का पूरा उद्देश्य ही निष्फल हो जाएगा। नवम्बर 1894 में शिकागो से दीवान जी को लिखे पत्र में वे कहते हैं-

"मैं ऐसे व्यक्ति को विश्वासघाती कहूँगा जो शिक्षित होने के बाद, लाखों पीड़ित गरीबों के श्रम से विलासिता में पोषित होते हैं किन्तु उनके बारे में एक बार भी नहीं सोचते।"[10]

वस्तुत: हमारे देश की एक जो निरंतर समस्या रही है, उसमें हमने शिक्षा को कुछ अभिजात्य लोगों तक सीमित कर दिया और उनके लिए वह एक 'स्टेटस सिम्बल' बन गया। इन अभिजात्य लोगों ने अशिक्षित और गरीब लोगों को तिरस्कार की दृष्टि से देखा। यह मानसिकता मूल्य-आधारित शिक्षा के उस आदर्श के विपरीत है जो हर मनुष्य को समान दृष्टि से देखती है, जिसमें राजा-प्रजा, अमीरी-गरीबी, जाति, लिंग, सम्प्रदाय,धर्म का कोई विभेद नहीं होता। इस बात पर चिंता

व्यक्त करते हुए उन्होंने 24 अप्रैल 1897 को 'भारती' के संपादक सरला घोषाल को 'द एजुकेशन दैट इंडिया नीड्स' शीर्षक से दार्जिलिंग से लिखा—

"भारत की बर्बादी का एक प्रमुख कारण अहंकार और राजकीय सत्ता द्वारा ज्ञान और बौद्धिकता की इस धरती को कुछ मुट्ठी भर लोगों के हाथों में सीमित कर देना था। यदि हमें दुबारा उठना है..... तो शिक्षा का प्रसार जन-सामान्य तक करना होगा।[11]

स्पष्ट है कि शिक्षा को केवल कुछ विशिष्ट लोगों की निजी स्वार्थपूर्ति तक ही सीमित नहीं होना चाहिए अपितु इसका उद्देश्य जन-कल्याण होना चाहिए, इसे विचारों का संग्रह-मात्र नहीं अपितु जीवंत भी होना चाहिए, जिससे हर व्यक्ति का जुड़ाव हो। निश्चित रूप से बौद्धिकता और अच्छी नौकरी शिक्षा के महत्त्वपूर्ण पक्ष हैं लेकिन ये अनिवार्य पक्ष नहीं हैं। इसलिए इनकी प्राप्ति मनुष्यता और नैतिक मूल्यों की कीमत पर नहीं होनी चाहिए। मानवता का दर्जा हमेशा निजी धन-अर्जन और बौद्धिकता से ऊपर रहेगा। इतिहास साक्षी है कि जिन लोगों ने भी राष्ट्रीय और अंतर्राष्ट्रीय स्तर पर विकास के नए प्रतिमान गढ़े हैं वे बौद्धिक रूप से भले ही औसत रहे हों लेकिन नैतिक मूल्य और सत्यनिष्ठा की दृष्टि से उच्चकोटि के इंसान थे। अल्बर्ट आइन्सटीन ने जोर देकर कहा था - "अधिकांश लोग कहते हैं कि महान वैज्ञानिक बुद्धि से बनते हैं। वे लोग गलत हैं : यह काम चरित्र से संभव है।" प्रसिद्ध मानव-परोपकारी और व्यवसायी वारेन बुफे (1930 -) ने इस संबंध में बहुत महत्त्वपूर्ण बात कही है

"किसी व्यक्ति में तीन चीजें देखो बुद्धि, ऊर्जा और सत्यनिष्ठा। यदि उसमें सत्यनिष्ठा नहीं है तो पहले दो पर ध्यान ही मत दो।"[12]

यह एक स्थापित तथ्य है कि पढ़ा-लिखा किन्तु मूल्यविहीन व्यक्ति एक अनपढ़ किन्तु नैतिक व्यक्ति की तुलना में समाज के लिए ज्यादा खतरनाक है। हम लोगों को स्कूल के दिनों में पढ़ाया गया था कि एक भूखा और अनपढ़ व्यक्ति मालगाड़ी से केवल कुछ किलोग्राम अनाज चुराएगा लेकिन नैतिकता से रहित विश्वविद्यालय का टॉपर पूरी मालगाड़ी ही उड़ा देगा। शिक्षित व्यक्ति के इस विरोधी प्रवृत्ति के सम्बंध में मार्टिन लूथर किंग जूनियर ने 1948 में अपने स्नातक की पढ़ाई के समय, मोरहाउस कॉलेज, अटलांटा के 'स्टूडेंट पेपर' में 'द पर्पज ऑफ एजुकेशन' शीर्षक से लिखा था-

"शिक्षा का उद्देश्य लोगों को गहन और आलोचनात्मक चिंतन के लिए तैयार करना है। लेकिन ऐसी शिक्षा जो कार्य-कुशलता के साथ समाप्त हो जाए वह समाज के लिए एक बहुत बड़ा खतरा सिद्ध होगी। नैतिकता के अभाव में बुद्धि से श्रेष्ठ व्यक्ति सबसे खतरनाक अपराधी हो सकता है।..... हमें यह अवश्य ध्यान रखना होगा कि बुद्धि ही पर्याप्त नहीं है। सच्ची शिक्षा का उद्देश्य है - बुद्धि और चरित्र।"[13]

संदेश साफ है! यह मूल्य आधारित शिक्षा ही है जो समाज से अनैतिक और भ्रष्ट मूल्यों को दूर कर एक बेहतरीन समाज का निर्माण कर सकती है। हम सभी जानते हैं कि आज के समय का सबसे बड़ा संकट पैसे या प्राकृतिक संसाधनों का नहीं अपितु मूल्यों की विकृति का संकट है। और इससे निपटने में मूल्य-आधारित शिक्षा ही सबसे कारगर हथियार है। यह मूल्य आधारित शिक्षा ही है जो 'स्व' और 'पर' में भेद करना नहीं सिखाती तथा व्यक्ति के व्यक्तित्व के सभी पक्षों नैतिक, भावनात्मक और बौद्धिक को समान महत्त्व देती है। दूसरे शब्दों में हृदय की पवित्रता मस्तिष्क की कुशाग्रता जितनी ही महत्त्वपूर्ण है। जैसा कि 27 अक्टूबर 1896 को लंदन के अपने व्याख्यान में स्वामी जी कहते हैं

"हम मस्तिष्क और हृदय का संयोजन चाहते हैं। अवश्य ही हृदय महान है। हृदय के माध्यम से जीवन की महत्वपूर्ण प्रेरणाएं आती हैं। मैं हजार बार एक छोटे हृदय और बिना मस्तिष्क वाला व्यक्ति होना पसंद करूंगा बजाए हृदय-रहित एक विशाल मस्तिष्क के। जीवन, प्रगति उसी के लिए संभव है जिसके पास हृदय है ,जो बिना हृदय केवल मस्तिष्क वाला है , वह शुष्कता में ही मर जाता है।"[14]

इसे और स्पष्ट करते हुए लंदन के एक अन्य व्याख्यान 'वेदान्त ऐंड प्रिविलेज' में वे कहते हैं-

"भगवान और शैतान के बीच का अंतर और कुछ नहीं है सिवाए नि:स्वार्थ और स्वार्थ के। शैतान भी भगवान जितना ही ज्ञानी और शक्तिशाली है, बस उसमें पवित्रता नहीं है। यही चीज आधुनिक दुनिया में भी लागू होती है : बिना पवित्रता के ज्ञान और शक्ति की अधिकता ने इंसान को शैतान बना दिया।"[15]

इसलिए सच्ची शिक्षा का अर्थ मानव-जीवन का सर्वांगीण शारीरिक, मानसिक, नैतिक और आध्यात्मिक विकास है। एक आदर्श शिक्षा व्यवस्था इनमें से किसी की भी उपेक्षा नहीं कर सकती। एक बेहतरीन शिक्षा मन, शरीर और आत्मा में एक बेहतरीन सामंजस्य की प्रस्तावना करती है। आधुनिक मनोविज्ञान भी इस तथ्य को मानता है कि मनुष्य एक समग्र प्राणी है, उसके जीवन में किसी एक पक्ष पर जरूरत से ज्यादा ध्यान देने और दूसरे की उपेक्षा करने से उसका व्यक्तित्व विखंडित हो जाता है।

यहाँ एक स्पष्टीकरण आवश्यक है। किसी को यह

गलतफहमी नहीं होनी चाहिए कि विवेकानन्द वैज्ञानिक और तकनीकी शिक्षा के विरोधी थे और मूल्य आधारित शिक्षा के लिए उन्होंने इनकी तिलांजलि दे दी। वे वैज्ञानिक और तकनीकी ज्ञान के महत्व को बखूबी जानते थे। उनकी चिंता केवल इस बात को लेकर थी कि इन्हें पाने के प्रयास में मनुष्य कहीं मानवीय अस्मिता को ही न खो दे।[16] यदि हम आज के शैक्षणिक संस्थानों पर नजर डालें तो पाएंगे कि वे बहुत बड़ी संख्या में सॉफ्टवेयर इंजीनियर,अधिकारी, डॉक्टर, प्रोफेसर, वकील, फिल्मकार, खिलाड़ी, खेल-विशेषज्ञ, सीए, सीएस, मीडिया-विशेषज्ञ इत्यादि पैदा कर रहे हैं। लेकिन विडम्बना देखिये कि अच्छी आर्थिक स्थिति होने के बावजूद इनमें से ज्यादातर लोग अपने गलत जीवन-मूल्य, उपभोक्तावादी जीवन-शैली के कारण एक मानसिक त्रासदी से गुजर रहे हैं। वे अपनी योग्यता के कारण अपने-अपने क्षेत्र में अच्छे सिद्ध हो रहे हैं, लेकिन क्या वे अच्छे इंसान हैं? यही वह प्रश्न है जिसका जवाब हमारे शैक्षणिक संस्थानों, नीति-निर्माताओं और परिवार के सदस्यों को सोचना है। पैकेज आधारित शिक्षा-व्यवस्था ने उनकी नैतिक अंत:चेतना को खोखला कर दिया है। ये अपने पारिवारिक जीवन में बिखरे और मानसिक सुकून को तरसते हुए लोग हैं। निश्चित रूप से वे अपने पूर्वजों की तुलना में ज्यादा 'बुद्धिमान' और 'आत्म-विश्वासी' हैं, लेकिन समस्या यह है कि इतनी प्रतिभा और आर्थिक-आत्मनिर्भरता के बावजूद अपने चरित्रबल में वे बहुत कमजोर हैं। विवेकानन्द की दूरदृष्टि ने इस समस्या को 130 साल पहले ही पहचान लिया था, इसलिए उन्होंने धन-अर्जन के बजाए चरित्र-निर्माण को शिक्षा का उद्देश्य माना था। अपने व्याख्यान 'द फ्युचर ऑफ इंडिया' में वे कहते हैं -

"हमें जीवन का निर्माण करने वाले, मनुष्यता को बनाने वाले और चरित्र-सृजन करने वाले विचारों की अत्यंत आवश्यकता है।"[17]

शिक्षा से संबन्धित कोई भी विचार तब तक सम्पूर्ण नहीं हो सकता,जब तक वह महिलाओं की स्थिति पर बात न करे। महिलाओं का सशक्तीकरण विवेकानन्द की मूल्य-आधारित शिक्षा व्यवस्था का एक अपरिहार्य पक्ष रहा है। वे महिलाओं, विशेषकर भारतीय महिलाओं की दयनीय स्थिति से काफी चिंतित थे। 23 सितंबर 1893 को शिकागो में मिस पॉटर पाल्मर द्वारा आयोजित एक कार्यक्रम 'विमिन ऑफ द ईस्ट' में वे कहते हैं 'किसी राष्ट्र की प्रगति जाँचने का सबसे अच्छा पैमाना है - महिलाओं के प्रति इस राष्ट्र के लोगों का व्यवहार।'[18] इसे और स्पष्ट करते हुए 1895 में वे अपने भ्राता-भिक्षु शशि को लिखते हैं

"जब तक महिलाओं की स्थिति में सुधार नहीं होता,तब तक दुनिया के कल्याण की कोई संभावना नहीं है। किसी चिड़िया के लिए एक पंख से उड़ना संभव नहीं।"[19]

विवेकानन्द के अनुसार यह शिक्षा ही है, जिसके द्वारा महिलाओं की स्थिति में सुधार होगा। दिसम्बर 1898 को 'प्रबुद्ध भारत' में दिये एक साक्षात्कार 'ऑन इंडियन विमिन -देयर पास्ट, प्रेजेंट ऐंड फ्युचर' में वे कहते हैं-

"नि:संदेह उनके पास बहुत सी और गंभीर समस्याएं हैं, लेकिन उनमें ऐसा एक भी नहीं है जो जादुई शब्द 'शिक्षा' से दूर न हो सके।"[20]

मूल्य-आधारित शिक्षा के संबंध में एक जो सर्वाधिक महत्वपूर्ण बात है- इन मूल्यों का नियमित अभ्यास जिससे कि वे हमारे चरित्र में आत्मसात हो सकें। हम अक्सर उद्धृत करते हैं कि 'ज्ञान शक्ति है'। जबकि वास्तव में ज्ञान केवल 'संभाव्य शक्ति' है। यह 'वास्तविक शक्ति' तभी बनती है जब हम दैनिक जीवन में उस ज्ञान का अभ्यास कर उसे अपने चरित्र का अनिवार्य हिस्सा बना लें। इतिहास साक्षी है कि केवल अच्छी किताब पढ़कर शायद ही किसी ने दुनिया के ऊपर कोई अमिट छाप छोड़ी हो। यह उन विचारों का अभ्यास और अनुप्रयोग था जिसने मानव इतिहास में अंतर पैदा किया। जैसा कि 'राज-योग' के अध्याय दो- 'द फर्स्ट स्टेप्स' में विवेकानन्द लिखते हैं—

"अभ्यास अनिवार्यत : जरूरी है। आप यहाँ बैठकर मुझे प्रतिदिन घंटों सुनते रहें, किन्तु यदि आप अभ्यास नहीं करेंगे तो आप एक कदम भी आगे नहीं बढ़ पाएंगे। सब कुछ अभ्यास या कार्य-व्यवहार पर निर्भर करता है। हम इन बातों को कभी भी नहीं समझ पाएंगे यदि हम उनका अनुभव नहीं करेंगे। हमें इन्हें समझना और अपने लिए महसूस करना होगा।"[21]

मूल्य-आधारित शिक्षा के संबंध में कुछ विदेशी चिंतकों ने भी बहुत सारगर्भित विचार व्यक्त किए हैं। हार्वर्ड विश्वविद्यालय में दिये गए अपने प्रसिद्ध व्याख्यान में जब अमेरिकी कवि आर डब्लू इमर्सन (1803-1882) ने कहा कि 'चरित्र का स्तर बुद्धि से ऊँचा होता है।'[22] तो युवा-मस्तिष्क पर इस सूत्र ने एक अमिट छाप छोड़ी। यहाँ उन्होंने बौद्धिक मूल्य के बजाय नैतिक मूल्य के विकास पर ज्यादा जोर दिया। इस व्याख्यान में इमर्सन ने मानवीय सद्गुणों की स्थापना पर पुन: जोर दिया, जिसकी प्रस्तावना अरस्तू ने ईसा पूर्व चौथी शताब्दी में अपनी पुस्तक 'द निकोमियन एथिक्स' में की थी किन्तु जिसे बाद के नीतिशास्त्र की दो मुख्य धाराओं परिणाम-निरपेक्षवाद (कांट) और परिणाम-सापेक्षवाद (बेंथम और जे एस मिल) ने जाने-अनजाने उपेक्षित कर दिया था। इस पुस्तक में अरस्तू ने दो तरह के

सद्गुणों नैतिक (साहस, उदारता, न्याय, मित्रता) और बौद्धिक (प्रज्ञा, अंतर्विवेक, कला) की व्याख्या की और मानव के समग्र विकास हेतु दोनों को ही महत्वपूर्ण माना।[23] बेंजामिन फ्रेंकलिन ने अपनी आत्मकथा में जिन तेरह सद्गुणों[24] (संयम, मौन, क्रमबद्धता, दृढ़-संकल्प, मितव्ययिता, समय की अहमियत, सच्चाई, न्याय, लचीलापन, स्वच्छता, शांत-चित्त, शुचिता और विनम्रता) के बारे में बात की उनमें लगभग सभी सद्गुण नैतिक हैं न कि बौद्धिक या आर्थिक। अब्राहम लिंकन ने अपने पुत्र के स्कूल-शिक्षक को जो पत्र लिखा था, वह तो मूल्य-आधारित शिक्षा के लिए एक आदर्श घोषणा-पत्र की तरह है। इस पत्र की अभिव्यक्तियाँ जैसे 'प्रिय शिक्षक, उसे पढ़ाएं कि हर शत्रु के बदले एक मित्र होता है, हर स्वार्थी राजनेता के बदले एक समर्पित नेता होता है। उसे ईर्ष्या से दूर रहना सिखाएं। इसमें समय लगेगा, मुझे पता है कि ज्यादा समय लगेगा, फिर भी यदि आप उसे पढ़ा सकते हैं तो पढ़ाएं कि कमाया हुआ एक डॉलर, पाये हुए पाँच डॉलर से ज्यादा कीमती है ..... उसे पढ़ाएं कि अपने शारीरिक और मानसिक शक्ति को तो वह ऊँचे दामों पर बेचे किन्तु अपनी अंतरात्मा का कभी कोई सौदा न करे।..... उसे पढ़ाएं कि गुस्सायी भीड़ के समक्ष साहस के साथ अकेले कैसे खड़ा हुआ जाता है। उसे प्यार से समझाएं किन्तु ज्यादा दुलारे नहीं क्योंकि अग्नि की आँच पर ही लोहा फौलाद बनता है।'[25], किसी भी विद्यार्थी के चरित्र को तराशने में बेहद सहायक हो सकती हैं।

मूल्य-आधारित शिक्षा के सम्बंध में एक शिक्षक का सबसे बड़ा दायित्व यह है कि वह विद्यार्थियों की ऐसी पीढ़ी तैयार करे जो कक्षा में ही नहीं अपितु कक्षा से बाहर की समस्याओं का भी साहस और आत्म-विश्वास से मुकाबला करे क्योंकि जीवन की असली परीक्षा तो तब होती है जब विद्यार्थी कॉलेज, विश्वविद्यालय की पढ़ाई पूरी कर व्यावहारिक जीवन की चुनौतियों से दो-चार होता है। जीवन की रण-भूमि में उसके किताबी-ज्ञान या प्रमाण-पत्र से ज्यादा महत्व उसके नैतिक मूल्य का होता है। जीवन की विषम-परिस्थितियों में साहस ही उसका सबसे बड़ा मित्र होता है। साहस के मूल्य को भारत के मशहूर वैज्ञानिक ए.पी.जे. अब्दुल कलाम[26] ने भी बहुत महत्वपूर्ण माना है क्योंकि साहस के अभाव में आप अन्य नैतिक मूल्यों का पालन निरंतरता के साथ नहीं कर पाएंगे। मूल्य-आधारित शिक्षा के संबंध में यह भी जानना महत्त्वपूर्ण है कि बच्चों के माता-पिता की भी इसमें बहुत बड़ी भूमिका होती है क्योंकि अपने नवनिर्माण-काल में बच्चे बहुत सारे मूल्य जाने-अनजाने अपने घर पर माता-पिता से ही सीखते हैं, इसके बाद शिक्षक की महत्वपूर्ण जिम्मेदारी होती है। स्पेन के दार्शनिक जॉर्ज सांटायना ने तो यहाँ तक कह दिया था कि केवल स्कूल में शिक्षित बच्चा वस्तुतः अशिक्षित है।[27]

निष्कर्ष रूप में हम कह सकते हैं कि आज के शिक्षा-तंत्र की सबसे बड़ी समस्या इसका मनुष्य के बौद्धिक विकास पर अत्यधिक जोर देना है, यहाँ तक कि मानवीय मूल्यों की कीमत पर। हम इस बात को नहीं समझ पाए और न ही दूसरों को समझा पाए कि एक 'अच्छा मनुष्य' होना एक 'शिक्षित व्यक्ति' होने की तुलना में ज्यादा आवश्यक है। अशिक्षित होना एक सभ्य समाज के लिए समस्या हो सकती है किन्तु अनैतिक होना तो पूरी दुनिया के लिए एक त्रासदी है। आज का हर समझदार व्यक्ति शिक्षा के इस विपथगमन से बहुत चिंतित है। आधुनिक विज्ञान और तकनीक के विकास ने ज्यादातर मनुष्यों को संवेदनशून्य बना दिया। उपभोक्तावाद के अति-लोभ ने अधिकांश लोगों को भौतिक वस्तु में रूपांतरित कर दिया, तभी तो ए पी जे कलाम को कहना पड़ा कि 'वी हैव गाइडेड मिसाइल्स बट मिस्गाइडेड ह्यूमन बीइंग्स'। व्यक्ति की आजीविका के लिए नौकरी शिक्षा का एक पक्ष थी, लेकिन विडम्बना देखिये कि उसे ही शिक्षा का अंतिम लक्ष्य मान लिया गया। अपनी पारखी दृष्टि से विवेकानन्द इन समस्याओं को वर्षों पहले ही समझ गए थे, इसलिए अपने लेखों व व्याख्यानों के माध्यम से उन्होंने इस खतरनाक प्रवृत्ति पर नियंत्रण लगाकर मनुष्य के समग्र विकास की बात की। उनके अनुसार 'सभी मनुष्य इस तरह से संरचित हैं कि उनके मन में दर्शनशास्त्र, रहस्यवाद, भावना और कर्म सभी समान रूप से विद्यमान हैं। यही लक्ष्य है, यही मेरे पूर्ण मनुष्य का लक्ष्य है।'[28] उल्लेखनीय है कि 1972 में प्रकाशित यूनेस्को की रिपोर्ट 'लर्निंग टू बी' में शिक्षा के उद्देश्य के सम्बन्ध में जो रूपरेखा तैयार की गयी थी, वह विवेकानन्द के इसी 'पूर्ण मनुष्य' की प्रतिध्वनि थी। रिपोर्ट में कहा गया कि 'शिक्षा के आधारभूत लक्ष्य की व्यापक परिभाषा के अनुसार एक व्यक्ति के भौतिक, बौद्धिक, भावनात्मक और नैतिक रूप से पूर्ण मनुष्य में समन्वीकृत होना ही शिक्षा है।'[29] अब जवाबदेही हम पर है कि हम मूल्य-आधारित शिक्षा के द्वारा उनके इस पूर्ण मनुष्य के लक्ष्य को साकार करें।

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भाषाई अस्मिता और हिन्दी का राष्ट्रीय संदर्भ

डॉ० जितेश कुमार

विभिन्न कोशों से इतर यदि 'अस्मिता' का वर्तमान प्रचलित अर्थ देखा जाए तो यह 'पहचान' है या 'आइडेंटिटी' है। हिन्दी साहित्य में 1950 के बाद 'अस्मिता' के अहंकारवाले अर्थ का अचानक परिवर्तन हो जाता है। आज हिन्दी क्षेत्र में अस्मिता का सवाल या उसका संकट क्रमशः पहचान का सवाल या उसका संकट ही है।

वर्तमान में व्यक्ति और उससे निर्मित समाज को अस्मिता प्राप्ति के लिए लगातार संघर्ष करना पड़ रहा है। अस्मिता का प्रश्न जहाँ उलझता नजर आता है वहीं उसे प्राप्त करना तो और भी कठिन प्रतीत होता है। वास्तव में अस्मिता, व्यक्ति या समाज को खुद को प्रकट करना है। सामाजिकता के विभिन्न स्तरों में व्यक्ति स्वयं को कहाँ स्थापित पाता है? इसकी संरचना ज्ञात करना ही अस्मिता है। साहित्यिक क्षेत्र में अस्मिता विभिन्न चीजों के साथ जुड़कर अपना अलग अर्थ व्यक्त करती है। नारी के साथ जुड़कर नारी अस्मिता, राष्ट्र से जुड़कर राष्ट्रीय अस्मिता, भाषा के साथ भाषाई अस्मिता, भारत के साथ जुड़कर भारतीय अस्मिता आदि। वर्तमान में अस्मिता की अवधारणा समय की मांग है। इसके पीछे यह कहना उचित होगा कि जब-जब अस्मिता खतरे में पड़ती है,उसे लेकर विचार-विमर्श करना आवश्यक हो जाता है।

भाषा के संदर्भ में अस्मिता का रूप राष्ट्रीय हो जाता है। भाषा की ताकत सर्वोपरि है। इसमें जोड़ने और तोड़नेवाली दोनों ही शक्तियाँ है। वास्तव में इसके पीछे जो समस्या है, वह है-सामाजिक अस्मिता। समाज में भाषा पूरी तरह से भावनात्मक होती है। इसी भावना के आधार पर यदि वह एकता का कारण है तो दूसरे समुदायों से अलग होने का कारण भी बनती है। रवींद्रनाथ श्रीवास्तव के शब्दों में "भाषा की विघटनकारी शक्ति अगाध है,इसीलिए इसे गोली भरे बंदूक की तरह इस्तेमाल करना भी संभव है।"[1]

भाषा स्वयं में मुक्त है। समाज उसके साथ सतत रूप से जुड़ा रहता है। "भाषा स्वयं में धार्मिक या अधार्मिक नहीं हुआ करती, न ही उसकी व्याकरणिक व्यवस्था में जातीयता का कोई पुट मिला हुआ करता है। उसको धार्मिकता या जातीयता के रंग में रंगने का काम उसके प्रयोगकर्ता किया करते हैं।"[2] चूँकि भारत एक बहुभाषी और बहुसांस्कृतिक देश है। इसीलिए हमारी सामाजिक अस्मिता और भाषाई अस्मिता भी अलग-अलग है। 1652 मातृभाषाओं, 200 वर्गीकृत भाषाओं और 10 लिपियों का प्रयोगकर्ता भारत, की अस्मिता भी अलग होना स्वाभाविक ही है।

यदि हम हिन्दी की बात करें तो राष्ट्रीय दृष्टि से यह अनेकता में एकता की गुजारिश करती है। हिन्दी भाषा की व्यापकता और व्यवहार क्षमता का अनुमान इस बात से ही लगाया जा सकता है कि इसे मातृभाषा के रूप में बोलनेवालों की संख्या सर्वाधिक है वहीं अन्य भाषा के रूप में भी इसे व्यवहार करनेवाले अधिक हैं। हिन्दी की अस्मिता आज अधिक सुदृढ़ है। इस बाबत श्रीवास्तवजी भी मानते हैं- "इस बात पर बल देने की आवश्यकता है कि हिन्दी के जनपदीय संदर्भ के आधार पर केवल उसकी विभिन्न बोलियों के प्रयोक्ता ही अपनी सामाजिक एवं सांस्कृतिक एकता का अनुभव नहीं करते,वरन विभिन्न क्षेत्रीय भाषाभाषियों को भी इसमें सामाजिक संस्कृति और सर्वसामान्य आचार-विचार का संस्कार प्राप्त होता है।"[3]

आज जबकि देश में सामाजिक गतिशीलता बढ़ती जा रही है, उस स्थिति में किसी एक भाषा को बरकरार रख पाना किसी के लिए भी चुनौती ही है। छोटी-छोटी भाषाओं के साथ हिन्दी का सामंजस्य न केवल आवश्यक है,बल्कि काफी महत्वपूर्ण भी है। सही तो यही है कि हिन्दी और अन्य राष्ट्रीय भाषा को खंडित करने की कोशिश नहीं होनी चाहिए। चूँकि देश में भाषायी विविधता है इसीलिए हर भाषा की आंतरिक अखंडता

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के.बी. झा कॉलेज, कटिहार

भी है। भाषा के साथ राजनीति के घालमेल से उसमें संकीर्णता का आ जाना स्वाभाविक है। राजनीतिक स्वार्थ और क्षेत्र की राजनीति करनेवाले भाषा को अस्मिता का प्रश्न बनाने से चूकते नहीं हैं। भारत में राज्यों का पुनर्गठन इसका प्रमाण है कि भाषा की अस्मिता कितनी प्रबल है।

हिन्दी क्षेत्र में आज हिन्दी के समक्ष अस्मिता का संकट आ पड़ा है। इस क्षेत्र में यह सभी को सामाजिक रूप से जोड़नेवाली भाषा के रूप में स्थापित नहीं हो पाई है। शंभुनाथजी के शब्दों में-"हिन्दीवालों को हिन्दू या मुसलमान होने में,ब्राह्मण,क्षत्रिय,यादव या दलित होने में, मर्द होने में, किसी खास जिले का होने में, जनेऊ और मूँछ रखने में गर्व है। उनमें हिन्दी होने का जातीय अहसास प्रभेदों में फँसे होने की वजह से पनप नहीं पाया है। वे छोटे-छोटे स्वार्थों की वजह से सामुदायिक झुंडों में बंटे हैं और एक-दूसरे के प्रति घृणा से भरे हुए हैं।"[4]

हिन्दी क्षेत्र यद्यपि समवेशी है,लेकिन उसमें स्थानीय विविधता है। संकीर्णताएँ भी हैं, लेकिन उदारवादी होने के प्रमाण भी मौजूद हैं। यहाँ शम्भुनाथजी के शब्दों को समझना और भी आवश्यक हो जाता है। जब वे लिखते हैं-"हिन्दी क्षेत्र में आजकल धार्मिक,जातिवादी और स्थानीय कूपमंडूकता ही नहीं बढ़ने लगी है, अंग्रेजी मिजाज और पश्चिम का अंधानुकरण भी तेजी से बढ़ रहा है। अब अंग्रेजी से रंगी-पुती हिन्दी माँएँ अपने दो-तीन साल के बच्चे से सिर्फ अंग्रेजी में बात करती है,उसके पास मातृभाषा के शब्द फटकने नहीं देती।"[5]

हिन्दी क्षेत्र के लोगों को सर्वप्रथम यह समझना आवश्यक होगा कि हिन्दी की उन्नति न केवल क्षेत्रीय उन्नति है, बल्कि राष्ट्र की तरक्की और सुधार के लिए भी हिन्दी की जरूरत है। हिन्दी आज राष्ट्रीय अस्मिता का सबसे मजबूत आधार है। हिन्दी राजभाषा से अधिक संपर्क भाषा के रूप में अपनी पहचान बना चुकी है। इस अर्थ में जब भाषाई अस्मिता की बात स्वीकार करनी हो, तो हिन्दी आज जिस स्थान पर खड़ी है, उसके सामने अन्य भाषा बौनी हैं।

भाषाई अस्मिता के स्वरूप को समझना हिन्दी क्षेत्र के लिए बहुत आवश्यक है। हम प्रत्येक चार वर्ष पर विश्व हिन्दी सम्मेलन करते हैं। हिन्दी को बढ़ावा देने का संकल्प लिया जाता है। बताया जाता है कि यह विश्वभाषा बनने की ओर अग्रसर है। लेकिन हिन्दी क्षेत्र की नयी पीढ़ी इसे मानने से इंकार कर देती है। उन्हें हिन्दी में अधिक रुचि नहीं रह गई है। इस क्षेत्र में शिक्षा का माध्यम अब अंग्रेजी होती जा रही है। हिन्दी में हमारा जो भावनात्मक लगाव होना चाहिए, वह बन नहीं पा रह है। आधुनिक पीढ़ी को भाषाई अस्मिता का अहम नहीं रह गया है। वैश्वीकरण के परिवेश में उसे अंग्रेजी अधिक भा रही है। इसके लिए न केवल व्यक्ति,बल्कि संस्था और समुदाय सभी जिम्मेदार हैं।

सिनेमा, मीडिया और मनोरंजन की दुनिया में हिन्दी का एक नया रूप सामने आ रहा है और इसी भरोसे हिन्दी क्षेत्र के लोग इतरा भी रहे हैं कि हिन्दी का वर्चस्व बढ़ रहा है। इस बाजार के प्रभाव में हिन्दी की चाल मस्त हाथी की तरह है। यदि हिन्दी का प्रभाव बढ़ा ही है, तो यह सोचने की बात सामने क्यों आती है कि हिन्दी की राष्ट्रीय और सामाजिक ताकत लगातार घटती जा रही है? हम हिन्दी के भरोसे अनुसंधान नहीं कर पा रहे हैं, बहस नहीं कर सकते हैं, राजनयिक वार्ताएं और दफ्तर तो चल ही नहीं सकती हैं। यहाँ शंभुनाथजी मानते हैं- "आज अक्सर किसी भाषा की ताकत की पहचान इससे की जाती है कि वह बाजार में कितनी दौड़ सकती है। इसमें संदेह नहीं कि आज बाजार में हिन्दी का एक दमकता रूप है। कहा भी जाता है कि हिन्दी बाजार में पैदा हुई, बाजार में पली-बढ़ी। हम आत्मनिरीक्षण कर सकते हैं कि क्या इस हिन्दी को बाजार की सूचनात्मक और चुलबुली भाषा के रूप में पाकर संतुष्ट हैं या संवेदना और ज्ञान की भाषा के रूप में इसकी कमजोर स्थिति देखकर विचलित हैं। किसी भाषा के साथ सबसे बड़ा विश्वासघात उसे सूचना और मनोरंजन की भाषा में सीमित कर देना है।"[6]

राष्ट्रीय संदर्भ में आज हिन्दी की अस्मिता उर्दू और अंग्रेजी से भी जुड़ी हुई है। बीसवीं सदी के आरंभ से ही लगातार हिन्दी भाषा को अपनी अस्मिता प्रकट करनी पड़ी है। आज जबकि प्रौद्योगिकी अपने चरम पर है तो भाषा के विकास की रफ्तार भी तेज है। लेकिन इसमें भाषा का सम्मिश्रण भी होता जा रहा है। हिन्दी के साथ भी लगभग यही स्थिति है। उचित-अनुचित से इतर हमें हिन्दी के शब्द भंडार को बढ़ाने के लिए अन्य भाषा के शब्दों को भी समाहित करने से गुरेज नहीं करना चाहिए। वहीं शंभुनाथ जी इस बात से असहमत हैं। वे मानते हैं कि "हिन्दी में अंग्रेजी के शब्दों की धड़ल्ले से मिलावट, पश्चिमी चटपटेपन और तेज गति का बुरा असर अब सामाजिकता और पारिवारिक भावनाओं पर भी दिखने लगा है। अंग्रेजी की संस्कृति या पॉप संस्कृति एक मनुष्य को दूसरे मनुष्य का दु:ख-दर्द महसूस करने नहीं देती। अपनी मातृभाषा छोड़नेवाले या उससे धीरे-धीरे दूर हटकर अंग्रेजी अपना लेनेवाले व्यक्ति रिश्ते-नातों का अहसास खोने लगते हैं। यही वजह है कि अब रिश्ते-नाते रूखे और औपचारिक हो उठे हैं।"[7] लेकिन यह कहना उचित नहीं होगा कि इस अपसंस्कृति में किसी भाषा का योगदान है। भाषा हमारे व्यवहार को कैसे बदल सकती है? क्या कोई हिन्दी बोलना शुरू

कर दे तो उसका सम्पूर्ण परिष्करण हो जाएगा? ऐसा नहीं है। हमने अन्य संस्कृति की बुरी चीजों को अपनाना शुरू कर दिया है। यही मूलभूत कारण है। आज हिन्दी को छोड़ने और अंग्रेजी को अपनाने से हमारा सामाजिक स्टेटस स्वीकार किया जा रहा है। यही हिन्दी की सबसे बड़ी कमजोरी है।

हिन्दी के अस्तित्व को समझना बिलकुल आसान है। लेकिन यह चिंता का विषय है कि हिन्दी की पहचान कई बुद्धिजीवी हिन्दू राष्ट्रवाद से जोड़ लेते हैं। हिन्दी का साहित्य इस बात का गवाह है कि हिन्दी कभी भी धर्म से नहीं जुड़ी है। हिन्दी, भाषा के रूप में समस्त भारत की जाति का बोध कराती है। इसके लिए हिन्दीभाषी को भी गर्व अनुभव करना होगा। विभिन्न स्थितियों को समझते हुए उससे सामंजस्य बनाना होगा। सारत: हिन्दी की अस्मिता न केवल हिन्दीपट्टी की भाषाई अस्मिता है बल्कि देश की उन्नति की बड़ी अस्मिता है।

संदर्भ

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कोरोना काल रंगमंच का अकाल

कपिल कुमार

वर्ष 2020 को यदि कोरोना वर्ष के नाम से संबोधित किया जाए तो शायद इस नामकरण से किसी को आपत्ति नहीं होगी। इतिहास के पन्नों पर यह वर्ष इतनी पक्की रोशनाई से छापा जाएगा कि जब तक मानव जाति का अस्तित्व रहेगा तब तक इसकी गाथा पूरे विश्व में गायी जाएगी। इस गाथा में हर्षोल्लास नहीं बल्कि सामूहिक रूदन का स्वर होगा।

कोरोना ऐसी वैश्विक महामारी के रूप में विश्व के सामने परिचित हुआ जिसने आम आदमी के जीवन में उथल-पुथल मचा दी। इस बीमारी के उपचार हेतु दवा के अभाव में विभिन्न देशों की सरकारों द्वारा राष्ट्र की तमाम गतिविधियों पर रोक लगा दी गई जिससे साधारण जनमानस की दिनचर्या पर गहरा असर पड़ा अथवा कहा जा सकता है कि उनके जीवन का प्रवाह ही थम गया। आम भाषा में इसे 'लॉकडाउन' की संज्ञा दी जाती है। कई अन्य विकसित देशों की भांति ही भारत में भी लॉकडाउन लागू किया गया जिसके पहले चरण की शुरूआत मंगलवार 24 मार्च, 2020 की मध्यरात्रि से हुई।[1]

इस लॉकडाउन के चलते देश की अर्थव्यवस्था डगमगाने लगी। साथ ही साथ जहां एक ओर इसने शैक्षिक, सामाजिक, सांस्कृतिक, व्यावसायिक इत्यादि क्षेत्रों को व्यापक रूप से प्रभावित किया, वहीं दूसरी ओर साहित्यिक जगत की इमारतों का निर्माण कार्य भी अवरुद्ध कर दिया। कोरोना काल में साहित्य की जिस विधा के स्वास्थ्य पर सबसे ज्यादा असर पड़ा, वह है- नाटक अथवा रंगमंच। नाटक पर सबसे ज्यादा प्रभाव पड़ने का एक कारण उसका अन्य साहित्यिक विधाओं से भिन्न होना भी है। इस संबंध में डॉ. अमरनाथ लिखते हैं कि ''साहित्य की दूसरी विधाओं में रचनाकार वर्णनात्मक, चित्रात्मक, एवं संगीतात्मक भाषा के जरिए ही विषयवस्तु को प्रकट करता है, किंतु नाटक में अभिनय के जरिए विषयवस्तु को प्रत्यक्ष घटित होते हुए दिखलाया जाता है। इसी अर्थ में नाटक, साहित्य की अन्य विधाओं से भिन्न है।''[2]

यह सर्वविदित है कि नाटक का संबंध सिद्धांत की तुलना में व्यवहार से अधिक है। व्यावहारिक रूप से कोई भी नाट्य कृति रंगमंच पर ही अपना संपूर्ण आकार ग्रहण करती है। रंगमंच को साहित्य के अंतर्गत संप्रेषण और साधारणीकरण का सशक्त माध्यम मान सकते हैं। किंतु कोरोना काल में साहित्य की इस अतुल्य विधा पर अर्धविराम सा लग गया है। इस दौरान शिक्षा जगत में ई-शिक्षा पर अत्यधिक बल दिया जा रहा है। आजकल 'सेमीनार' के स्थान पर 'वेबिनार' का आयोजन किया जा रहा है जिसके अंतर्गत कार्यक्रम आयोजित किये जाते हैं। कई आधुनिक तथा विकसित ई-माध्यमों द्वारा साहित्य की अन्य विधाओं पर बात-चीत, पढ़ना-पढ़ाना, परीक्षाओं का आयोजन इत्यादि संभव है किंतु रंगमंच में इन सभी बातों की गुंजाईश बहुत कम नजर आती है क्योंकि रंगमंच का संबंध पढ़ने-पढ़ाने के साथ-साथ करने-कराने से भी है और इसकी परीक्षा किसी कागज या कंप्यूटर में न होकर ठोस मंच पर होती है। गिरीश रस्तोगी लिखते हैं कि ''नाटक कोई 'पाठ्य-पुस्तक' मात्र नहीं है जैसे कि कहानी और उपन्यास और उसकी तरह नाटक का सीधा संबंध पाठकों से होता है। बल्कि नाटक एक जीवंत अनुभव है जो अपनी जीवंतता रंगमंच पर ही प्राप्त करता है। नाटक की सही कसौटी रंगमंच ही है।''[3]

रंगमंच में रट्टेबाजी की कोई संभावना ही नहीं है, यहां तो मेहनत, अनुभव और नवीन प्रयोगों से कलाकार अपने ज्ञान के फलक को विस्तार देता है। रंगमंच किसी एक व्यक्ति विशेष केंद्रित नहीं होता, यह तो सामूहिक गतिविधि है जिसमें निर्देशक, अभिनेता, दृश्य सज्जाकार, सहायक इत्यादि कारकों के साथ-साथ दर्शकों को भी महत्वपूर्ण अंग समझा जाता है। रामस्वरूप चतुर्वेदी इसे और अधिक विस्तार से समझाते हुए लिखते हैं कि ''नाटक के प्रस्तुतिकरण में अनेक व्यक्तियों का सामूहिक योगदान है— नाटक-लेखक, निर्देशक, अभिनेता, सज्जा-सहायक, मंच-व्यवस्थापक, प्रकाश चालक और इनके पीछे कार्य करने वाले अनेक शिल्पी तथा कारीगर। नाट्य-रचना में इन सबका गुणात्मक सहयोग है। दूसरी ओर नाटक का आस्वाद भी अपनी प्रकृति में सामूहिक है।''[4] अत: रंगमंचीय गतिविधियां न होने के कारण उपर्युक्त सभी का कौशल एवं प्रतिभा प्रभावित हो रही है। वर्तमान परिवेश में कोरोना महामारी के चलते इन सभी इकाइयों का एक स्थान पर एकत्र हो पाना संभव नहीं हैं। अत: साहित्य की अन्य गतिविधियों का आयोजन तो संभव है किंतु रंगमंचीय प्रस्तुति पर विचार करना भी कठिन है।

शोधार्थी, हिंदी विभाग, कुमायूँ विश्वविद्यालय, नैनीताल

इन दिनों रंगमंच हाशिये पर जाता दिखाई दे रहा है। हालांकि विभिन्न साहित्यिक कार्यक्रमों की भांति रंगमंच पर भी वेबिनार आयोजित किया जा सकता है किंतु वहां रंगमंच की केवल सैद्धांतिक बातें ही संभव हैं और जैसा कि पूर्व में चर्चा की जा चुकी है कि व्यवहार के बिना रंगमंच अधूरा है। ऑनलाईन कार्यक्रम की बात की जाए तो राष्ट्रीय नाट्य विद्यालय ने वेबिनार शृंखला का आयोजन किया था[5] जिसमें रंगमंच के कई बड़े नामों ने अपनी बातें साझा की किंतु एक बार एन.एस.डी. के विद्यार्थियों से ही पूछा जाना चाहिए कि क्या वह केवल इन वेबिनार के आयोजनों से खुश एवं संतुष्ट हैं? और केवल एन.एस.डी. ही क्यों, रंगमंच से जुड़े तमाम कलाकारों से पूछा जाए कि क्या वेबीनार थियेटर की जगह ले सकता है?

रंगमंच के थमे हुए प्रवाह का असर नाट्य लेखन पर भी पड़ रहा है और यह असर तब तक रहेगा जब तक रंगमंच अपनी वास्तविक गति इख्तियार नहीं कर लेता। कोई भी नाट्यकृति अपनी सार्थकता एवं महत्वता मंच पर ही साबित करती है। नाटक मंच पर ही सही जिंदगी जीता है और नाटक में प्राण-प्रतिष्ठा भी मंच ही करता है। रंगमंच के अभाव में नाट्य लेखन का कुंठित हो जाना स्वाभाविक है।

रंगमंचीय गतिविधियों की अवरुद्धता के लिए न ही सत्ता को दोष दिया जा सकता है और न ही व्यवस्था को। लॉकडाउन से आम आदमी का जीवन अस्त-व्यस्त तो हुआ है किंतु इस पाबंदी के पीछे भी जनता का हित ही अंतर्निहित है। कुछ जोशीले और जुनूनी लोग यह दलील पेश कर सकते हैं कि जब वैवाहिक समारोह के लिए पचास लोगों की अनुमति मिल सकती है तो साहित्यिक कार्यक्रमों अथवा रंगमंचीय गतिविधियों के लिए क्यों नहीं? ऐसी स्थिति में इस बात को समझना होगा कि विवाह जैसे कार्यक्रमों के लिए तैयारियों की आवश्यकता होती है किंतु प्रेक्टिस या रिहर्सल की नहीं। थियेटर के साथ बात बिल्कुल पलट जाती है। यहां प्रेक्टिस और रिहर्सल पर ही पूरा मामला टिका है। एक दिन की मंचीय प्रस्तुति के पीछे लगभग एक महीने की मेहनत होती है। और यह मेहनत वैयक्तिक होने के साथ-साथ सामूहिक भी होती है। नाट्य प्रस्तुति के सामूहिक सहयोग के संबंध में गिरीश रस्तोगी अपना मत रखते हुए कहते हैं कि "नाटक एक त्रिकोण से आबद्ध है- नाटककार, निर्देशक (सूत्रधार) और दर्शक लेकिन अभिनेता और अन्य सारा समूह भी उसका अनिवार्य अंग है इसलिए सारी नाटक-प्रक्रिया इनके निरंतर तारतम्य, सहयोग, सामंजस्य से ही संभव है जो प्रत्यक्षत: रंगमंच पर दृष्टिगोचर होता है।"[6] अत: ऐसी स्थिति में जब पूरे देश की रफ्तार ठप्प पड़ी हो, रंगमंचीय आयोजन की कोई संभावना नजर नहीं आती।

कोरोना काल में नाटक खेलने की गुंजाईश कहीं दिखाई देती है तो वह है नुक्कड़ नाटक की फार्म में। स्वतंत्र रूप से नुक्कड़ नाटक खेलने की भी मंजूरी आपको नहीं है किंतु विशिष्ट मामलों में ऐसा संभव है। यदि आप नुक्कड़ नाटक खेलने में दिलचस्पी रखते हैं तो किसी राजनैतिक पार्टी से संपर्क कर लीजिए। देश में सबकुछ रुक सकता है किंतु चुनाव नहीं, और यह बात किसी से नहीं छुपी कि चुनावी माहौल में कई राजनैतिक दल नुक्कड़ नाटकों द्वारा अपनी पार्टी का प्रचार करते हैं। यदि चुनाव नहीं भी हुए तो भी कोरोना काल के दौरान अपनी पार्टी द्वारा किए गए जनोद्धार और इनके द्वारा दी गई सहायता का बखान तो पार्टी के कार्यकर्ता करेंगे ही जिसके लिए नुक्कड़ नाटकों का सहारा लिया जा सकता है। किंतु ऐसे नुक्कड़ नाटकों को साहित्यिक श्रेणी से अलग, व्यवसाय की श्रेणी में रखना शायद ज्यादा जायज होगा।

बहरहाल जैसा कहा जाता है कि उम्मीद पर दुनिया कायम है, तो हम भी यह उम्मीद करते हैं कि जल्द से जल्द स्थिति सामान्य होगी और एक अनचाहे ठहराव के बाद रंगमंचीय गतिविधियों का सिलसिला पुन: अपनी गति पकड़ेगा। साथ ही साथ इस बात में भी कोई संदेह नहीं किया जा सकता कि स्थिति सामान्य होते ही कई नाटक कोरोना महामारी तथा लॉकडाउन से संबंधित विषयों पर ही खेले जाऐंगे। आशा करते हैं कि जल्द ही रंगमंच की दुनिया में फिर से चहल-पहल होगी। निर्देशक और कलाकार फिर से, नाटक खेलने से एक रोज पहले स्टेज का जायजा लेंगे। इतने समय से सुनसान और वीरान थियेटर में फिर से तालियों की गड़गड़ाहट गूंज उठेगी। उदासी में प्रतीक्षा कर रहा मायूस मंच फिर से अपने कलाकारों की आहट पहचान पाएगा। अंधकार में डूबा हुआ ऑडिटोरियम फिर से रोशनी में जगमगाएगा। जल्द ही मंच का पर्दा फिर से उठेगा। जल्द ही...

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हमारे ऊपर 'देव-ऋण' की भाँति है राष्ट्रभाषा का दायित्व!

प्रो. हरीश कुमार शर्मा

भारतीय आचार्यों ने व्यक्ति के जीवन पर तीन ऋण स्वीकार कर उनसे उसे मुक्त होना आवश्यक बताया है। ये ऋण हैं- पितृ-ऋण, गुरु-ऋण और देव-ऋण। पर, उन्होंने राष्ट्र का पर्याप्त स्तुतिगान करते हुए भी राष्ट्र-ऋण की बात नहीं की। कदाचित् उन्होंने इसकी जरूरत नहीं समझी। हमारे यहां राष्ट्र को भी देवता माना गया है और इस नाते उसका समाहार देव-ऋण में ही हो जाता है। यह भी एक ऋण है- राष्ट्र-ऋण। हमें याद है, जब हम बचपन में स्कूल की ओर से प्रभात-फेरी के लिए निकलते थे तो 'भारत माता की जय', 'महात्मा गांधी की जय', 'जवाहरलाल नेहरू की जय' आदि नारे लगाते हुए यह भी उद्घोष करते थे कि 'जन्म जहां पर हमने पाया, उसकी रक्षा हम करेंगे', 'अन्न जहां का हमने खाया, उसकी रक्षा हम करेंगे'। एक लड़का पहली बात बोलता था और फिर सब विद्यार्थी समवेत स्वर में तीन बार यह नारा गुंजाते थे- 'हम करेंगे, हम करेंगे, हम करेंगे'। तो यह जज्बा था राष्ट्र के प्रति उन नारों में।

कहना यह है कि हमारे तमाम तरह के दायित्वों के साथ ही एक बड़ा दायित्व भी हमारा होता है- राष्ट्रीय दायित्व। जिस राष्ट्र में हमने जन्म लिया है, जहां हमारा पालन-पोषण हुआ है, जिस भूमि पर विकास कर हम आगे बढ़े हैं, उसके प्रति हमारी जो जिम्मेदारियां हैं, कर्तव्य हैं, दायित्व हैं- उनका निर्वाह करना। राष्ट्रभाषा भी हमारा ऐसा ही एक महत्वपूर्ण राष्ट्रीय दायित्व है। राष्ट्र के अनेक प्रतीकों में से राष्ट्रभाषा एक जीवंत प्रतीक है, जो कि हमारी अस्मिता की अवबोधक है। राष्ट्रगीत, राष्ट्रगान, राष्ट्रध्वज आदि भावात्मक प्रतीक हैं, जिनके प्रति सम्मान-भाव रखकर हम अपने भीतर गर्व और प्रेरणा जगाते हैं, पर राष्ट्रभाषा जीवन्त प्रतीक है- क्रियात्मक। इसके प्रति मात्र सम्मान प्रदर्शित करने भर से कुछ नहीं होता, इसको हमें अपने दैनंदिन जीवन में अपनाना होता है। इसका विकास करना होता है। इसका विस्तार करना होता है। इसे समृद्ध करना होता है। तब कहीं जाकर हमारे इस दायित्व की पूर्ति होती है। इसके लिए कुछ अलग से बहुत प्रयत्न करने की जरूरत नहीं होती है। बस, अपनी भाषा और संस्कृति से जुड़े रहकर उनके प्रति स्नेह-भाव और पूरा सम्मान रखते हुए उनमें सहज भाव से काम करते रहने की जरूरत होती है। काम करने का भी मतलब यह नहीं कि सबको साहित्य-सृजन करना है। अपने दैनंदिन क्रिया-कलापों में अपनी भाषा का प्रयोग करना- यह भी उसको बचाने एवं उसके उत्थान में सहायक बन जाता है।

दिक्कत यह है कि हिंदी की बात करते ही हमारे यहां दो तरह की धारणाएं बना ली जाती हैं और लोग प्रकट-अप्रकट रूप में उसका विरोध करने लगते हैं- एक तो अंग्रेजी-विरोध तथा दूसरा भारतीय भाषा-विरोध। जबकि वास्तव में यह दोनों ही बातें सही नहीं हैं। अपनी भाषा से प्रेम करने के लिये दूसरी भाषा का विरोध करना जरूरी नहीं, पर अपनी भाषा की कीमत पर उसे अपनाया भी नहीं जा सकता। वैश्विक सन्दर्भ में वर्तमान में जो अंग्रेजी की उपयोगिता है उसके कारण उससे दूरी बना लेना आज किसी भी राष्ट्र के लिये सम्भव नहीं, पर सवाल तो अपने देश में उसके अनिवार्य बनते चले जाने को लेकर है। आज देश में स्थितियां धीरे-धीरे करके ऐसी बनती जा रही हैं कि बिना अंग्रेजी-ज्ञान के चपरासी की भी नौकरी नहीं मिलने वाली। जब अपनी भाषाओं की उपयोगिता अपने ही देश में कुछ नहीं रहेगी तो हम उन्हें कैसे बचा पायेंगे? सक्षम लोग अंग्रेजी पढ़ें- दुनिया की बातें भारत में लाने के लिये तथा भारत की बातें दुनिया तक पहुंचाने के लिये। पर, देश में एक आवेदन लिखने तक के लिये अंग्रेजी क्यों जरूरी हो? नौकरी पाने, न्याय पाने, कोई कारोबार करने आदि के लिये क्यों उसका मुखापेक्षी होना पड़े? देशवासी की उन्नति में वह बाधा क्यों बने? अंग्रेजी ज्ञान के अभाव में देशवासी में हीनता-बोध क्यों पैदा हो? एक विदेशी भाषा के कारण देश भारत और इण्डिया में क्यों बंटे? अपनी भाषाओं को भुला देने या उनकी उपेक्षा करने या उनके प्रति हीन भाव उत्पन्न करने का कारण क्यों अंग्रेजी बने?

प्रोफेसर-हिन्दी विभाग एवं भाषा संकायाध्यक्ष (डीन), राजीव गांधी विश्वविद्यालय, रोनो हिल्स, दोइमुख (ईटानगर), अरुणाचल प्रदेश-791112, ई-मेल : hksgpn@gmail.com

और, रही बात हिन्दी से अन्य भारतीय भाषाओं को कोई हानि होने की, तो इसका तो कोई प्रश्न ही नहीं उठता क्योंकि दोनों की भूमिका अपने-अपने स्थानों पर अलग-अलग है और एक-दूसरे से कम महत्त्व की नहीं है। इसे भारत के नेताओं ने भी बार-बार स्पष्ट रूप से अनेक स्थलों पर घोषित किया है। महात्मा गांधी ने आजादी से ठीक पहले ही इस शंका का निवारण स्पष्टत: किया था। उन्होंने कहा था कि "महान प्रान्तीय भाषाओं को उनके स्थान से च्युत करने की कोई बात ही नहीं है क्योंकि राष्ट्रीय भाषा की इमारत प्रान्तीय भाषाओं की नींव पर ही खड़ी की जानी है। दोनों का लक्ष्य एक-दूसरे की जगह लेना नहीं, बल्कि एक-दूसरे की कमी पूरी करना है।" इसलिये यहां दो बातें बहुत ही साफ तरीके से समझ लेनी चाहिए। पहली यह कि हिन्दी के समर्थन का मतलब अंग्रेजी सहित किसी भी विदेशी भाषा का विरोध करना नहीं है। दूसरी यह, कि हिन्दी के समर्थन और उत्थान का मतलब सिर्फ हिन्दी भाषा से नहीं, अपितु हिन्द की सभी भाषाओं से होना चाहिए।

आजादी से पहले देश के समक्ष भाषा का प्रश्न प्रश्न के रूप में नहीं था, एक हल के रूप में था और यह हल देश की विभिन्न प्रांतीय भाषाओं में समन्वय एवं केंद्र-राज्य संबंधों के लिए हिंदी के प्रयोग के रूप में ढूंढ लिया गया था। किंतु, आजादी के बाद भाषा का जो प्रश्न उठा, या कहें कि उठा दिया गया, वह आज पहले से भी और अधिक जटिल हो गया है तथा अपनी शाखाओं-प्रशाखाओं के रूप में फैलता हुआ जटिलतर होता जा रहा है। जब तक इस प्रश्न का कोई समुचित समाधान नहीं मिलता, यह विचारणीय ही बना रहेगा। आज हमें सोचना यह है कि अपनी राष्ट्रभाषा के रूप में हम हिंदी को अपना सरताज बनायें जिससे हमारा स्वत्व और स्वाभिमान सुरक्षित रहता है और जो देश की रगों में स्वाभाविक रूप से समाई हुई है, या फिर अपने स्वत्व और स्वाभिमान को खोने की कीमत पर अंग्रेजी को अपने सिर का बोझ बनाकर उसे अपने ऊपर लाद लें। यूं सैद्धांतिक रूप में भले हिंदी का प्रयोग घटा हो, पर व्यावहारिक तथा जनमाध्यम रूप में आज इसका फैलाव कहीं अधिक बढ़ा ही है।

राष्ट्र की मात्र भौगोलिक-राजनीतिक पहचान ही नहीं, सांस्कृतिक पहचान भी हुआ करती है और संस्कृति का एक बहुत ही महत्वपूर्ण अवयव है- भाषा। भाषा साहित्य का अभिव्यक्ति पक्ष है और साहित्य संस्कृति का अनुभूति पक्ष। इसलिए भाषा में मात्र भाषा का प्रश्न ही सम्मिलित नहीं होता, अपितु साहित्य और संस्कृति के प्रश्न भी मिले-जुले होते हैं। भाषा का संस्कृति से गहरा संबंध है और संस्कृति का पहचान से। अनेकता में एकता की विशेषता रखने वाली भारतीय संस्कृति की एकता में संस्कृत भाषा का बड़ा योगदान रहा है। यूरोपीय देशों के सभी लोग हमें एक जैसे लगते हैं, लेकिन उनकी भाषा से आसानी से पहचान हो जाती है कि यह जर्मन है, यह फ्रांसीसी, यह रूसी कि यह इतालवी। एशिया के लोगों की पहचान भी बाहर अधिकतर भाषा से ही आसानी से हो जाती है। भारतीय उपमहाद्वीप के अधिकतर लोगों के एक जैसे लगने के बावजूद भाषा उनकी सहजता से पहचान करा देती है।

कुछ मायनों में तो भाषा और संस्कृति धर्म से भी बड़ी चीजें हैं और कई बार तो यह राष्ट्र और राष्ट्रीयता की हदों को भी पार कर जाती हैं। भारत, बांग्लादेश, पाकिस्तान, नेपाल, श्रीलंका, भूटान आदि देश ही नहीं, सात समंदर पार के मॉरीशस, सूरीनाम, फिजी, गुयाना, त्रिनिनाद जैसे देश भी इसका उदाहरण हैं। भारत और बांग्लादेश दो अलग राष्ट्र हैं, पर बांग्ला भाषा और संस्कृति को लेकर भारतीय बंगाल और बांग्लादेश में कोई विशेष दुराग्रह नहीं। उर्दू और हिंदी को धर्म का आधार देकर भले कभी विवाद पैदा करने की कोशिश की गई हो, परंतु पाकिस्तान बनने के बाद उर्दू वहां की तो भाषा बनी ही, भारत ने भी उसको राष्ट्रीयता का आधार मानकर किनारे नहीं कर दिया। भारत के पड़ोसी राष्ट्र नेपाल में अलग राष्ट्रीयता होने के बावजूद हिंदी के प्रयोग को लेकर कोई कुंठा नहीं और भारत में तो नेपाली खैर संविधान की अष्टम अनुसूची में उल्लिखित भाषा है ही। विश्व के अनेक देशों में भारतवंशी पीढ़ियों से बसे हुए हैं। वहां के स्थायी नागरिक बनकर विभिन्न भूमिकाओं में, यहां तक कि राजनीति तक में अपनी साझेदारी करते हुए और जिम्मेदारी निबाहते हुए उन देशों के विकास में अपना बहुमूल्य योगदान दे रहे हैं, पर उन्होंने भारतीय भाषाओं और संस्कृति को बचाये और बनाये रखा है। वे उनकी राष्ट्रीयता की भावना और राष्ट्र के प्रति कर्तव्य-बोध में कभी आड़े नहीं आतीं।

प्रसिद्ध गीत 'सारे जहां से अच्छा हिन्दोस्तां हमारा' आप सबने सुना होगा। इसके रचयिता मुहम्मद इकबाल थे, जो बाद में द्विराष्ट्रवाद के समर्थक हुए और पाकिस्तान चले गये। अपने इसी गीत में वे आगे लिखते हैं-

यूनान मिस्र रोमा सब मिट गए जहां से,
बाकी मगर है अब तक नामो-निसां हमारा।
कुछ बात है कि हस्ती मिटती नहीं हमारी,
सदियों रहा है दुश्मन दौरे जहां हमारा।

यह यूनान, मिस्र, रोम के मिटने का क्या मतलब है? क्या ये देश अब दुनिया के नक्शे में नहीं हैं? अवश्य हैं। भौगोलिक रूप से उनकी अवस्थिति अब भी है। फिर, इकबाल उनके किस रूप में मिटने की बात अपने इस गीत में करते हैं? आधार

है- संस्कृति, जो कि उन देशों की मूलभूत पहचान थी। इन देशों की पुरातन सभ्यता-संस्कृति नष्ट हो गई। फिर वह जिस भारतीय हस्ती के अमिट रहने की बात करते हैं तो क्या उसका धर्म से कोई संबंध है? तकरीबन चौदह-पंद्रह सौ साल पुराने इस्लाम धर्म से कोई संबंध है, जिसे उनके पूर्वजों ने कुछ ही पीढ़ी पहले अपना लिया था? निश्चित रूप से इसका संबंध धर्म से नहीं, संस्कृति से है। धर्म तो भारत में समय-समय पर बहुत से आते रहे- अंदर से भी, बाहर से भी और लोग उन्हें अपनाते भी रहे। पर, सांस्कृतिक रूप में, भारतीयता के रूप में, भारत राष्ट्र और उसके निवासी एक भारतीय जन के रूप में हमारी पहचान सदा ही अक्षुण्ण रही है, राजनीतिक रूप से भले हमारी पहचानें समय-समय पर बदलती रहीं।

वह कौन सी बात है हमारी, हमारे भीतर कि जिसके कारण हमारी हस्ती मिट नहीं सकी। बावजूद इसके कि समय-समय पर तमाम तरह के राजनीतिक, धार्मिक और अन्य आक्रमण हम झेलते रहे। वह बात है हमारी अपनी धरोहरों को सँजोये-सहेजे रखने की प्रवृत्ति की। अपनी परंपराओं से जुड़े रहने की। अपनी चीजों के प्रति मोह की। अपनी उपलब्धियों के सम्मान की, उन पर गौरव-भाव मन में रखने की। नालंदा, तक्षशिला, विक्रमशिला जैसे विश्व-प्रतिष्ठित विश्वविद्यालयों के न रहने पर भी, उनको भारी क्षति पहुंचाने, यहां तक कि नष्ट कर दिए जाने के बावजूद यदि हमारी ज्ञान-संपदा सुरक्षित रह सकी तो कैसे? एक तो ज्ञानार्जन की श्रुति-स्मृति परंपरा और दूसरे पुस्तकों के प्रति हमारे मन में उत्पन्न किया गया सम्मान का भाव। एक तरह का अंधविश्वास भी इसे आप कह सकते हैं कि एक सामान्य व्यक्ति के घर में, यहां तक कि वह अनपढ़ भी हो तो भी- रामायण, महाभारत, गीता जैसे ग्रंथ यदि बड़े कायदे से कपड़ों में बांधकर रखे गए होंगे, तो कोकशास्त्र जैसी पुस्तकें भी। किताबों के प्रति पूज्यभाव हमारे मन में ऐसा है कि किताब गिर जाए या उस पर पैर लग जाए तो उसको तुरंत प्रणाम करेंगे, माथे से लगायेंगे। तो, यह वह चीज थी जिसने हमको बचाया, हमको एक जीवित कौम बनाये रखा। आज हर चीज के प्रति अनास्था पैदा करने की कोशिश की जा रही है, बिना उसको जांचे-परखे, बिना उसकी उपयोगिता-अनुपयोगिता पर विचार किये कि यह चीज पुरानी है, यह तो अमुक वर्ग द्वारा बनायी-चलायी गयी है, इसलिये इसे छोड़ो, इसे खत्म करो।

कहने को हम आजाद हुए, अंग्रेजी शासन बदला, लेकिन अंग्रेजी शासन व्यवस्था? वह तो नहीं ही बदली! शिक्षा की हालत यह है कि हम ले-देकर तमाम किंतु-परंतु के बाद आखिर वहीं पहुंच जाते हैं कि अंग्रेजी पढ़ाई जाये छोटी कक्षाओं से ही। यह अंग्रेजी का भूत हमारे दिमाग में ऐसा घुसा बैठा है कि हमें लगता है इसके बिना हम आगे बढ़ ही नहीं सकते। और यह अंग्रेजी का भूत इसलिए है, क्योंकि अंग्रेजों के भूत से हम मुक्त नहीं हो पाए। जबकि यथार्थ यह है कि इस अंग्रेजी के भूत ने ही हमारा काफी नुकसान किया है। आपको पता है, हिंदी क्षेत्रों में ग्रामीण स्कूलों के विद्यार्थियों को गणित के बाद किस विषय का डर सर्वाधिक सताता है? अंग्रेजी का। अंग्रेजी की बाध्यता के चलते ही उनमें से बहुत से पास नहीं हो पाते और नकल के लिए भी सर्वाधिक मारामारी इन्हीं दो विषयों में चलती है। आखिर क्यों हमने देश में अंग्रेजी पढ़ना अनिवार्य किया? क्या इससे अच्छा यह नहीं हो सकता था कि अकेले अंग्रेजी के स्थान पर संविधान में अनुसूचित 22 भाषाओं में से किसी एक भाषा को रखा जाता। अलग-अलग स्कूलों में अलग-अलग भाषाओं के अध्यापक होते और जिस विद्यालय में जिस भाषा का अध्यापक होता उसमें उसी भाषा की पढ़ाई होती। भारतीय भाषाओं को बच्चे सीख भी सहजता से सकते थे। इसी आधार पर नौकरी लगने के बाद उन्हें प्रारंभ में कुछ वर्षों के लिए उस प्रांत में जाकर बिताना अनिवार्य किया जाता। इससे भाषाएं जुड़तीं, संस्कृति जुड़ती, कार्य-संस्कृति बदलती और भावनात्मक आधार पर देश भी जुड़ता।

इस समय हिंदी के सामने घर-बाहर से दो चुनौतियां बड़ी हैं। बाहर से तो उसको सबसे बड़ी चुनौती अंग्रेजी दे ही रही है और अपनों के ही हाथों हिंदी को हर मौके-बेमौके अपमानित कराने का कोई मौका नहीं छोड़ रही। हिंदी इस चुनौती से बड़ी आसानी से निपट सकती थी यदि उसे अपने घर से सहयोग मिला होता। यदि आंतरिक एकता की शक्ति हो, तो बाहर की बड़ी-से-बड़ी चुनौती का सामना बड़ी सरलता से कर, उस पर विजय पाई जा सकती है। लेकिन, यदि घर कमजोर होने लगे, तो सामने आई छोटी चुनौती भी बहुत बड़ी बनकर संग लगने नहीं देती। भारतीय भाषाओं का पूर्ण सहयोग न मिलने से हिंदी की लड़ाई पहले ही अंग्रेजी से कमजोर पड़ रही थी कि अब उसकी अपनी सबसे बड़ी ताकत बोलियों को आपस में लड़ाने या प्रतिद्वंद्वी के रूप में उभारने का मौका और यहां के नेतृत्व वर्ग ने सुलभ करा दिया। हिंदी-अंग्रेजी की प्रतिस्पर्धा में अपना झुकाव अंग्रेजी की तरफ दिखाकर अन्य भाषा-भाषी तो यह भूल ही गए कि यदि हिंदी जैसी सशक्त, समृद्ध और उनकी भाषा से अधिक व्यापक वर्ग में समादृत भाषा हारेगी, तो उनकी भाषाओं की पराजय भी बहुत दूर नहीं रह जाएगी। लेकिन चिंता तो यह है कि चंद सुविधाओं की खातिर हिंदी क्षेत्र के लोग भी यह भूल रहे हैं कि उनकी अपनी-अपनी बोलियों के हित हिंदी के साथ होने में अधिक सुरक्षित हैं। अलग-अलग होने से उनकी कमजोरी प्रकट होगी, जो हिंदी को तो कमजोर करेगी ही, उनकी बोलियों

के भी हित में नहीं होगा।

आखिर वह कौन सी वजह है जो पहले मैथिली हिंदी से अलग हुई, अब भोजपुरी, राजस्थानी जैसी भाषाएं अपना अलग स्थान मांग रही हैं? फिर ब्रज, अवधी, कन्नौजी, गढ़वाली आदि अन्य बोलियों की बारी आएगी। क्या कभी कल्पना की है हमने कि हिंदी को बांटने और तोड़ने का यह सिलसिला कहां जाकर रुकेगा? जिस अपने महान लोकतंत्र का गुणगान और बखान करते हम नहीं अघाते, उस लोकतंत्र ने हमें कैसे बाँट और काट दिया है आपस में, कभी इसकी भी कल्पना की है किसी ने? जातियों, धर्मों, क्षेत्रों, भाषाओं और बोलियों आदि के नाम पर विभाजन और विद्वेश के बीज बोने और तात्कालिक लाभ की फसल काटने का क्रम कहीं रुकेगा क्या? क्या समस्या है हिंदी की बोलियों को? क्या मैथिली के विद्यापति हिंदी में नहीं पढ़ाये जाते और परिगणित नहीं किये जाते? राजस्थानी के चन्दवरदाई, भोजपुरी के कबीर, अवधी के तुलसीदास और जायसी, ब्रज के सूरदास ही जब हिंदी की पहचान नहीं रह जाएंगे, अपनी-अपनी भाषाओं के अलग मन्दिर बनाकर उनकी प्राण-प्रतिष्ठा जब वहां की जायेगी तो नानक, रैदास, नामदेव, चैतन्य महाप्रभु, शंकरदेव आदि का क्या होगा? जरूरत हिन्दी का विस्तार करने की थी, हम उसे संकुचित कर रहे हैं।

संकट सिर्फ हिंदी पर है, ऐसा भी नहीं है। अंग्रेजी का दखल हर भाषा में बढ़ रहा है। प्रत्येक भारतीय भाषा आज अंग्रेजी से संक्रमित हो रही है और सबमें उसका दबदबा धीरे-धीरे बढ़ रहा है। लेकिन, किसी को परवाह नहीं है। एक-आध आवाज कहीं से उठती है तो वह उतना असर नहीं छोड़ पातीं, क्योंकि समवेत स्वर तो उसमें मिलते ही नहीं। अंग्रेजी-ज्ञान को हमने अपनी शान से जोड़ लिया है और उसके ज्ञान से अपने को सभ्य और सुसंस्कृत बनाने का भ्रम पाले हुए हैं। इसके कारण हुआ यह है कि जो टूटी-फूटी भी अंग्रेजी जानता है या जो नहीं भी जानता है, वह भी अपने अंग्रेजी-ज्ञान का दिखावा करता हुआ गलत ही सही, बोलने की कोशिश करता है। इसके कारण अंग्रेजी शब्दों का चलन दिनानुदिन भाषाओं में बढ़ता ही जा रहा है, क्योंकि मीडिया भी उसी को परोसने में लगा है।

परिणाम यह कि अब हमारे पास भारतीय टीम नहीं, टीम इंडिया है। यहां भ्रष्टाचार नहीं, करप्शन होता है। अब हमारे पास मुख्यमंत्री, प्रधानमंत्री, राष्ट्रपति नहीं, अपितु चीफ मिनिस्टर (सी एम), प्राइम मिनिस्टर (पी एम), प्रेसिडेंट हुआ करते हैं। और, हम मान लेते हैं कि इन सब शब्दों को देश का हर आदमी समझ रहा है। समझना ही पड़ेगा देशवासी को, क्योंकि उसकी यह नियति बना दी गयी है! देश के नेता जब पूर्वोत्तर में आते हैं तो अंग्रेजी में बोलते हैं, बिना यह जाने कि यहां के लोगों ने अपने राष्ट्र और राष्ट्रभाषा प्रेम के चलते कैसे मेहनत से हिंदी सीखी है। उनको क्या पता कि एक आम आदमी के लिए अंग्रेजी यहां भी वैसे ही सिर के ऊपर से गुजर जाने वाली भाषा है, जैसी कि अन्य क्षेत्रों में उसकी स्थिति है।

जब तक हम अपनी भाषाओं में नहीं सोचेंगे या सोचने-करने का मौका नहीं देंगे तब तक न तो हम समग्र विकास और सबके लिए विकास की सोच को मूर्त रूप दे पाएंगे और न अपनी स्वाधीनता और संप्रभुता को अखण्ड, अक्षुण्ण और सशक्त बना सकेंगे। देश के निर्माण में हर व्यक्ति की भागीदारी हो और हर तरह की प्रतिभा का उपयोग हो सके, इसके लिए भाषा जो एक बड़ा बंधन है, उसे हमें हटाना ही पड़ेगा। अगर आप राष्ट्रीय उपयोग के लिए हिंदी के महत्व को स्वीकार कर पाएंगे, तभी प्रांतीय उपयोग के लिए अपनी भाषा का महत्व समझ कर उसे मजबूती से अपना पाएंगे।

मुझे भारतेन्दु हरिष्चन्द्र द्वारा सुनाया गया एक किस्सा याद आ रहा है जो उन्होंने अपने ददरी (बलिया) के मेले वाले व्याख्यान में सुनाया था। कोई एक सज्जन उधार के कपड़े पहनकर एक समारोह में गये। वहां लोगों ने सब पहचान लिया कि यह कुर्ता तो अमुक का है, टोपी तो फलाने की है कि जूते तो अलाने के हैं- वगैरह-वगैरह। जब सब पहचान लिया गया तो हंसने लगे और बोले कि 'भैया, अपनी तो बस मूंछें-ही-मूंछें हैं।' तो मित्रो! यह भाषा और संस्कृति भी हमारी मूंछें जैसी ही हैं- हमारे अस्तित्व और अस्मिता की अवबोधक, हमारी पहचान का आधार! सब कुछ उधार का लेकर भी कम-से-कम हम इन्हें तो बचाये रखें। इसलिये हमारे लिये आवश्यक है कि हम अपनी भाषाओं से जुड़ें और अपनी नयी पीढ़ी को भी जोड़ें। अपनी भाषाओं का विकास भी करें। उनमें बाहरी ज्ञान-विज्ञान की नकल ही नहीं भरें। मौलिक सूझ-बूझ के साथ कुछ नया उनमें प्रस्तुत करें। विश्व के 200 चोटी के विश्वविद्यालयों में भारत का एक भी विश्वविद्यालय सम्मिलित नहीं। नालन्दा और तक्षशिला जैसे विश्वविद्यालयों के देश भारत के लिये यह लज्जा की बात है। पर, इसकी बजह क्या है? मेरी समझ में- नकल! मौलिकता की कमी! जब हमने अध्ययन के लिये भाषा परायी अपनायी तो पद्धति भी हमें वह अपनानी ही थी। जब तक हम अपनी भाषाओं को सम्मान देते हुए अपनी शिक्षा-पद्धति विकसित नहीं कर लेंगे, अपना मौलिक कुछ नहीं दे सकेंगे, तब तक स्थिति ऐसी ही रहेगी। इस स्थिति को बदलना होगा। सरकारें जब जो करेंगीं, तब वह करें पर तब तक निजी तौर पर हम जो कुछ कर सकते हैं, वह करते रहें। वही हमारा देश के लिये योगदान होगा।

ब्रज लोक नाट्य रासलीला : पुराण से परिवर्तन तक

डॉ. नृत्य गोपाल

भारत के लोक की अपनी महत्ता है। लोक जीवन, लोक संस्कृति, लोक साहित्य, लोक वार्ता, लोक हित, लोक गीत, लोक नाट्य आदि के रूप में भारतीय लोक फैला पसरा हुआ है। इस लोक के अपने अलिखित सिद्धांत और अनाम सिद्धांतकार हैं। लोक स्थिर भी है और तीव्र परिवर्तनगामी भी। लोक की विराटता को व्याख्यायित करते हुए आचार्य हजारी प्रसाद द्विवेदी ने लिखा है-''लोक शब्द का अर्थ जनपद या ग्राम नहीं है, बल्कि नगरों और ग्रामों में फैली समस्त जनता है, जो विलासिता और सुकुमारिता को जीवित रखने वाली आवश्यक वस्तुएं उत्पन्न करते हैं।''[1] लोक की भाव सत्ता का स्वरूप व्यापक है। इसे ग्राम्य, नगरीय या इसी प्रकार की किसी शब्दार्थी सीमा में आबद्ध नहीं किया जा सकता।

लोक ने अपनी आवश्यकताओं के साधन स्वयं जुटाए हैं। यह भारतीय लोक की ताकत है। भारतीय समाज और अर्थ व्यवस्था का निवास लोक में निहित है। इसने अनेक बार भारत को वैश्विक आर्थिक संकटों से उबारा है। स्वयं का अनाज, दूध, दही, घी, सब्जी, मसाले, बर्तन, कपडा आदि उत्पादित करना तथा उसी पर निर्भर रहना हमें आत्मनिर्भर बनाता है। एक किसान के यहां उसके परिवार और पशु धन के लिए वर्ष भर का आवश्यक सामान उपलब्ध रहता है। इस लोक ने सामाजिक मनोरंजन के भी अपने साधन विकसित किए हैं। ये लोक साहित्य और लोक नाट्य के रूप में देखे समझे जा सकते हैं। यहां हम भारतीय लोक नाट्य परंपरा के अंतर्गत ब्रज लोक नाट्य विधा रासलीला पर चर्चा करेंगे। समय के साथ लोक नाट्य विधाओं ने स्वयं को लोक की मांग के अनुरूप परिवर्तित किया है। रासलीला का स्वरूप भी पुराण काल से आज तक इस परिवर्तन का साक्षी रहा है।

पश्चिमी उत्तर प्रदेश का बडा भू भाग 'ब्रज क्षेत्र' या 'ब्रज प्रदेश' कहलाता है। मथुरा आगरा इसका केंद्र है। एटा, मैनपुरी, अलीगढ, हाथरस आदि जिले ब्रज क्षेत्र में समाहित हैं। भाषाई रूप में ब्रजभाषा क्षेत्र और व्यापक हो जाता है। जहां इसमें राजस्थान के भरतपुर , धौलपुर, कोटा जिले आ जाते हैं वहीं हरियाणा के फरीदाबाद तथा मेवात क्षेत्र का एक भाग भी इसकी सीमा में आ जाता है। उधर मध्य प्रदेश के भिंड, मुरैना और ग्वालियर तक ब्रज भाषा का क्षेत्र फैला हुआ है। क्षेत्रीय और भाषाई विस्तार के बावजूद ब्रज की पहचान मथुरा जिले पर केंद्रित हो गई है। इसके दो प्रमुख कारण हैं एक- यहां भारतीय संस्कृति में पूजनीय स्थान रखने वाले श्री कृष्ण का जन्म और दूसरे भारतीय लोक जीवन में महत्वपूर्ण स्थान रखने वाली गाय। वस्तुतः ब्रज का अर्थ ही है गौपालन का क्षेत्र या गौ खिरक। संयोग से कृष्ण की एक पहचान गाय पालक से होती है इसलिए भारतीय जनमानस में ब्रज क्षेत्र की लोकप्रियता का आधार पुष्टता को प्राप्त हो गया।

ब्रज क्षेत्र में लोक मनोरंजन की कई नाट्य शैली प्रचलित हैं। जैसे- रासलीला, रामलीला, नौटंकी, स्वांग, भगत, रसिया आदि। इनमें रासलीला सबसे प्राचीन और लोकप्रिय विधा है। रासलीला का संबंध कृष्ण चरित्र से है। कृष्ण भारतीय जनमानस की आस्था के केंद्र में स्थापित हैं। रासलीला को लोकनाट्य की सीमा में लाना भक्ति तथा आध्यात्मिक क्षेत्र से जुडे लोगों के लिए आपत्तिजनक भी हो सकता है। फिर भी, वर्तमान से मुंह नहीं मोडा जा सकता जहां रासलीला लोकनाट्य के रूप में स्थापित है।

रासलीला का अर्थ विकास- 'रासलीला' शब्द 'रास' और 'लीला' दो शब्दों के योग से बना है। "रास शब्द का मूल अर्थ रस है। रसरूप स्वयं श्रीकृष्ण ही 'रसो वै सः' या 'रसानां समूहो रासः' हैं। जिस क्रीडा में एक ही रस अनेक रसों के रूप में प्रकट होकर अनन्त-अनन्त रसों का समास्वादन करे, एक रस ही रस समूह में प्रकट हो कर स्वयं आस्वाद्य एवं आस्वादक लीलाधाम और विभिन्न आलम्बन एवं उद्दीपन के रूप में क्रीड़ा करे, उसका नाम रास है।"[2] लीला शब्द का अर्थ है-"ऐसा कार्य या व्यापार जो सिर्फ मनुष्यों के मनोरंजन के लिए किया जाए,

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खेल, क्रीडा। भक्तों की दृष्टि में इस धरती पर मानव के रूप में अवतार लेने वाले भगवान के क्रियाकलाप। अवतारों के चरित्र का अभिनय जैसे- कृष्ण लीला, राम लीला।"[3] हिंदी साहित्य कोश भाग एक में रासलीला को परिभाषित करते हुए लिखा गया है-''सोलहवीं शती में श्री वल्लभाचार्य तथा हित हरिवंश आदि महात्माओं ने लोक प्रचलित जिस शृंगार प्रधान रास में धर्म के साथ नृत्य, संगीत की पुन:स्थापना की और उसका नेतृत्व रसिक शिरोमणि श्रीकृष्ण को दिया था, वही राधा तथा गोपियों के साथ कृष्ण की शृंगारपूर्ण क्रीडाओं से युक्त होकर रासलीला के नाम से अभिहित हुआ।

रासलीला लोकनाट्य का एक प्रमुख अंग है। भक्तिकाल में इसमें राधा कृष्ण की प्रेम क्रीडाओं का प्रदर्शन होता था, जिनमें आध्यात्मिकता की प्रधानता रहती थी। इनका मूलाधार सूरदास तथा अष्टछाप के कवियों के पद और भजन होते थे। उनमें संगीत और काव्य का रस तथा आनंद, दोनों रहता था। लीलाओं में जनता धर्मोपदेश तथा मनोरंजन साथ साथ पाती थी।''[4]

रासलीला का पौराणिक रूप- रासलीला का आधार श्रीमद् भागवद्महापुराण है। श्रीमद् भागवद्महापुराण में कृष्ण चरित्र का व्यापक स्वरूप वर्णित है। श्रीमद्भागवत के दशम स्कंध में 29 से लेकर 31 अध्याय तक रास पंचाध्यायी के रूप में विख्यात हैं। "तथापि एक सौ इक्कीस अध्यायों में श्रीकृष्ण चरित्र का वर्णन होने से भागवत को श्रीकृष्ण परक ही कहा जाता है। श्रीमद्भागवत को श्री कृष्ण का स्वरूप मानकर स्कंधों को श्री कृष्ण के स्वरूप में विभक्त किया है। वहां दशम स्कंध को भगवान् का हृदय-स्थल माना है और रासलीला के पांच अध्यायों को पंच प्राण माना है।"[5] श्रीमद्भागवत के रासपंचाध्यायी के पांच अध्यायों का वर्ण्य विषय कुछ इस प्रकार है-"रास पंचाध्यायी के पांच अध्यायों में प्रथम श्री कृष्ण अपनी वंशी वादन से गोपियों का आवाहन करते हैं और उन्हें नारी धर्म के अनुसार घर में रहकर सब की सेवा करने का आदेश देते हैं। गोपियाँ निराश होकर प्रार्थना करती हैं। श्री कृष्ण प्रसन्न होते हैं और प्रथम रास होता है। गोपियों में अभिमान आ जाने पर प्रभु अंतर्ध्यान हो जाते हैं। द्वितीय अध्याय में गोपियाँ खोजती हैं। तीसरे अध्याय में मिलने की प्रार्थना करती हैं। चौथे अध्याय में भगवान् प्रकट होते हैं। पांचवें अध्याय में रासक्रीडा का वर्णन है।"[6] इस प्रकार रास का आधार श्रीमद्भागवत महापुराण है। परिवर्ती रास स्वरूप और काव्यगत रास स्वरूप से श्रीमद्भागवत का रास वर्णन भिन्न है। इस ओर संकेत करते हुए मानस शास्त्री लिखते हैं कि—"काव्य ग्रंथों में नृत्य, वाद्य और गायन का समवेत् स्वरूप ही रास है और इसका प्रत्यक्ष उदाहरण गुजरात, मध्य प्रदेश, आसाम, उडीसा आदि में आज भी दिखाई देता है परन्तु यह जो रासलीला है, उसका उपक्रम और उपसंहार दोनों ही भगवान से ही सम्बन्धित हैं। रास लीला के प्रथम श्लोक में 'भगवानपि ता: रात्री:' और अंत में 'विक्रीडितं व्रजवधूभिरिदं च विष्णो:' वर्णन किया है।''[7] पौराणिक दृष्टि से रास श्री कृष्ण की लीला है और श्री कृष्ण स्वयं परमात्मा स्वरूप हैं। रास लीला का वर्णन भलेहि श्रीमद्भागवद् में हुआ हो पर कृष्ण का उल्लेख वेद वाड्मय से ही माना जाता है। कृष्ण के नानाविध रूपों का उल्लेख महाभारत में प्राप्त होता है। "भारतीय वाड्मय में वेद और उपनिषदों के बाद महाभारत का स्थान है। इसका रचना काल दुर्गाशंकर केवलराम शास्त्री ने अपने ग्रंथ 'वैष्णवधर्मनो संक्षिप्त इतिहास' में 350 ई.पूर्व माना है। महाभारत में कृष्ण के वासुदेव कृष्ण अथवा राजनीतिज्ञ कृष्ण का तथा बाल कृष्ण का रूप उभरकर आया है। प्रथम के अनुसार कृष्ण एक महान योद्धा और राजनीतिज्ञ कूटनीतिज्ञ हैं जिन्होंने पाण्डवों की युद्ध में सहायता कर उन्हें विजयश्री दिलाने में महत्वपूर्ण भूमिका निभाई। विद्वानों के मत में महाभारत में कृष्ण का जो रूप वर्णित है यही उनका वास्तविक रूप है। बालकृष्ण का रूप जिन खण्डों में रूपायित किया गया है वे अंश प्रक्षिप्त अंश माने गए हैं।"[8] महाभारत के अंश हरिवंश महापुराण में कृष्ण के वृंदावन निवास का उल्लेख मिलता है। रास लीला का संबंध वृंदावन की लीलाओं से है।

रासलीला का दार्शनिक संबंध- रासलीला का संबंध कृष्ण से है। अवतारवाद की दार्शनिक अवधारणा में कृष्ण विष्णु का अवतार हैं। परमात्मा इस धरातल पर सगुण निर्गुण रूप में उपस्थित हैं। कृष्ण सगुण अवतार हैं। अष्टछाप के तर्कशील कवि नंददास की गोपियां उद्धव से प्रश्न करती हैं-

जो उनके गुण नांहिं और गुण भए कहां ते,
बीज बिना तरु जमैं मोहि तुम कहौ कहां ते,
वा गुण की परछांहरी माया दर्पण बीच
गुण ते गुण न्यारे भए अमल वारि ज्यों कीच
सखा सुन स्याम के।[9]

रासलीला के दार्शनिक चिंतन से प्रत्यक्षत: निम्बार्क और वल्लभ सम्प्रदाय जुडे हुए हैं। "निम्बार्क के द्वैताद्वैत मत में सर्वप्रथम राधा कृष्ण को उपास्य रूप में प्रतिष्ठित किया गया। श्रीकृष्ण के भावात्मक स्वरूप की अन्यतम प्रेरक शक्ति श्री राधा का कृष्ण के साथ प्रथम संप्रदाय प्रवेश (दार्शनिक समावेश) इसी मत में हुआ। अत: यहां कृष्ण अकेले नहीं हैं। वह युगलरूप हैं। वृषभानु नंदिनी राधा अपनी सहस्रों सखियों के साथ इनके वामांग में विराजमान हैं।"[10] निम्बार्क सम्प्रदाय के संतों ने कृष्ण

चरित्र में निकुंज विहार का प्रवेश कराया। इसी सम्प्रदाय के दो भक्त कवि श्री भट्ट तथा श्री हरिदेव व्यास ने युगल उपासना में सखी भाव का समावेश कर दिया। ''श्री राधा कृष्ण की निकुंज लीला में राधा जी की सखी सहचरियों का ही प्रवेशाधिकार है। अत: नित्य विहार की रसोपासना सखी भाव से ही की जा सकती है।''[11]

रासलीला को लोक के निकट लाने तथा जन जन में रसिक भाव जागृत करने का श्रेय वल्लभ सम्प्रदाय को जाता है। आचार्य वल्लभ का जीवन काल सं. 1535 से 1587 तक है। ''वल्लभ सम्प्रदाय में श्री कृष्ण परमब्रह्म पुरुषोत्तम हैं। पुरुषोत्तम अपनी आनन्दविधायिनी लीला का प्रसार करने के निमित्त ही, श्रुतियों के प्रार्थनानुसार, कृष्ण रूप में अवतरित हुए। श्रुतियां ही गोपी तथा अन्य लीला परिकर रूप में ब्रज में आविर्भूत हुईं। इस प्रकार लीला विस्तार के हेतु ही पुरुषोत्तम का नित्य गोलोक कृष्ण का ब्रज मण्डल बन कर भूतल पर अवतरित हुआ।''[12] आचार्य वल्लभ ने ही पुष्टिमार्ग की स्थापना की। वल्लभ के पुत्र आचार्य बिट्ठल ने आगे चलकर अष्टछाप की स्थापना कर कृष्ण के लोकरंजक रूप को लोकप्रिय बनाया।

रासलीला के मंचन में इन दोनों दार्शनिक चिंतनों का प्रत्यक्ष प्रभाव दिखाई पडता है। उपासना, तिलक, मुकुट छवि के आधार पर इनके सूक्ष्म भेद को देखा जा सकता है। जैसे वल्लभ सम्प्रदाय के अनुयायी रासाचार्य कृष्ण के शृंगार में तिलक नासिका के ऊपर रखते हैं तथा यह रोली या लाल चंदन से बनाया जाता है। जबकि निम्बार्क अनुयायी नासिका के मध्य भाग तक तिलक लगाते हैं बीच में श्री स्वरूप स्यामवर्णी बिंदी लगाते हैं। राधा कृष्ण की आराधना में गाए जाने वाले पदों में भी यह भेद दिखाई पडता है। वल्लभ सम्प्रदाय के अनुयायी रासाचार्य युगल उपासना में राधा कृष्ण को एक प्राण दो देही कहते हैं और निम्बार्क के उपासक राधा को कृष्ण की आह्लादिनी शक्ति के रूप में पूजते हैं। वृंदावन के संत आश्रमों की रासलीलाओं में इस पार्थक्य को स्पष्ट रूप से देखा जा सकता है। यद्यपि लीला मंचन दोनों का एक सा होता है। भाव, संवाद, अभिनय आदि में किसी प्रकार का कोई भेद नहीं होता।

रासलीला की लोक प्रतिष्ठा—ब्रज क्षेत्र में कृष्ण चरित्र, विशेषत: उनके लीला बिहारी स्वरूप, को लोकप्रिय बनाने में भक्तिकाल की विशेष भूमिका है। यहां प्रचुर मात्रा में कृष्ण काव्य की रचना हुई है। अनेक कृष्ण भक्ति सम्प्रदाय विकसित हुए। उन्होंने ब्रजराज कृष्ण, निकुंज बिहारी कृष्ण, लोकरंजक कृष्ण आदि रूपों का विशद् वर्णन किया। प्रस्थानत्रयी में श्रीमद्भगवद्गीता की व्याख्या ने भी कृष्ण चरित्र को जन जन तक पहुंचाने का बडा कार्य किया। श्री महाप्रभु वल्लभाचार्य, श्री चैतन्य महाप्रभु, श्री नारायण भट्ट, श्री घमंडदेव, स्वामी श्री हरिदास, श्री हित हरिवंश, श्री हरिराम व्यास आदि संतजन अथवा रसिकजनों ने रासलीला को तद्युगीन समाज में आध्यात्मिक और सांस्कृतिक चेतना का आधार बना दिया। इनमें से श्री नारायण भट्ट गोस्वामी को तो The father of vraj yatras And Rasalila Performences कहा जाता है। आपकी कृति 'ब्रज भक्ति विलास' कालांतर में कृष्ण लीलाओं का आधार ग्रंथ बन गई थी। नारायण भट्ट जी के बारे में कहा जाता है –भट्ट नारायण अति सरस, ब्रज मंडल सौं हेत।

ठौर ठौर रचना करी, निकट जान संकेत।।

कृष्ण चरित्र के लीला स्थलों को लोकप्रिय और जन चेतना से जोडने का श्रेय श्री नारायण भट्ट गोस्वामी जी को जाता है। आपने ब्रज क्षेत्र के 333 स्थलों को कृष्ण चरित्र से जोडकर उनकी लीलाओं का वर्णन किया है। कालांतर में ये स्थल ही कृष्ण चरित्र के लीला स्थल के रूप में विकसित और लोक की आस्था के केंद्र हुए। ब्रज यात्राएं इन स्थलों से निकलने लगीं।इन ब्रज यात्राओं में रासलीला मंडली संग चलती थीं। स्थान विशेष के आधार पर रासलीला होती थी।

श्रीमद्भागवत महापुराण में वर्णित रास कब लोक नाट्य का रूप धारण कर गया यह कहना कठिन है। रासलीला के मंचीय स्वरूप ने भारत के बडे भू भाग को लंबे समय तक आनंदित किया है। रासलीला ने लोक नाट्य विधा के रूप में भारत और भारत से बाहर भी ख्याति प्राप्त की है। 'रासलीला मंचन का इतिहास' बिंदु से डॉ.रामनारायण गोयल लिखते हैं–''रासलीला का मंचन कब से आरंभ हुआ यह निश्चित रूप से नहीं कहा जा सकता है। किंतु, श्रीमद्भागवत पुराण के दशम स्कंध में वर्णित रासलीला के आधार पर यह कहा जा सकता है कि रासलीला अथवा रास क्रीडा का प्रादुर्भाव कृष्ण कालीन ही है। इस प्रकार लगभग 2500 वर्ष से ब्रज का यह लोकनृत्य रूप सबसे पुराना माना जाता है। ऐतिहासिक दृष्टिकोण से भी पातंजलि महाभाष्य में (जो ईसा के 2 शताब्दी पूर्व का माना जाता है) रास का वर्णन मिलता है। उसके बाद के संदर्भों में नारायण भट्ट जी का 'वाणी समाहार नाटक', मौलाना दाउद की कृति चन्दायन (10वीं शती) तथा नानक जी की वाणी (16वीं शती) का आधार रासलीला को एक प्राचीन नृत्य क्रीडा सिद्ध करता है। आज भी धार्मिक भावना से प्रेरित यह लोक नृत्य नाटक के रूप में अपना सानी नहीं रखता है।"[13]

'रासलीला' मंचीय स्वरूप का विकास—मंचीय रासलीला का वर्ण्य विषय अष्टछाप के कवियों तथा अन्य कृष्ण

भक्त कवियों के पदों पर आधारित था। इन कवियों ने ब्रज बिहारी , ब्रजराज , रसराज, निकुंजराज आदि रूपों में कृष्ण का वर्णन किया है। कृष्ण की बाल लीलाओं में परमतत्व की स्थापना कर कृष्ण को भगवान स्वरूप में वर्णित किया है। देवकी नंदन, यशोदा नंदन, नंदनंदन, गोपी वल्लभ रूपों में कृष्ण के चरित्र को दिखाया है। भक्तिकालीन कृष्ण भक्तों के काव्य में कृष्ण का जो रूप वर्णित हुआ वही कृष्ण लीलाओं का आधार बना।

मध्यकालीन संतों में भक्त घमंडदेव हुए जिनका समय 16 वीं 17 वीं शती है। उन्हें इस बात का श्रेय दिया जाता है कि वे वृंदावन में निवास करते हुए राधाकृष्ण की झांकी बनाने लगे और यत्र तत्र निकुंजों में बैठकर रास बिहारी की लीलाओं का गान करते थे। 5-5, 7-7 वर्ष के छोटे छोटे बालकों को राधा कृष्ण के रूप में तैयार करते। चंदन और पुष्प आदि से उनका शृंगार कर राधा कृष्ण का रूप धारण कराते । संतजन मिलकर उस झांकी के सम्मुख राधा कृष्ण के निकुंज विहार की माधुरी का गान करते थे। यह रूप माधुरी वृंदावन में इतनी प्रचलित हो गयी कि जगह जगह संत और भक्त इस प्रकार के आयोजन करने लगे। इसे नित्य रास अथवा निकुंज रास कहा जाता था। इसका मूल भाव यही है कि प्रिया प्रियतम राधा कृष्ण नित्य निकुंज बिहारी हैं। वृंदावन उनकी क्रीडा स्थली है। चिर नवीन युगल जोडी की आराधना में संत और भक्त रास रस पान करते थे। वृंदावन का यह निकुंज बिहारी स्वरूप रास रस केलि के रूप में एक लंबे समय तक स्थापित रहा। आज भी वृंदावन में कई स्थानों पर यह निकुंज उपासना विधिवत बनी हुई है। वृंदावन बंशीवट स्थित सुदामा कुटी में आज भी सायं काल प्रतिदिन रासलीला का आयोजन होता है। यहां नित्य निकुंज बिहारी की बाल लीलाओं का मंचन किया जाता है। यह भी उल्लेखनीय है कि सुदामा कुटी रामानंदी संप्रदाय का प्रतिनिधि आश्रम है। रामनंदी आश्रम में रास बिहारी की उपासना इस बात का प्रमाण है कि वृंदावन में संतों के बीच रूप भेद का कोई बडा महत्व नहीं है।

रासलीला का व्यावसायिक अथवा आधुनिक रूप- जैसा विदित है कि रासलीला का मंचीय रूप भौतिक संसाधनों से परे मध्यकाल से ही चला आ रहा था। ब्रज भ्रमण पर आने वाले लोगों के लिए यह रासलीला आध्यात्मिक और मनोरंजन का रूप धारण करती जा रही थी। 'ब्रज' जैसे जैसे आध्यात्मिक चिंतन से छिटक कर पर्यटन के केंद्र में परिवर्तित हो रहा था वैसे वैसे रासलीला का स्वरूप भी बदलने लगा। यहां आने वाले लोगों में कुछ लोग इसे भक्ति भाव के रूप में देख रहे थे तो कुछ के लिए यह मनोरंजन की नाट्य विधा बन रहा था। रासलीला मंडल भी इसके स्वरूप में जन समुदाय की मांग के अनुरूप बदलाव कर रहे थे। अर्थात् इसका व्यावसायिक रूप विकसित होने लगा।

स्वतंत्रता संग्राम के दौर में लोक नाट्यों की भूमिका का भी अपना महत्व है। महात्मा गांधी ने अपनी कृति 'सत्य के साथ मेरे प्रयोग' में लिखा है कि वे नाटक सत्य हरिश्चंद को देखकर बहुत प्रभावित हुए थे। यह लोक नाट्य की ताकत थी। वृंदावन अपनी आध्यात्मिक और भक्ति चेतना के कारण अनेक महापुरुषों के लिए आकर्षण का केंद्र रहा था। स्वामी विवेकानंद जैसे तर्कशील व्यक्ति भी इस आकर्षण से बच न सके थे। सन् 1888 में वे वृंदावन गए थे। गांधी जी ने भी दो बार मथुरा वृंदावन की यात्रा की। महामना मदन मोहन मालवीय ब्रज क्षेत्र के गौ संरक्षण से इतने प्रभावित हुए कि वर्ष 1935 में उन्होंने वहां पर हासानंद गौशाला की स्थापना की। कहने का आशय यह है कि ब्रज विचारकों, समाज सुधारकों को अपनी ओर आकर्षित कर रहा था साथ ही पर्यटकों को भी लुभा रहा था। पर्यटकों की आवाजाही ने रासलीला के नए स्वरूप के विकास में बडा योगदान दिया है। 20 वीं शती के छठे से नौवें दशक के बीच का समय रासलीला के व्यावसायिक रूप का स्वर्णकाल कहा जाना चाहिए। यह वह समय है जहां ब्रज क्षेत्र में अनेक रासमंडली अस्तित्व में आयीं। रासलीला अनेक लोगों की आजीविका का साधन बनी। अनेक लोग रासलीला से जुड रहे थे। ब्रज की इस लोक विधा के आयोजन भारतवर्ष के प्रत्येक प्रांत में हो रहे थे। बरसाना के पास कमई, करहला और मंडोई गांव इस नए अवतार का केंद्र बने। ये तीनों गांव भौगोलिक रूप में आसपास हैं। इन्हीं गांवों के मध्य स्वामी घमंडदेव की समाधि स्थित है। घमंडदेव मध्यकाल के प्रसिद्ध संत थे जिनका उल्लेख हम पूर्व में कर चुके हैं। करहला में संत घमंडदेव के नाम से एक मंदिर बना हुआ है। यहां कृष्ण झूल बिहारी के रूप में विराजित हैं। यहां आज भी प्राचीन रासमंडल बना हुआ है। इस मंदिर में आज भी चौबीसों घंटे हरिनाम संकीर्तन चलता रहता है। घमंडदेव का एक मंदिर फरीदाबाद जिले के लीखी गांव में भी स्थित है यहां पर भी प्रतिवर्ष रासलीला का आयोजन होता है तथा भव्य शोभा यात्रा निकाली जाती है। करहला के संदर्भ में यह अनुमान लगाना कठिन नहीं होगा कि यदि स्वामी घमंडदेव यहां कुछ दिन साधनारत रहे होंगे तो उन्होंने रासलीला के आयोजन जरूर कराए होंगे। दूसरा कारण यह भी है कि यहां पर रासाचार्यों की जो परंपरा है वे किसी न किसी रूप में स्वामी घमंडदेव से प्रभावित रहे हैं। यहां के रासाचार्यों में स्वामी धीरज जी, चोथा स्वामी, स्वामी हरिद्वारी लाल, स्वामी लाडली लाल, स्वामी रमनलाल और अब स्वामी प्रवीण कुमार जी तक रासलीला मंचन के प्रचारक प्रसारक

रहे हैं। करहला और मंडोई में आज भी प्रतिवर्ष भाद्रपद शुक्ला पूर्णिमा के दिन महारास का आयोजन होता है। करहला में एक प्राचीन भवन बना हुआ है जिसे महल कहा जाता है। निकटवर्ती गांव मंडोई में उसी के समकालीन बनी हुई एक हवेली है। यहां ऐसी मान्यता है कि किसी राजा ने रासलीला की आध्यात्मिक प्रस्तुति पर चमत्कृत होकर इन भवनों का निर्माण कराया तथा सवा पांच किलो सोने का मुकुट उपहार स्वरूप प्रदान किया। यहां महल श्री कृष्ण के लिए तथा हवेली श्री राधा के लिए बनवाई गई। महारास के अवसर पर आज भी श्री कृष्ण को वही पुराना सवा पांच किलो सोने का मुकुट धारण कराया जाता है। वर्तमान में यह मुकुट सरकारी संपत्ति के रूप में बैंक के लॉकर में संरक्षित है। प्रतिवर्ष महारास के अवसर पर प्रशासन की देखरेख में इस मुकुट को रासस्थली पर ले जाया जाता है। वहां इसकी पूजा होती है और श्री कृष्ण बनने वाले स्वरूप को यह धारण कराया जाता है। आसपास के गांवों से हजारों की संख्या में ग्राम वासी इस मुकुट के दर्शन करने आते हैं। रासलीला का आनंद उठाते हैं। भव्य मेला जुडता है। करहला में स्वामी चोथा राम जी का बनवाया हुआ भवन स्वामियों की हवेली के नाम से प्रसिद्ध है। उनके परिवारीजन आज भी यहां पर निवास करते हैं। इस प्रकार रासलीला के मंचीय रूप को विकसित करने में करहला गांव की बडी भूमिका है। इन लोगों ने रासमंडली बनाकर विभिन्न तीज त्यौहार , धार्मिक आयोजन या अन्य उत्सवों के अवसर पर पूरे देश में अनेकानेक प्रस्तुतियां दी हैं। निश्चित रूप में ये प्रस्तुतियां कहीं न कहीं रासलीला के व्यावसायिक रूप से जुडी हुई हैं।

रासलीला के व्यवसायीकरण में दो नाम विशेष रूप से उल्लेखनीय हैं। एक स्वामी रामस्वरूप तथा दूसरा स्वामी हरगोविंद का। कमई गांव के स्वामी मेघस्याम का नाम भक्ति और लीलापरक रसिया लेखन में उल्लेखनीय है। उनके रसियाओं का संग्रह तीन खण्डों में प्रकाशित है। यह रसिया कृष्ण की किसी न किसी लीला से संबंधित हैं। प्राय: इनका संबंध निकुंज लीलाओं से है। इनके सुपुत्र स्वामी राम स्वरूप अपने समय के श्रेष्ठ बाल कलाकार थे। छ: वर्ष की आयु में ही ये कृष्ण का अभिनय करने लगे थे। सुंदर अभिनय और वाणी की मधुरता के कारण वृंदावन के संत इन्हें बहुत स्नेह करते थे। इनके मधुर गायन ने रासलीला को नई लोकप्रियता प्रदान की। जब ये कुछ बडे हो गए तो इन्होंने अपनी एक रास मंडली बनाई। ये वृंदावन में निवास करने लगे। इनकी रास मंडली की ख्याति ऐसी लोकप्रिय हुई कि भारत के विभिन्न प्रदेशों में ये रासलीला मंचन के लिए आमंत्रित किए जाने लगे। भारत से बाहर कुछ अन्य देशों में भी इन्होंने प्रस्तुतियां दीं। लोक कला के विकास में इनके महत्वपूर्ण योगदान के लिए भारत सरकार ने इन्हें वर्ष 2005 में पद्म श्री पुरस्कार से सम्मानित किया। ललित कला अकादमी द्वारा भी आपको पुरस्कृत किया गया।

स्वामी हरगोविंद भी कृष्ण के बाल चरित्र की भूमिका में अत्यंत लोकप्रिय हुए। भरतपुर जिले के जनूथर गांव निवासी हरगोविंद जी वाणी की मधुरता और स्पष्टता के लिए जाने जाते थे। छोटे कद के स्वामी हरगोविंद जी भक्त हृदय थे। 1936 में रासलीला से जुडे स्वामी हरगोविंद निरंतर नाम स्मरण और रास बिहारी भगवान में अगाध आस्था रखते थे। जीवन भर रासबिहारी की सेवा करते रहे। रास मंडली का संचालन करते रहे। आकाशवाणी केंद्र दिल्ली के ब्रजमाधुरी कार्यक्रम के लिए भेंटवार्ता के दौरान आपने इन पंक्तियों के लेखक को बताया कि 'रास बिहारी साक्षात् परमात्मा हैं। रास बिहारी की सेवा से स्वामी हरगोविंद और स्वामी रामस्वरूप को दुनिया जान गई। भारत सरकार ने पद्मश्री से सम्मानित किया।'' रासलीला में गोपियों की महत्ता को रेखांकित करते हुए स्वामी हरगोविंद ने नंददास का एक पद –'गोपी प्रेम की ध्वजा।' गाकर गोपियों की प्रेमाभक्ति को श्रेष्ठ बताया। इन्हें भारत सरकार द्वारा वर्ष 2006 में पद्म श्री सम्मान मिला। कई अन्य पुरस्कार भी इन्हें प्राप्त हुए। आपने बैंकोक, थाइलैंड, सिंगापुर आदि देशों में भी रासलीला मंचन किया। चैतन्य महाप्रभु के चरित्र को गौरांग लीला के रूप में प्रस्तुत कर आपने गौडिया भक्ति परंपरा को नई दिशा दी।

रासलीला में मंचीय सज्जा, प्रकाश व्यवस्था, पात्रों की अधिकता, आवागमन का व्यय, वस्त्राभूषणों का व्यय आदि के कारण रासलीलाओं के आयोजन में खर्च की अधिकता होने लगी। रास मंडली के सदस्य मासिक वेतन पर रखे जाने लगे। इस प्रकार रासलीला मंडलियों में व्यावसायिकता का दवाब बढता गया। एक निश्चित न्यौछावर तयकर मंडलियां रासलीला करने लगीं। श्रीकृष्ण जन्माष्टमी के अवसर पर इन मंडलियों की मांग अधिक रहती थी। आज भी जन्माष्टमी के अवसर पर भारत में अनेक स्थानों पर रासलीलाएं देखने को मिलती हैं। यद्यपि अब कुछ चर्चित अभिनेता या अभिनेत्री कृष्ण राधा के शृंगार में वैयक्तिक प्रस्तुतियां देने लगे हैं।

आज भी वृंदावन में अनेक लोग रासलीला के व्यवसाय से जुडे हुए हैं। यह ठीक है कि अब इस क्षेत्र में आजीविका की संभावनाएं कम हुई हैं फिर भी ब्रज में इस लोक कला से लोग जुडे हुए हैं। वर्तमान में रासलीला के जो रूप अधिक दिखाई पड रहे हैं उनमें – होली रास (फूल होली तथा लट्ठमार होली) मयूर नृत्य और चरकुला नृत्य हैं। ब्रज में शरद रात्रि के अवसर

पर रासलीला के भव्य आयोजनों की परंपरा का निर्वाह अब भी हो रहा है। भाद्रपद मास में बूढी लीलाओं के आयोजनों के माध्यम से स्थानीय स्तर पर गावों में रासलीलाएं होती हैं।

रासलीला : मंचीय प्रस्तुति—मंचीय रासलीला के दो हिस्से हैं—'रास' और 'लीला'। 'रास' में राधा कृष्ण के नित्य रास बिहार को प्रस्तुत किया जाता है। जैसा पूर्व में कहा गया कि वृंदावन में राधा कृष्ण को चिर नवीन युगल स्वरूप माना गया है। श्री राधा रास रासेश्वरि हैं। नित्य रास बिहार उन्हीं की आज्ञा से आरंभ होता है। इस रास मंचन को क्रमशः देखें तो कुछ इस प्रकार का स्वरूप दिखाई पडता है।

रास के लिए रास मंडल की आवश्यकता होती है। ब्रज के प्राचीन रासमंडल इस बात का प्रमाण हैं कि ये गोलाकार होते थे। इस पर एक ओर छोटा सा कुर्सीनुमा सिंहासन बना होता है। इसका आकार इतना बडा होता है कि उस पर राधा कृष्ण बने स्वरूप सहजता से बैठ सकें। उसको यथा संभव सजाया संवारा जाता है। इस रास मंडल के आस पास कोई एक ऐसा स्थान भी होता है जहां पर मंचन के लिए पात्रों को तैयार किया जाता है। इसे शृंगार घर कहा जाता है।

रास प्रस्तुति के तीन भाग कहे जा सकते हैं। स्वरूप , स्वामी और साजिंदे। मंच पर सबसे पहले साजिंदे आते हैं। आरंभ में सारंगी, मृदंग और झांझ प्रमुख साज हुआ करते थे। समय के साथ हारमोनियम , तबला, बांसुरी आदि का समावेश भी हो गया। रास के आरंभ में साजिंदे आकर कुछ भजन आदि गाते हैं। स्वामी जी आकर सबसे आगे स्थान ग्रहण करते हैं। ध्रुपद, धमार और भजन गायन आरंभ होता है। रास लीला में नृत्य, संगीत और अभिनय का संयोग है। यहां से संगीत आरंभ होता है। मध्य कालीन ब्रजभाषा काव्य में अधिकांश रचनाएं किसी न किसी राग में निबद्ध हैं। स्वामी जी उनमें से किसी रचना को उठाते और गाते हैं। साजिंदों के इस समूह को समाज कहा जाता है। प्रत्येक समाजी कोई न कोई भक्ति या आध्यात्मिक पद गाकर राधा कृष्ण की स्तुति करते हैं। इसी बीच मंच पर लगा परदा हटता है और सभी को स्वरूप दर्शन होते हैं।

स्वरूपों की संख्या 6 से 10 होती है। ये 6 से 12 वर्ष तक के बालक होते हैं। उनमें राधा, कृष्ण तथा राधा की आठ सखियां होती हैं। राधा कृष्ण मध्य में सिंहासन पर विराजित होते हैं। इसमें दाएं श्री कृष्ण तथा बाएं भाग में श्री राधा विराजित होती हैं। इनके दोनों ओर बराबर संख्या में सखियां बैठी अथवा खडी होती हैं। परदा हटते ही सबसे पहले स्वामी जी तथा उनके पश्चात् अन्य समाजीगण प्रणाम कर रास बिहारी भगवान के चरण स्पर्श करते हैं। रास बिहारी के प्रति आस्था को इस बात से समझा जा सकता है कि यदि स्वामी जी या अन्य किसी भी समाजी का पुत्र स्वरूप बना हुआ है तब भी वे उस सांसारिक संबंध को छोडकर श्री रास बिहारी भगवान के चरण स्पर्श करते हैं।

रास आरंभ होता है। सबसे पहले सखियां आरती गायन करती हैं। उनके हाथ में आरती का थाल होता है। वे आरती गाती हैं—"आरती कुंज बिहारी की कि गिरिधर कृष्ण मुरारी की।" या आरती बाल कृष्ण की कीजै, अपनौ जनम सुफल कर लीजै।" अथवा 'अधर धर मुरली बजैया की कि गिरधर कृष्ण कन्हैया की।" इसी प्रकार की एक और आरती—'जै जै राधावर ब्रजधर गिरिधर की गावौ सखी आरती युगल वर की।' आदि आरितियों का गायन सखियां करती हैं। यहां महत्वपूर्ण बात यही है कि आरती के केंद्र में चिर नवीन युगल सरकार ही रहते हैं। सखियों के हाथ में दीप सज्जित थाल होते हैं। क्रमशः सभी सखियां आरती करती हैं। आरती गायन में समाजीगण सखियों का संग देते हैं।

आरती के उपरांत सखियां राधा कृष्ण की स्तुति परक, शृंगार शोभा अथवा रासस्थली वृंदावन और ब्रज की महिमा का गुणगान करते हुए प्रिया प्रियतम से निवेदन करती हैं कि—"हे प्रिया प्रियतम जू आपके नित्य रास विहार कौ समय है गयौ है, कृपा करकें रास मंडल में पधारौ।" श्री कृष्ण सखियों की विनती स्वीकार करते हुए श्री राधा जी से रास में पधारने का निवेदन करते हैं—"हे श्री किशोरी जी आपके नित्य रास विहार में पधारवे कौ समय है गयौ है कृपा करकें नित्य रास में पधारें।" यहां वे राधा स्तुति में गाते हैं—"श्री राधे वृषभानुजा रसिकन प्राणाधार। वृंदाविपिन विहारिणी प्रणवहुं बारंबार।''

रास रासेश्वरि श्री राधे जी की अनुमति और सहभागिता से ही रास विहार संभव हो पाता है। श्री राधा गाती हैं-''प्यारे रास विलास कौ मोहि बडौ उत्साह। चलौ चलें सब सखियन लै कें नवल कुंज के मांहि।'' इसके साथ सभी स्वरूप रास मंडल के मध्य आ जाते हैं। यहां रास में नृत्य की उपस्थिति होती है। यहां भरत नाट्यम या कत्थक नृत्य की प्रस्तुति भी कई बार देखी जाती है। राधा कृष्ण कोई युगल संयोग शृंगार गीत गाते हैं। जैसे-

कृष्णः चलौ खेलिबे किशोरी बोलें गहवर में मोर

राधाः मैं न चलूंगी बिहारी वहां बसत हैं चोर।

कृष्णः कमल की कली कौ वृषभानु की लली कौ राधे

मुख चंद्र हू ते नीकौ मेरे नैना हैं चकोर। चलौ खेलिबे किशोरी बोलें गहवर में मोर।

राधा कृष्ण के युगल विहार से सखियां आनंदित होती

रहती हैं। राधा कृष्ण भिन्न भिन्न मुद्राएं बनाकर सखियों एवं दर्शकों को आनंदित करते हैं। इस प्रकार नित्य रास पूर्ण होता है। राधा कृष्ण सिंहासन पर विराजित हो जाते हैं। पर्दा गिर जाता है। कोई एक या दो सखी पर्दे के बाहर रह जाती हैं। वे दर्शकों के साथ हरिगुण गान या ब्रज महिमा, रास महिमा का मनोरंजक संवाद स्थापित करती हैं। कुछ मिनिटों के इस संवाद के मध्य पर्दे के पीछे श्रृंगारी राधा कृष्ण की कोई झांकी तैयार कर लेते हैं। झाँकियां वृंदावन के किसी मंदिर में विराजित स्वरूपों पर आधारित होती हैं। राधा वल्लभ , राधा रमण, बांके बिहारी, गोवर्धन धारी आदि। पर्दा उठता है। दर्शकों को झांकियों के निकट दर्शन का अवसर दिया जाता है। यथा योग्य लोग न्यौछावर भी चढाते हैं। इसी बीच श्रृंगार घर में लीला के निमित्त अन्य पात्र वस्त्राभूषण धारण कर लेते हैं। ये पात्र स्वरूप और समाजी दोनों में से होते हैं। इसके बाद आरंभ होती है लीला। लीला, जैसा कि पूर्व में कहा गया है, यह चरित्र आधारित मंचन है। सामान्यत: लीलाओं में कृष्ण की बाल लीलाएं, निकुंज लीलाएं और भक्त-संत चरित्रों का मंचन किया जाता है। बाल लीलाओं में -माखन चोरी, गौचारण, कृष्ण जन्मोत्सव, महादेव दर्शन, पूतना वध, तृणावर्त वध, कालीय नाग नाथन, आदि हैं। इनमें कुछ विशुद्ध बाल लीलाएं तथा कुछ कृष्ण की लोकोत्तर चमत्कार पर आधारित हैं। निकुंज लीलाओं में दान लीला, मानलीला , मोर लीला, चीर हरण, झूला लीला, स्याम सगाई , मनिहारिन लीला, वेणी गूथन, मनिहारिन, राजदान लीला आदि आती हैं।

भक्त चरित्र आधारित लीलाओं का मंचन अपेक्षाकृत नवीन विधा है। इसका श्रेय स्वामी किशन लाल जी को दिया जा सकता है। इन्होंने मीरा लीला, ध्रुव चरित्र, प्रह्लाद चरित्र, सुदामा चरित्र, उद्धव लीला, नरसी भगत, नानी बाई का मायरा आदि का उल्लेखनीय मंचन किया। स्वामी किशन लाल जी के सुपुत्र मोहन लाल और वल्लभ जी संगीत साधक थे। आप दोनों ने भक्तों के चरित्रों का मनमोहक मंचन किया। भक्त चरित्रों के माध्यम से रासलीला को ब्रज से बाहर का रूप दिया। जैसे भक्त नरसी चरित्र के माध्यम से गुजरात, मीरा के माध्यम से राजस्थान, नानी बाई का मायरा के माध्यम से राजस्थान को जोडा गया। प्रह्लाद और ध्रुव चरित्र के माध्यम से बालकों को भक्ति और सत्य की शिक्षा दी जाने लगी।

गुजरात के काठियावाड़ लोगों द्वारा ब्रज परिक्रमा का इतिहास लगभग 400 वर्ष पुराना है। इनके यहां श्रीनाथ जी की पूजा का विधान है। स्वामी किशन लाल जी दो दशक से भी अधिक समय तक इन यात्राओं में रासलीला करते रहे। यहां कृष्ण को श्रीनाथ जी का मुकुट धारण कराया जाता था। इसके साथ ही स्वामी हरगोविंद जी एवं श्री राम जी ने चैतन्य महाप्रभु के जीवन चरित्र पर आधारित गौरांग लीलाओं की प्रस्तुति भी आरंभ कीं। इनमें नाम संकीर्तन की प्रधानता होती है। इनके लेखन का श्रेय गौडिया संत प्रेमानंद बाबा को जाता है। पश्चिम बंगाल में ये लीलाएं बहुत प्रभावशाली रहीं। ब्रज में बंगाली साधुओं का आगमन भी इन लीलाओं को केंद्र में लाने का कारण था।

रासलीला में संगीत का योगदान अहम है। शास्त्रीय संगीत की प्रधानता पर आधारित अष्टयाम लीलाओं का उल्लेख इस दृष्टि से महत्वपूर्ण है । इसमें अष्टयाम सेवा पर आधारित पदों का गायन होता है। ब्रज में संगीत की प्रधानता इस लीला स्वरूप में देखी जा सकती है। यह लीला स्वरूप विशुद्ध शास्त्रीय संगीत पर आधारित है। इसे रासधारियों की संगीत शिक्षा के रूप में भी देखा जाता था। स्वामी श्रीराम जी एवं स्वामी कन्हैया लाल जी का उल्लेख इस दृष्टि से महत्वपूर्ण है।

स्वामी राम स्वरूप जी ने हरिदासी सम्प्रदाय के पदों पर आधारित हरिदासी रासलीलाएं कीं। इनके माध्यम से हरिदास-तानसेन, हरिदास-अकबर आदि पर आधारित लीलाएं होने लगीं। स्वामी हरिदास, संत हित हरिवंश, सूरदास जैसे महापुरुषों के जीवन पर आधारित रासलीलाओं का मंचन भी होने लगा। इस प्रकार विविध प्रयोगों से रासलीलाओं में नवीनता आई।

प्राय: रासलीला का समय रात्रिकाल में 7 से 10 या 8 से 11 तक का होता है। लीला के समापन पर मुकुट बिहारी की आरती की जाती है। आरती के उपरांत शयन के पद गाए जाते हैं। ये पद बिना वाद्ययंत्रों के गाए जाते हैं। इनका भाव यही होता है कि अब युगल सरकार के शयन का समय हो गया है। उन्हें सोने दिया जाए। 'अब पौढन कौ समय भयौ।' जैसे पद गाए जाते हैं। अथवा 'धन धन राधिका के चरण।' जैसे पदों से रास बिहारी को शयन कराया जाता है।

रासलीला और रसिया- 'रसिया' ब्रज लोक गीत विधा है। राग रंग से दूर रसिकता को केंद्र में रखकर रसिया की रचना होती है। होली उत्सव के अवसर पर इनका विशेष गायन होता है। आरंभ में रासलीला में रसिया गायन का उल्लेख नहीं मिलता। संत और भक्तों के मध्य रास होता था तो स्वाभाविक है कि उसमें भजन गाए जाने लगे होंगे। ये भजन लीला विशेष पर आधृत हो सकते हैं और आध्यात्मिक चिंतन परक भी। कालांतर में हाथरस के पंडित नथाराम शर्मा के कृष्ण चरित्र आधारित रसिया रासलीला में गाए जाने लगे। स्वामी मेघ स्याम जी ने अनेक रसिया लिखे। निकुंज लीला, बाल लीला, आध्यात्मपरक रसिया। रासलीलाओं

में सर्वाधिक इन्हीं के रसिया गाए जाते रहे। चंद्र सखी के रसिया भी रासलीलाओं में गाए जाते हैं। गोवर्धन निवासी घासीराम छीतरमल इस क्षेत्र के सुप्रसिद्ध लोकगीत लेखक और गायक हुए। इन सभी के रसियाओं में राधा कृष्ण की निकुंज लीलाओं का वर्णन अधिक किया गया। इस प्रकार रसिया रास में स्थान बनाने लगे। 'रास' और 'लीला' के संधि स्थल पर इनकी उपयोगिता सटीक बैठती थी। रसिया गायन की दूसरी उपयोगिता मनोरंजन के रूप में संगत रही। इसमें वाद्ययंत्र तेज ध्वनि के साथ बजते हैं इसलिए ये लोक नृत्य के अनुरूप होते हैं। लोक नृत्य जन सामान्य को अपने अधिक पास दिखाई पडता है। इस प्रकार रास में रसिया का समावेश हो गया और लोकप्रिय भी।

रासलीला का भविष्य- भारत में लोक विधाओं का ह्रास बडी तेजी से हुआ है। लोकनाट्य भी इनमें से एक है। रासलीला भी इसका अपवाद नहीं हैं। रासलीलाओं का मंचन व्यय साध्य होता चला गया। इधर भक्ति और आध्यात्म की गति बहुत मंद हो गई। यह गति जन सामान्य में से भी गई और रासधारियों में भी व्यावसायिकता के कारण उसका ह्रास हुआ। फिर, आधुनिक युग के नए मनोरंजन साधनों के सामने रासलीला ठहर नहीं पाई। बहुत दिन तक रासलीलाएं आजीविका का साधन बनी रहीं तब नए बालक इस ओर आ जाते थे। बहुत बार आर्थिक अभाव में भी माता पिता बच्चों को रास मंडलियों में भेज देते थे। शिक्षा का अभाव भी उसका एक कारण था। इधर शिक्षा के प्रचार प्रसार के उपरांत नए स्वरूप मिलना बंद हो गए। एक संकट यह था कि स्वरूप बनने की आयु तक तो इस क्षेत्र में रोजगार की संभावना बनी रहती थी पर बडे होने पर यहां रोजगार की सीमाएं बंध जाती हैं। इसलिए आजीविका के क्षेत्र का संकुचित होना भी इसके ह्रास का बडा कारण बना। रासलीला में नवीनता के अभाव ने भी इस विधा को संकुचित किया है अन्यथा जिस प्रकार रामलीला आज भी लोकप्रिय है वैसे ही रासलीला को भी बचाया जा सकता था। यह ठीक है कि अभी भी रासलीला मंडलियां कार्यरत हैं। पर अब इनमें वह धार नहीं है। लोकप्रियता का ग्राफ बहुत नीचे आ गया है।

रासलीला मंडलियों के बंद होने के उपरांत इनसे जुडे अधिकांश लोग मंदिर देवालयों में सेवक के रूप में जुड गए। कुछ ने उपरोहित्य कर्म को अपनी आजीविका का क्षेत्र बनाया। कुछ लोग श्रीमद्भागवत या भजन गायन को आजीविका का क्षेत्र चुन बैठे। यद्यपि बदले हुए सामाजिक परिदृश्य में इनमें से कोई भी मार्ग स्थाई आर्थिक सुरक्षा का भाव पैदा नहीं कर पा रहा है। वर्तमान में रासलीला के कुछ मंडल या संगीत प्रशिक्षण केंद्र मयूर नृत्य, फूल होली उत्सव, चरकुला नृत्य या परंपरागत रासलीला की प्रस्तुति दे रहे हैं। भारत सरकार तथा अन्य प्रदेश सरकारों के संस्कृति मंत्रालय द्वारा संस्कृति संरक्षण के अभियान में ये लोग इस विधा को संरक्षित करने का प्रयास कर रहे हैं। पर, इसका स्वरूप और प्रस्तुतिकरण रास लीला के मूल रूप से एकदम भिन्न है। रासलीला का यह रूप कितनी दूर तक जाएगा यह कहा नहीं जा सकता।

तथ्य प्रस्तुति

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संत कबीर-काव्य में भारतीय संस्कृति की अभिव्यक्ति

डॉ करुणा शर्मा

मानवतावादी, लोक कल्याणकारी और उच्च स्तर की चेतना से संपन्न संत कबीर हिंदी साहित्य जगत के वे चमकते हुए नक्षत्र हैं जिनकी चमक आज लगभग छह सौ वर्षो के बाद भी ज्यों की त्यों बनी हुई है। उनका सारा जीवन सत्य की खोज और असत्य के खंडन में बीता। 'मसि कागद छूओ नहीं, कलम गहि नहीं हाथ।' के अनुसार वे पढ़े-लिखे तो नहीं थे लेकिन उनके द्वारा कही गई यह उक्ति 'तू कहता कागद की लेखी। मैं कहता आँखिन की देखी।' सिद्ध करती है कि उन्होंने जो कुछ कहा, अपने अनुभव के आधार पर कहा। अपने परिवार के साथ रहते हुए, चरखा चलाकर कमाई गई आजीविका-अर्जन से परिवार का पालन करते हुए अर्थात् एक सद्गृहस्थ के कर्तव्यों का पूर्ण रूप से निर्वहन करते हुए आध्यात्मिकता के शिखर पर पहुँचना संत कबीर के जीवन की महान उपलब्धि थी। ऐसे 'संत कबीर के काव्य में भारतीय संस्कृति की अभिव्यक्ति' पर विचार करने से पूर्व संस्कृति शब्द को समझ लेना अपेक्षित होगा।

संस्कृति शब्द संस्कृत भाषा की 'सम्' धातु से बना है। इस धातु से तीन शब्द बनते हैं-प्रकृति अर्थात् मूल स्थिति, संस्कृति अर्थात परिष्कृत स्थिति तथा विकृति अर्थात अवनत स्थिति। जब प्रकृत पदार्थ परिष्कृत किया जाता है तो यह संस्कृत हो जाता है और जब यह बिगड़ जाता है तो विकृत हो जाता है। लैटिन भाषा के कल्ट अथवा कल्टस शब्द से अंग्रेजी में आया कल्चर शब्द का एक अर्थ विकसित करना अथवा परिष्कृत करना भी होता है। यदि संक्षेप में इसका अर्थ करें तो हम कह सकते हैं कि संस्कृति संस्कारित करती है, शोधित करती है, परिष्कृत करती है।

संस्कृति किसी देश की आत्मा होती है। इससे उन संस्कारों का बोध होता है जिनके सहारे वह देश सामूहिक या सामाजिक जीवन के आदर्शों का निर्माण करता है। इसमें धर्म, ज्ञान, विश्वास, रीति-रिवाज, कला, आदर्श, नियम आदि सभी बातें आ जाती हैं जिन्हें इन वर्गो में बाँटा जा सकता है-धार्मिक तथा आध्यात्मिक जीवन, समाज संगठन, राजनीति, आर्थिक तंत्र, लोकविश्वास, आस्थाएं तथा मान्यताएं, ललित कलाएं आदि। इन तत्वों से किसी भी देश की, किसी काल-विशेष में संस्कृति का ज्ञान होता है।

भारतीय संस्कृति सदैव मानवतावादी और उदारतावादी रही है। यह अध्यात्म और चिंतन की सर्वश्रेष्ठ अभिव्यक्ति है। भारतीय संस्कृति के लचीलेपन में जब भी जड़ता की स्थिति निर्मित होती है, तभी कोई न कोई महापुरुष इसे गतिशीलता प्रदान कर इसकी सहिष्णुता को एक नई आभा से मंडित कर देता है जैसे शंकराचार्य, गुरुनानक, चैतन्य महाप्रभु, स्वामी विवेकानंद आदि। यही काम मध्यकाल में संत कबीर ने किया। भारतीय संस्कृति में आई जड़ता को कबीर ने अपनी अनुभवसिद्ध वाणियों से गतिशीलता प्रदान कर उसे एक नई आभा से महिमामंडित किया।

किसी प्रबंध काव्य में तत्कालीन संस्कृति की जैसी स्पष्ट अभिव्यक्ति हो सकती है, वैसी किसी मुक्तक काव्य में संभव नहीं हो पाती। कबीर ने मुक्तक काव्य की रचना की है, अत: उनके काव्य में संस्कृति की स्पष्ट रूपरेखा तो देखने को नहीं मिलती तथापि कहीं प्रत्यक्ष रूप में और कहीं प्रसंगवष तत्कालीन संस्कृति के स्वरूप की झांकी देखने को अवष्य मिलती है।

कबीर का ज्ञान वेदादि धर्म-ग्रंथों पर आधारित नहीं था अपितु स्वयंसंवेद्य था। वे किसी प्राचीन व्यवस्था में नहीं बँधे थे अपितु अपनी वैयक्तिक अनुभूति के सहारे निर्भीकतापूर्वक अपने समय की सामाजिक विकृतियों के सुधार में लगे रहे। उनके काव्य में समाज के विभिन्न पहलुओं का वर्णन अपने आप आ गया है। यद्यपि वे निर्लिप्त थे तथापि चारों ओर व्याप्त पाखंडपूर्ण वातावरण से स्वयं को विलग नहीं रख सके। संत कबीर के समय में ईश्वर को पाने के लिए अनेक प्रकार के धार्मिक आडंबर, अंधविश्वास, बहुदेवोपासना, मूर्तिपूजा, अनेक प्रकार

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के जप-तप, अनेक प्रकार की साधनाएं, साथ ही विविध प्रकार का आडंबरयुक्त आचरण देखे जा रहे थे। मूर्ति पूजा अपने चरम पर थी मूर्ति की मंदिरों में प्रतिष्ठा की जाती थी, उन पर लड्डू, लपसी आदि मिष्ठान्नों का भोग लगाया जाता था और जो चढ़ावा चढ़ाया जाता था, मंदिर का पुजारी मूर्ति के मुख से छुआकर अपने घर ले जाता था-

पांहण केरा पूतला, करि पूजैं करतार।
लाडू लावण लापसी, पूजा चढै अपार।
पूजि पुजारा ले गया दे मूरति कै मुहि छार।

उन्होंने इन सब विकृतियों को अपने काव्य में वर्णित तो किया ही है किंतु इन विकृतियों को दूर करने के लिए तत्कालीन समाज को भारतीय संस्कृति के अनुरूप संस्कारित भी किया। जब उन्होंने देखा कि ईश्वर प्राप्ति के लिए लोग विभिन्न प्रकार का आडंबरयुक्त आचरण कर रहे हैं तो उन्होंने अत्यंत सरल जनवाणी में अपने विचारों को कुछ यों अभिव्यक्त किया-

ज्यों नैनन में पूतरी, त्यों मालिक घर मांहि।
मूरख लोग न जानिए, बाहर ढुढत जाहिं।।

अर्थात जैसे नेत्रों में पुतली रहती है, वैसे ही ईश्वर तुम्हारे शरीर में ही विराजमान है, उसे खोजने के लिए बाहर जाने की आवश्यकता नहीं है।

भारतीय संस्कृति की एक विशिष्टता पुनर्जन्म और कर्मफल में कबीर स्वयं भी अटूट विश्वास रखते थे। वे एक स्थान पर कहते हैं-

पूरब जनम हम ब्राँह्मन होते, वोछै करम तप हीनाँ।
रामदेव की सेवा चूका, पकरि जुलाहा कीन्हा।।

अर्थात् पहले जन्म में मैं एक ब्राह्मण था, लेकिन निम्न कोटि के कर्म करने के कारण और ईश्वर की सेवा न करने के कारण ही मुझे जुलाहे के रूप में जन्म लेना पड़ा।

संत कबीर को प्रभु-अनुकंपा प्राप्त हो गई थी, इसके पीछे भी वह पूर्व जन्म के कर्मों का परिणाम मानते हैं। नियति पर भी उन्हें पूरा विश्वास था। जो भाग्य में लिख गया है, वह करोड़ों उपायों के द्वारा न मासे भर घटाया जा सकता है और न बढ़ाया ही जा सकता है। उसे तो भोगना ही पड़ेगा।

करम करीमाँ लिखि रहया, अब कछू लिख्या न जाइ।
मासा घटे न तिल बधै, जो कोटिक करौ उपाइ।।

वर्णाश्रम धर्म व्यवस्था जो भारतीय समाज का मेरूदंड रही, अब जाति-व्यवस्था में परिवर्तित हो गई थी। इसके परिणामस्वरूप अनेकानेक जातियाँ अस्तित्व में आ गई थीं। यद्यपि कबीर स्वयं वर्ण और जाति व्यवस्था के धुर विरोधी थे, फिर भी अपनी समकालीन जातियों और उद्योग-धंधों का यथा प्रसंग वर्णन किया है। कबीर ब्राह्मण, कुम्हार, धोबी, नाई, बढ़ई, कसाई आदि के व्यवसायों को एक पद में उल्लेख करते हुए कहते हैं-

कुंमरा हवै करि वासन घरिहु, धोबी हवै मल धोऊं।
चमरा हवै करि रंगौ अधौरी, जाति पाँति कुल खोऊँ
तेली हवै तन कोल्हूँ करिहौं, पाप पुंनि दोऊ पीरौं।
पंच बैल जब सूध चलाऊँ, राम जेवरिया जोरूँ।
क्षत्रि हवै करि खड्ग सँभालूँ, जोग जुगति दोउ साधूँ।
नऊवा हवै करि मन को मूँडूँ, हवै बाढ़ी कर्म बाढूँ।
अवधू हवै करि यहु तन धूतौ, बधिक हवै मन मारूँ।
बनजारा हवै करि तन कूँ बनिजूँ, जुवारी हवै जम हारूँ।

कबीर स्वयं भी जुलाहा थे, उनके काव्य में जुलाहा जाति और उसके वस्त्र बुनने के व्यवसाय का उल्लेख अनेक बार मिलता है। जीवन भर उन्होंने इस जाति के धर्म को संपादित किया, 'झीनी-झीनी रे बीनी चदरिया'।

भारतीय संस्कृति की कर्म आधारित वर्ण-व्यवस्था धीरे-धीरे जन्म आधारित हो गई थी और फिर यह सैंकड़ों जातियों और उपजातियों में विभाजित हो गई। इसका दुष्परिणाम यह हुआ कि ब्राह्मण तो उच्च स्थान पर प्रतिष्ठित हो गए और शूद्रों की स्थिति बहुत निम्न और दयनीय हो गई। इस व्यवस्था को देख संत कबीर का हृदय बहुत द्रवित हो उठा। वे चाहते थे कि अति शीघ्र समाज को इस व्यवस्था से मुक्ति मिले। उनका मानना था कि ईश्वर की दृष्टि में सभी एक समान हैं और एक ही ज्योति से सबकी उत्पत्ति हुई है। वे कहते हैं-

एक बूंद एकै मलमूत्र, एक चम्म एक गूदा।
एक ज्योति थैं सब उत्पन्ना, कौन बाम्हन कौन सूदा।

वे यह भी मानते थे कि ईश्वर यत्र-तत्र-सर्वत्र विद्यमान है। कोई ऐसा जीव नहीं, कोई ऐसा स्थान नहीं, जहाँ ईश्वर की उपस्थिति न हो। अपनी एक साखी में वे यही बात वर्णित करते हैं-

जल में कुंभ कुंभ में जल है, बाहर भीतर पानी।
फूटा कुंभ जल जलहिं समाना, यह तत्त कहै गियानी।।

भारतीय संस्कृति के मूलतत्व 'प्रेम' को उनके काव्य में पर्याप्त अभिव्यक्ति मिली है। वे कहते हैं कि चाहे कोई कितने ही शास्त्रों का अध्ययन कर ले, वह पंडित नहीं हो सकता। जो ढाई अक्षर वाले 'प्रेम' शब्द को गहराई से पढ़ लेगा, वही पंडित होगा-

पोथी पढ़ि पढ़ि जग मुआ, पंडित भया न कोय।
ढाई आखर प्रेम का पढ़े सो पंडित होय।।

'प्रेम' तत्व को महत्व देने वाली अनेक साखियाँ उनके काव्य में देखी जा सकती हैं।

भारतीय संस्कृति में तो गुरु का अनन्य स्थान है। आध्यात्मिकता का शिखर बिना गुरु की सहायता के नहीं पाया जा सकता, यह बात संत कबीर ने अत्यंत प्रारंभ में ही समझ ली थी। इसीलिए उन्होंने उस समय के महान गुरु स्वामी रामानंद को गुरुरूप में स्वीकार किया। उन्होंने लिखा भी है-

हम कासी में प्रगट भए हैं, रामानंद चेताए।

गुरुमहिमा का अपने जीवन पर प्रभाव को देखकर ही उन्होंने गुरु को ईश्वर से भी बड़ा माना। उनका यह दोहा तो पढ़े-लिखे और अनपढ़ सभी को कंठस्थ है-

गुरु गोविंद दोउ खड़े काके लागूं पांय।
बलिहारी गुरु आपणे, गोविंद दियो बताय।

अपनी एक साखी में वे लोगों को यह बताते हुए भी देखे जा सकते हैं कि सद्गुरु को पाना अत्यंत कठिन काम है। अगर उसे पाने के लिए शीश का बलिदान भी करना पड़े तो भी उसे सस्ता सौदा ही समझना चाहिए-

यह तन विष की बेलरी, गुरु अमृत की खान।
शीश दियो जो गुरु मिले, तो भी सस्ता जान।

स्वयं कबीर ने गुरु पाने के लिए अनेक बाधाओं का सामना किया था।

ईश्वर का सतत स्मरण ही मनुष्य को दुखों से मुक्ति दिला सकता है, इस बात को लोगों को वे इस प्रकार समझाते हैं-

दुख में सुमिरन सब करैं सुख में करे न कोय।
जो सुख में सुमिरन करैं तो दुख काहे को होय।।

भारतीय संस्कृति में निर्गुण और सगुण भक्ति पर पर्याप्त बल दिया गया है। यद्यपि कबीर निर्गुण भक्त कवि के रूप में स्वीकार्य हैं तथापि उनकी निर्गुण भक्ति की यात्रा सगुण की प्रतीकात्मकता से ही पूर्ण होती है-

दुलहिनीं गावहु मंगलाचार।
हम घरि आए हो राजाराम अवतार।
तन रत करि मैं मन रति करिहूँ, पंच तत बराती।
रामदेव मोरैं पाहुनैं आए, मैं जोबन मैं माती।
सरीर सरोवर बेदी करिहुँ, ब्रह्मा बेद उचार।
रामदेव संगि भाँवरि लैहूँ, धंनि धंनि भाग हमार।।

कबीर ने किसी विषय को केंद्रित कर अपने काव्य की रचना नहीं की। वे तो सहज प्रतिभा संपन्न मनमौजी कवि थे। आध्यात्मिक भावना पर आधारित इस पद में भारतीय संस्कृति के वैवाहिक संस्कार का भी पूरा आनंद लिया जा सकता है। सौभाग्यवती स्त्रियों का विवाह के अवसर पर मंगलगान गाना, द्वार पर बारात का आना, बारातियों का स्वागत-सत्कार, बेदी बनाना आदि वैवाहिक कर्म आज भी किए जाते हैं।

अन्त्येष्टि संस्कार का वर्णन भी उनके काव्य में देखा जा सकता है। हिंदुओं में जब किसी की मृत्यु हो जाती है, तो उस अवसर पर मृतक के लिए कफन बनाना, पिंड दान के लिए आटा सानना, खाली हांडी में अग्नि लेकर मृतक को लेकर भाई-बंधुओं का श्मशान लेकर जाना आदि का वर्णन इस साखी में हुआ है-

पांच गज दोवटी मांगी, चूंन लीयौ सांनि।
बैसंदर पोषरी हांडी, चल्यै लादि पलानी।।

कपाल क्रिया, पिंडदान, गंगा मे अस्थि विसर्जन, श्राद्धादि के समय ब्राह्मणों और कौओं को भोजन खिलाना आदि रस्मों पर बात करते हुए संत कबीर ने उनके खोखलेपन को भी पहचाना था।

कबीरकालीन समाज में पर्दा प्रथा तो थी लेकिन सभी स्त्रियाँ पर्दा नहीं करती थीं। अविवाहित कन्या का शृंगार करना अशोभनीय माना जाता था। कबीर ने कहा भी है,

कबीर कन्या करै स्यंगार, सोच न पावै बिन भरतार।

उस समय पतिव्रता स्त्रियाँ अपने पति का नाम नहीं लेती थीं। वे पति को संबोधित करने के लिए 'ननद के भाई' कहती थीं जैसे

कातौंगी हजरी का सूत, नणद के भइया की सौं।

अपनी बात की प्रामाणिकता के लिए वे अपने पति की शपथ लेती थीं। उस समय सती प्रथा तो विद्यमान थी लेकिन हर स्त्री सती हो ऐसा भी आवश्यक नहीं था। लेकिन जिसके पति की मृत्यु हो जाती थी, वह स्त्री किसी प्रकार का शृंगार नहीं कर सकती थी। पति की मृत्यु पर सती होने की इच्छा रखने वाली स्त्री अपने सभी सौभाग्य सूचक चिह्नों को एकत्र करके, हाथ में सिंदूर पात्र 'सिंधौरा' लेकर अपने सती होने के संकल्प को बताती थी।

अब तो जरें बरें बनि आवै, लीन्हों हाथ सिंधौरा।

संत कबीर के समय समाज में उच्च, मध्य और निम्न वर्ग थे। समाज में एक ओर वैभव-विलास की भरमार थी तो दूसरी तरफ दैन्य और निर्धन लोगों का करुण क्रंदन। वे कहते हैं-

एकनि दीना पाट पटंबर, एकनि सेज निवारा।
एकनि दीनी गरै गूदरी, एकनि सेत पयारा।।

कबीर के काव्य में तत्कालीन अर्थ तंत्र की स्पष्ट झांकी मिलती है। उनके काव्य में ऐसे अनेक प्रसंग आए हैं जिनसे तत्कालीन उद्योग-धंधों का, व्यापार का, लोगों के रहन-सहन का पता चलता है। उनके समय में आजीविका के तीन साधन थे-कृषि, विभिन्न धंधे तथा व्यापार। उनकी रचनाओं में कृषि की भूमि, सिचाई फसल की रक्षा, खेती में काम आने वाले

औजारों आदि का उल्लेख मिलता है। उद्योग-धंधों में रुई का उद्योग, मदिरा-निर्माण, मिट्टी के बरतन आदि बनाने का उद्योग, लुहारी, सुनारी, कपड़ा रंगने का व्यवसाय, सिकलीगिरी अर्थात अस्त्रों और औजारों पर धार या सान चढ़ाने अथवा कलई करने का काम, कसाई का धंधा, पान बेचने, कपड़े धोने और इस्त्री करने का व्यवसाय, माली आदि का वर्णन मिलता है। रंगरेज मंजीठ का रंग कपड़े पर चढ़ाता था, वह रंग बहुत पक्का होता था और धोने पर भी छूटता नहीं था बल्कि और भी चमकदार हो जाता था। कपड़े रंगने के व्यवसाय का प्रतीकात्मक चित्रण करते हुए कबीर कहते हैं-

सतगुरु है रंगरेज, चूनर मेरी रंगि डारी।
स्याही रंग छुड़ाइ के रे, दियो मजीठा रंग।
धोये से छूटै नहीं रे, दिन दिन होत सुरंग।
भाव के कुंड नेह के जल में, प्रेम रंग दई बोर।।

लोकविश्वास, मान्यताएं और आस्थाएं किसी भी संस्कृति की रीढ़ होती हैं। कबीर के काव्य में हिंदुओं और मुसलमानों के धार्मिक, पौराणिक और लोक प्रचलित विश्वासों और रूढ़ियों का चित्रण मिलता है। उस काल में कुछ ऐसी मान्यताएं और आस्थाएं प्रचलित थीं जो जन जीवन में ऐसे समा गई थीं कि उन्हें ही लोगों ने अपने जीवन का सब कुछ मान लिया था।

सामान्य लोक में यह विश्वास भी प्रचलित है कि अच्छे कर्मों से स्वर्ग और बुरे कर्मों से नरक मिलता है और ऐसा ही इस्लाम धर्म में भी माना जाता है। कलमा, रोजा, नमाज, जकात और हज करने वाला तो जन्नत में जाता है और इनसे विमुख रहने वाला दोजख में जाता है-

रोजा करैं निवाज गुजारैं कलमैं भिसत न होई।

यद्यपि कबीर ने हिंदू और मुस्लिम संप्रदायों में प्रचलित इस मान्यता का खंडन किया है। कबीर काल में अवतारवाद पर भी लोगों का विश्वास था। इसके साथ ही पूजा के भी विभिन्न प्रकार प्रचलित थे। अवतार संबंधी कई कथाओं का उल्लेख उनके काव्य में मिलता है-

राम कृष्ण अवतार हैं, इनकी नांही मांड।
जिन साहिब सृष्टि किया, किनहूँ न जाया रांड।

संत कबीर के समय में यह विश्वास प्रचलित था कि काशी में मरने पर स्वर्ग और मगहर में मरने पर नरक मिलता है। लेकिन कबीर का मानना था कि यदि काशी में मरने पर मुक्ति मिल जाए तो लोग मोक्ष के लिए राम से प्रार्थना क्यों करें-

लोका मति के भोरा रे।
जो कासी तन तजै कबीरा, तौ रामहि कहा निहोरा रे।

उनके काव्य में भारतीय संस्कृति के अभिन्न अंग ज्योतिष, तंत्र-मंत्र पर विश्वास, शकुन विचार आदि का भी वर्णन मिलता है। दक्षिण दिशा में कुत्ते का भूकना शुभ शकुन माना जाता है-

दखिन कूट जब सुनहां भूका, तब हम सगुन विचारा। जैसे अनेक वर्णन देखे जा सकते हैं।

ललित कलाएं किसी देश की उच्च स्तरीय अभिरुचि तथा उसकी सांस्कृतिक परंपरा की उत्तम निदर्शक हुआ करती हैं। वास्तुकला, मूर्तिकला, चित्रकला, संगीतकला एवं नृत्यकला आदि का बहुत कम वर्णन कबीर के काव्य में मिलता है। उनके काव्य से हमें इस बात की जानकारी अवश्य मिलती है कि उनके समय में साधारण लोगों के मकान ईंट-पत्थर के बने होते थे जबकि राजा, मंत्री आदि के विशिष्ट भवन होते थे। गांवों में लोग चूने और मिट्टी से बने मकानों में रहते थे। हिंदुओं में मूर्ति कला का प्रचलन था। देवमूर्तियां अधिकांशत: पत्थर और मिट्टी की बनी होती थीं। कबीर ने चित्रकार के तरह-तरह के चित्रों का उल्लेख किया है—

चचा चरित चित्र है भारी, तजि विचित्र चेतहुँ चितकारी।

संगीतकला की जानकारी भी कबीर के काव्य में मिलती है—

सातौं सबद जु बाजते, घरि घरि होते राग।

संगीत के विभिन्न यंत्र जैसे दमामा, निशान, शहनाई, नगाड़े, ढोल, डुगडुगी, वीणा, मंदल, रबाब भेदी, तुरही आदि का प्रयोग उनके काव्य में देखने को मिलता है। नृत्यकला के बारे में कबीर के काव्य में कुछ विशेष ज्ञात नहीं होता। नर्तक के लिए वे नट शब्द का प्रयोग करते हैं।

भारतीय सांस्कृतिक मूल्य भी उनके काव्य-संसार में कदम-कदम पर खोजे जा सकते हैं। किसी भी बात की अति मानव जीवन के लिए दुख का कारक बन जाती है, इस बात को वे बड़ी ही सरल भाषा में समझा भी देते हैं, साथ ही इस संदेश को भी बड़ी कुशलता से प्रेषित कर देते हैं कि अति से सर्वदा बचना चाहिए-

अति का भला न बोलना, अति की भली न चूप।
अति का भला न बरसना, अति की भली न धूप।

वाणी ऐसी बोलनी चाहिए जो तुम्हें भी आनंदित करे और दूसरों को भी।

ऐसी वानी बोलिए मन का आपा खोय।
औरन को सीतल करै आपुहि सीतल होय।

भारतीय संस्कृति में इस बात पर बल दिया गया है कि दूसरों के मूल्यांकन से पहले व्यक्ति को आत्म मूल्यांकन करना चाहिए। कबीरदास ने इस बात को अपने जीवन में भी उतारा, तभी तो वे कह पाए—

बुरा जो देखन मैं चला बुरा न मिल्या कोय।
जो मन देखा आपणा, मुझसे बुरा न कोय।

जब वे दूसरे व्यक्तियों को अन्य लोगों पर हँसते हुए देखते हैं तो वे उन पर व्यंग्यात्मक कटाक्ष करते हुए कहते हैं–

दोस पराए देखि करि चला हसंत हसंत।
अपने याद न आवई जिनका आदि न अंत।।

वे लोगों को इस बात के लिए भी शिक्षित करते हैं कि कभी किसी को अपने से हीन मानकर उसकी निंदा नहीं करनी चाहिए–

तिनका कबहुँ न निंदिए, जो पाँव तरि होए।
कबहुँ उड़ि आँखन परि, पीर घनेरी होए।।

वे संसार की क्षणभंगुरता का अनुभव करने के पश्चात बड़े ही सरल उदाहरण से लोकभाषा में इस प्रकार अभिव्यक्ति प्रदान करते हैं–

माली आवत देखि करि कलियन करी पुकार।
फूलि फूलि चुन लई काल्हि हमारी बार।।

धर्म का निवास कहाँ है, पाप कब होता है, काल कब आ जाता है और स्वयं ईश्वर कहाँ रहता है, इतनी सारी बातों का वर्णन एक साखी में कबीर जैसा व्यक्तित्व ही कर सकता है–

जहाँ दया तहाँ धर्म है, जहाँ लोभ तहाँ पाप।।
जहाँ क्रोध तहाँ काल है, जहाँ क्षमा तहाँ आप।

ऐसे अनेकानेक सांस्कृतिक तत्वों से कबीरदास का काव्य संसार भरा पड़ा है।

इस प्रकार कहा जा सकता है कि संत कबीरदास जैसे कवि युगों-युगों में कभी-कभी जन्म लेते हैं। उनके स्वयं के जीवन में भारतीय संस्कृति रची-बसी थी, इसीलिए भारतीय संस्कृति के विविध रूपों को उनके काव्य में पर्याप्त अभिव्यक्ति मिली है। इस से यह भी सिद्ध हो जाता है कि जनजीवन से उनका घनिष्ठ संबंध था। चाहे वह आध्यात्मिकता की बात करते हैं या समाज सुधार की, उनकी रचनाओं में भारतीय संस्कृति स्वत: ही प्रस्फुटित हो उठी है।

रामायण में पर्यावरण चिंतन

डॉ. वेद प्रकाश

रामायण आदि कवि महर्षि वाल्मीकि द्वारा प्रणीत ऐसी महत्वपूर्ण रचना है जिसका विस्तार विविध आयामी है। चौबीस हजार श्लोक, पाँच सौ सर्ग तथा सात काण्डों में इस महाकाव्य का विस्तार मिलता है। जिसमें जीवन- जगत के अनेक महत्वपूर्ण विषयों की विस्तृत व्याख्या है। रामायण में इतिहास, दर्शन, भूगोल, राजनीति तथा मनोविज्ञान के साथ-साथ धर्म, अर्थ, काम, मोक्ष के नाम से प्रसिद्ध चारों पुरुषार्थों का सांगोपांग निरूपण मिलता है। जीवन- जगत का कोई कोना ऋषि दृष्टि से अछूता नहीं रहा है। रामायण के महत्व का उद्घाटन प्रथम अध्याय के चौबीसवे श्लोक में इस प्रकार मिलता है-

धर्मार्थकाममोक्षाणाम् साधनं च द्विजोत्तमा:।
श्रोतव्यं च सदा भक्तया रामायणपरामृतम्।[1]

अर्थात् रामायण धर्म, अर्थ, काम और मोक्ष का साधन तथा परम अमृत रूप है अत: सदा भक्तिभाव से उसका श्रवण करना चाहिए। रामायण एक ऐसी पुण्य सलिला है, जिसमें अवगाहन करने से व्यक्ति भ्रम, भय, चिंता तथा विविध आयामी अवसादो से मुक्त होकर सद्गति की ओर अग्रसर होता है।

मनुष्य को समस्त जीव सृष्टि में श्रेष्ठ माना गया है। इस जीव की निर्मिति से पूर्व परमात्मा ने उसके जीवन की सुचारूता तथा सुविधा हेतु अग्नि, जल, वायु तथा प्रकृति आदि से संबंधित पर्यावरण की रचना की। भारतीय चिंतन परंपरा में अनेक स्थानों पर उपर्युक्त बातों की पुष्टि अथवा चर्चा मिलती है। ऋग्वेद के नौवें मंडल के दूसरे सूक्त में कहा गया है-

आ वच्यस्व महि प्सरो वृषेन्दो द्युम्नवत्तम:रू।
आ योनि धर्णसि: सद:।।[2]

अर्थात् परमात्मा कोटि- कोटि ब्रह्माण्डों का आधार है, उसी के शासन में द्युलोक, भूलोक, स्वलोक इत्यादि लोक लोकान्तर परिभ्रमण करते हैं, वही इस चराचर ब्रह्मांड का आधार है।

आज हमें पुन: इस बात को समझने की आवश्यकता है कि विज्ञान के अति आच्छादन्न में हमने यह भूलाने का प्रयास किया है कि इस चराचर ब्रह्मांड का आधार मनुष्य अथवा विज्ञान नहीं है अपितु परमात्मा है। उसी ने मनुष्य के जीवनयापन हेतु पर्यावरण तथा प्रकृति की व्यवस्था-संरचना की है। ऋग्वेद के नौवें मण्डल के चौथे सूक्त में कहा गया है-

अवावशन्त धीतयो वृषभस्याधि रेतसि।
सूनोर्वत्सस्य मातर:।।[3]

अर्थात् गौ अपने बच्चे को दुग्ध पिलाकर जिस प्रकार परिपुष्ट करती है,उसी प्रकार प्रकृति अपने इस कार्यरूप ब्रह्मांड को अपने परमाण्वादी दुग्धों द्वारा पुष्ट करती है। तात्पर्य यह है कि प्रकृति इस जगत का उपादान कारण है। परमात्मा निमित्त कारण है और यह संसार वत्स समान प्रकृति और वृषभरूपी पुरुष (परमात्मा) का कार्य है।

'पर्यावरण' शब्द का अर्थ है—अड़ोस पड़ोस, चारों ओर की स्थिति, आसपास की घटनाएं, रीति-व्यवहार आदि। सामान्यत: कहा जा सकता है कि पर्यावरण एक ऐसी संकल्पना है जो किसी जीवधारी को उसकी आवश्यकता के अनुरूप आवरण (वातावरण) प्रदान कर उसके सुखद जीवन का मार्ग प्रशस्त करता है। अपने विकास क्रम में मनुष्य ने प्रकृति में विकृति का प्रयास करना आरंभ किया। अधिकाधिक दोहन, अधिकाधिक उत्पादन और अधिकाधिक लालसा पर्यावरणीय असंतुलन का कारण बनती चली गई। वनों की अंधाधुंध कटाई, नदी क्षेत्रों में अतिक्रमण, पहाड़ों की कटाई, महानगरों का विस्तार तथा औद्योगिक प्रतिस्पर्धा में विषैली तथा हानिकारक गैसों का उत्सर्जन आदि से पर्यावरण की समस्या विकराल होती जा रही है। आज आंकड़े बताते हैं कि वन क्षेत्र की दृष्टि से दुनिया में भारत का दसवां स्थान है। भारत का क्षेत्रफल लगभग 32.87 लाख वर्ग किलोमीटर है।जिसमें वन क्षेत्र केवल 7.12 लाख वर्ग किलोमीटर ही है। आज भारत की आबादी लगभग एक सौ तीस करोड़ है, जिसमें से लगभग 40 करोड प्रत्यक्ष अथवा अप्रत्यक्ष रूप से वनों पर आश्रित हैं। भारत वर्ष के लगभग 6.

डॉ. वेदप्रकाश, असिस्टेंट प्रोफेसर, हिंदी विभाग, हंसराज कॉलेज, दिल्ली विश्वविद्यालय
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50 लाख गावों में से दो लाख गांव जंगलों में व इनके आसपास बसते हैं। अर्थव्यवस्था की दृष्टि से विचार करने पर आंकड़ों के अनुसार भारत की जीडीपी में वनों का 0.9 फीसद योगदान है। इनसे ईंधन के लिए सालाना 12.8 करोड टन लकड़ी प्राप्त होती है। प्रतिवर्ष 4.1 करोड़ टन टिम्बर मिलता है। इसके अतिरिक्त नीम, तुलसी, पीपल, महुआ, चंदन, तेल तथा विभिन्न औषधीय पौधे भी प्राप्त होते हैं। विडंबना तथा चिंता का विषय यह है कि पर्यावरणीय असंतुलन से कड़ाके की ठंड, बर्फबारी, अति वर्षा, सूखा, बाढ़, अत्यधिक गर्मी तथा ग्लोबल वार्मिंग जैसे संकट पैदा हो रहे हैं। जो जीव सृष्टि के लिए घातक हैं। अर्थात ईश्वर प्रदत्त आवरण जो जीव के लिए नितांत आवश्यक है वह विकृत हो रहा है,ध्वस्त हो रहा है। जन जागरूकता तथा जनभागीदारी के प्रयास आरंभ हो रहे हैं। जिससे पर्यावरण का संरक्षण तथा संवर्धन किया जा सके। राष्ट्रीय तथा अंतरराष्ट्रीय समुदाय ने इस विषय को महत्वपूर्ण सरोकार मानते हुए कार्य योजना बनाई हैं और उन्हें क्रियान्वित भी किया जा रहा है। आज भिन्न-भिन्न रूपों में प्राकृतिक आपदाएं दस्तक दे रही हैं। हम सभी की सजगता मानवता के कल्याण हेतु अनुकूल वातावरण बना सकती है।

विश्व चिंतन के आदि स्रोत वैदिक ग्रंथ हैं। ऋग्वेद विश्व का पहला ग्रंथ माना जाता है, जिसमें जीव-जगत के अनेक विषय वर्णित हुए हैं। वेदों में पर्यावरण चिंतन की भी गंभीरता अनेक स्थानों पर मिलती है। जीव-प्रकृति तथा पर्यावरण का अभिन्न हिस्सा है। इस प्रकृति तथा पर्यावरण से ही जीव का जीवन संभव है। इस विचार को महत्वपूर्ण मानते हुए आदि कवि वाल्मीकि ने अनेक स्थानों पर पर्यावरण चिंतन तथा प्रकृति के सौंदर्य को प्रस्तुत किया है। जल- जीव का उत्पत्ति स्थल है।आदि कवि ने रामायण में अनेक स्थानों पर तुंगभद्रा, मंदाकिनी, तमसा, सरयू, सोनभद्र, सोन, कोशिकी, गंगा, यमुना, गोदावरी, कावेरी, गंडकी, वेदश्रुति, गोमती, मालिनी, शरदण्डा, सुदामा, नर्मदा, शैलोदा, शिलावहा, सरस्वती, कुलिंगा तथा उतानिका आदि नदियों की चर्चा की है।उनके आराध्य एवं ग्रंथ के नायक श्रीराम जिस- जिस दिशा में भी जाते हैं, वहां नदियों के दर्शन होते हैं और वे नदी स्नान तथा पूजन के द्वारा इन जल स्रोतों के प्रति अपना सम्मान तथा समर्पण व्यक्त करते हैं। अयोध्याकाण्ड के पचपनवे सर्ग में यमुना जी से सीता जी प्रार्थना कर रही हैं—

कालिंदीमथ सीता तु याचमाना ताञ्जिलि:[4]

अर्थात् सुंदरी सीता हाथ जोड़कर यमुना जी से प्रार्थना कर रही थी, इतने में ही वे दक्षिण तट पर जा पहुंची। इसी प्रकार, मंदाकिनी नदी के सौंदर्य का उद्घाटन मिलता है-

सुरम्यमासाद्य तु चित्रकूटं

नदी च ता माल्यवती सुतीर्थाम्।[5]

अर्थात् चित्रकूट पर्वत बड़ा ही रमणीय था। वहां उत्तम तीर्थों से सुशोभित माल्यवती नदी बह रही थी, जिसका बहुत से पशु-पक्षी सेवन करते थे। उस पर्वत और नदी का सानिध्य पाकर श्री रामचंद्र जी को बड़ा हर्ष और आनंद हुआ। वह नगर से दूर वन में आने के कारण होने वाले कष्टों को भूल गए। उत्तरकाण्ड में नर्मदा के सौंदर्य का विशद् वर्णन है। सरिताओं में श्रेष्ठ नर्मदा परम सुंदरी प्रतीत होती हैं। हंस, चक्रवाक् तथा अन्य अनेक जल जीव वहाँ सानंद क्रीड़ा कर रहे हैं। नर्मदा के सौंदर्य को देखकर रावण कहता है—

प्रख्याय नर्मदा सोड्थ गंग्डेयमिति रावण:।[6]

ये साक्षात् गंगा हैं—ऐसा कहकर दशानन रावण ने नर्मदा की प्रशंसा की और उसके दर्शन से हर्ष का अनुभव किया। बालकाण्ड के पैंत्तीसवे सर्ग में देव नदी गंगा की उत्पत्ति, उसकी श्रेष्ठता आदि का विशद् वर्णन है। गंगा को पृथ्वी, आकाश तथा पाताल तीनों को पवित्र करने वाली माना गया है—

ते गत्वा, जाह्नवी सरिता श्रेष्ठा।[7]

अर्थात् बहुत दूर का मार्ग तय कर लेने पर दोपहर होते-होते उन सब लोगों ने मुनि जन सेवित, सरिताओं में श्रेष्ठ गंगा जी के तट पर पहुंचकर उनका दर्शन किया। कहने का भाव यह है कि रामायण में अनेक स्थलों पर नदियों के सौंदर्य, प्रदूषण रहितता तथा उनके महत्व का उद्घाटन मिलता है। जिससे यह स्पष्ट है कि हमें वर्तमान तथा भविष्य संवारने के लिए इन महत्वपूर्ण जल स्रोतों का वंदन करते रहना होगा। यह चिंतन आज मानव ने भुला दिया है। देव नदियां आज प्रदूषण का शिकार हैं। पर्यावरण का बड़ा एवं महत्वपूर्ण घटक जल अनेक रूपों में प्रदूषित हो रहा है।

पेड़-पौधे तथा वन संपदा पर्यावरणीय प्रदूषण को कम करने एवं जीवों के लिए आवश्यक वायु, औषधि, फल, फूल आदि के प्रदाता हैं। रामायण में भारुण्ड, दण्डक, मत्तंग, चेत्ररथ, लोध्र व क्रौंचारण्य आदि वनों की चर्चा मिलती है। रामायण के विभिन्न काण्डों में सैकड़ों तरह के फल-फूल वाले वृक्षों एवं वनस्पतियों की चर्चा है। अयोध्याकाण्ड के चौरानवे सर्ग में लिखा है—

आम्रजम्ब्वसनैर्लोध्रै: प्रियालै:,प्रियंका पुष्पत्ययं गिरि:।।[8]

अर्थात् आम, जामुन, असन, लोध, कटहल, धव, अंकोल,भव्य, तिनिश, बेल, आंवला, कदंब, बेर, धन्वन, बीजक आदि घनी छाया वाले वृक्षों से जो फूलों और फलों से लदे होने के कारण मनोरम प्रतीत होते थे, व्याप्त हुआ यह पर्वत अनुपम

शोभा का पोषण एवं विस्तार कर रहा है। यह चित्रकूट की शोभा का वर्णन-प्रसंग है। अयोध्याकाण्ड के पचपनवे सर्ग में सीता जी के द्वारा श्यामवट की पूजा का वर्णन मिलता है। जिसमें वे उस महावृक्ष को नमस्कार करते हुए परिक्रमा करती हैं और कहती हैं-

न्यग्रोधं समुपागम्य विदेही, नमस्तेस्तु महावृक्ष, पर्यगच्छन्मनस्विनी।।[9]

अर्थात् वट के समीप पहुंचकर विदेहनंदिनी सीता ने उसे मस्तक झुकाया और इस प्रकार कहा—श्महावृक्ष! आपको नमस्कार है। आप ऐसी कृपा करें, जिससे मेरे पतिदेव अपने वनवास-विषयक व्रत को पूर्ण करें तथा हम लोग वन से सकुशल लौटकर माता कौशल्या तथा यशस्विनी सुमित्रा देवी का दर्शन कर सकें। इस प्रकार कहकर मनस्विनी सीता ने हाथ जोड़े हुए उस वृक्ष की परिक्रमा की। अभिप्राय यह है कि वाल्मीकि जी ने वृक्षों को जीवनदायक होने के साथ-साथ वरदायक के रूप में भी स्थापित किया है और यह संदेश दिया है कि मनुष्य सदैव उनका रक्षण करें। किंतु आज मनुष्य वृक्षों की अंधाधुंध कटाई कर रहा है। जिससे पर्यावरण में प्रदूषण और असंतुलन पैदा हो रहा है।

पर्वत पर्यावरण के महत्वपूर्ण घटक हैं। दूरदृष्टा ऋषि ने प्रस्रवणगिरि, महेंद्र, विंध्य, मेरू, कैलाश, मंदराचल, उदय, मैनाक, वाराह, सोमगिरि, मलय, चित्रकूट तथा लंम्ब आदि पर्वतों का भी वर्णन किया है। अयोध्याकाण्ड के चौवनवे सर्ग में महामुनि भारद्वाज श्रीराम से कहते हैं—

चित्रकूट इति ख्यातो, कपालशिरसा सह।[10] अर्थात् चित्रकूट नामक पर्वत बहुत मनोहर है। उस पर बहुत से लंगूर विचरते रहते हैं। वह पर्वत चित्रकूट नाम से विख्यात है और गंधमादन के समान मनोहर है। जब मनुष्य चित्रकूट के शिखरों का दर्शन कर लेता है तब कल्याणकारी पुण्य कर्मों का फल पा लेता है और कभी पाप में मन नहीं लगाता है।

नदी, पर्वत तथा वृक्षों की भांति बंदर-भालू, कीट-पतंगे, पशु-पक्षी भी पर्यावरण के महत्वपूर्ण अंग हैं। रामायण में वाल्मीकि जी ने कई स्थानों पर इनसे संवाद दिखाया है। इसका अभिप्राय यह है कि मनुष्य मानवेतर जीवों के रक्षण में भी संलग्न हो, जिससे पर्यावरण का संतुलन बना रह सके। अरण्यकाण्ड के साठवे सर्ग में लिखा है कि—

अस्ति कच्चित्त्वया दृष्टा, न ते भयम्।[11] अर्थात् एक वृक्ष से दूसरे वृक्ष के पास दौड़ते हुए वे पर्वतों, नदियों और नालों के किनारे घूमने लगे शोक से समुद्र में डूबे हुए श्री रामचंद्र जी विलाप करते-करते वृक्षों से सीता के विषय में पूछने लगे—वे कदंब, अर्जुन, कुटज, अशोक, ताल, जामुन, कनेर, आम, कदम्ब, साल, कटहल और अनार आदि वृक्षों को देखकर उनके पास गए और पूछते फिरे। इसी प्रकार वे हिरण, गजराज व व्याघ्र आदि सभी से भी उनका पता पूछते हैं, संवाद करते हैं। किष्किंधाकाण्ड में वानर, भालू आदि से भी मैत्री करते हैं। इससे यह स्पष्ट होता है कि मानवेतर जीव भी मनुष्य के लिए बहुत सहायक हो सकते हैं।

स्पष्टतः महर्षि वाल्मीकि द्वारा प्रणीत रामायण आदि ग्रंथ है,जिसमें दूरदृष्टा ऋषि ने पर्यावरण चिंतन के विविध आयामों को रूपायित किया है। आज जब समूची मानवता पर्यावरण संकट के भिन्न-भिन्न रूपों से जूझ रही है,तब आदि काव्य रामायण में वर्णित पर्यावरण चिंतन हमारा मार्गदर्शन कर सकता है।

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मथुरा की कला एक अध्ययन

बलराम शर्मा

प्राचीन काल से ही मथुरा विभिन्न धर्मों की उपासना स्थली रही है। यही नहीं, कला के क्षेत्र में भी विभिन्न काल-खण्डों द्वारा वहाँ के कला साधकों ने नवीन कीर्तिमान स्थापित किये। वस्तुत: भारतीय कला की मुख्य विचारधारा में मथुरा कला का योगदान अविस्मरणीय है, जिसमें मथुरा के तत्कालीन शिल्पियों ने न केवल स्वदेशी तत्वों का समवेष किया अपितु उनके विकास में भी महत्वपूर्ण भूमिका निभायी। कुषाणकाल मथुरा मूर्तिकला का स्वर्णिम काल था। तत्कालीन युग की ब्राह्मण, जैन तथा बौद्ध प्रतिमाएं इन कलाकारों के प्रवीण कला चातुर्य का उदाहरण हैं। विभिन्न हिन्दू देवी-देवताओं की छवियों के साथ-साथ जैन तीर्थकरों तथा स्वयं बुद्ध की प्रथम मूर्ति निर्माण का श्रेय भी मथुरा की सतत कला साधना को जाता है। वास्तुकला के क्षेत्र में प्राचीन काल के अंतर्गत मथुरा में अनेक धार्मिक भवनों का निर्माण हुआ परन्तु मध्यकालीन मुस्लिम शासकों के सानिध्य में मंदिर निर्माण की जिस शैली का विकास हुआ वह सर्वथा अन्य वास्तु शैलियों से भिन्न रही। परिणामत: पूर्व में जिस प्रकार मुस्लिम वास्तुकला पर हिन्दू तत्वों का आवरण पाया गया, ठीक उसी प्रकार इन मंदिरों पर भी मुस्लिम वास्तुकला की छाप दिखाई देती है। इस सन्दर्भ में 'मदन मोहन मंदिर', 'जुगलकिशोर मंदिर' तथा 'राधा गोविन्द मंदिर' इत्यादि प्रमुख हैं।

मथुरा, उत्तर प्रदेश के उत्तरी सीमा प्रान्त पर यमुना नदी के किनारे स्थित है। इसकी उत्तरी सीमा हरियाणा तथा दक्षिणी सीमा राजस्थान से संलग्न है। दिल्ली से मथुरा दक्षिण-पूर्व में लगभग 145 कि. मी. (90 मील) तथा आगरा से यह 55 कि. मी. (34 मील) की दूरी पर उत्तर में स्थित है। मुख्य भाषा के रूप में यहाँ हिंदी भाषा का प्रयोग होता है जबकि सामान्य सम्प्रेषण हेतु ब्रजभाषा का प्रचलन है। राजमार्ग NH 19 पर स्थित होने के कारण मथुरा सड़क परिवहन द्वारा तथा रेल मार्ग से भी सहज रूप में पंहुचा जा सकता है।

वस्तुत: मथुरा एक प्राचीन एवं धार्मिक नगरी है जो कि विशेष रूप से वैष्णव धर्म के प्रमुख देवता 'वासुदेव कृष्ण' के जन्म से सम्बंधित है। वैष्णव धर्म के अतिरिक्त अन्य प्राचीन धर्म जैसे जैन तथा बौद्ध धर्म का भी मथुरा प्रमुख स्थल रहा है । इन सभी धर्मों को इस पावन स्थली में न केवल आश्रय ही प्राप्त हुआ, अपितु इन सभी के विकास में भी मथुरा का महत्वपूर्ण योगदान है। पुराणों के मतानुसार मोक्षगामी सप्त-पुरियों में गणना होने के कारण मथुरा धार्मिक पर्यटन का विशेष केंद्र तो है ही साथ ही 'गोल्डन ट्रायंगल' (दिल्ली-आगरा-जयपुर) मार्ग पर स्थित होने के कारण यह विदेशी पर्यटकों के आगमन का भी प्रमुख स्थल है। 'कृष्ण जन्मभूमि', 'मथुरा संग्रहालय' तथा 'गिर्राज' पर्वत के अतिरिक्त वृन्दावन के अनेकश: मंदिर वहाँ विशेष रूप से दर्शनीय हैं।

सिन्धु घाटी सभ्यता के विघटन के बाद आर्य जाति (उत्तर भारत में) नगरीय सभ्यता को त्याग कर ग्रामीण ईकाइयों में परिवर्तित हो गई। आर्यों ने नदियों को यातायात हेतु तथा उनके किनारों को रहने हेतु प्रयुक्त समझा। मथुरा भी इस प्रकार के स्थलों में से एक था जो कि वर्तमान में यमुना नदी के किनारे स्थित है। इस क्षेत्र का प्रारम्भिक उदाहरण 16 महाजनपद काल से प्राप्त होता है जिसमें शूरसेन राज्य की राजधानी मथुरा बताई गयी है। पुरातात्त्विक अवशेष इसकी उपस्थिति वैदिककाल से मानते हैं जहाँ साक्ष्यों के रूप में PGW तथा NBPW संस्कृति वाले मृदभांड प्राप्त होते हैं। मौर्यकाल में मथुरा के परखम ग्राम से प्राप्त यक्ष-यक्षिणी की आदमकद मूर्तियाँ भारतीय कला की विशेष उपलब्धियां हैं। प्राचीनकाल में मथुरा एक मुख्य व्यापारिक क्षेत्र के रूप में विकसित हो चुका था जो कि भारत के मुख्य मार्गों द्वारा रेशम मार्ग से जुड़ा हुआ था। रेशम मार्ग वस्तुत: प्राचीन काल का वह मार्ग था जो पूर्वी देशों को पश्चिमी देशों से जोड़ता था और जहाँ व्यापारी अपनी वस्तुओं का एक दूसरे देशों के साथ आदान-प्रदान करते थे।

कुषाण शासक जिन्हें 'इंडो-शिथियन' या 'श्वेत हुण'

बलराम शर्मा, शोध छात्र, कला इतिहास एवं पर्यटन विभाग, कला संकाय, बी. एच. यू.
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इत्यादि नामों से जाना जाता है, वस्तुत: बाहरी जाति से सम्बंधित थे तथा जिनकी दो प्रमुख राजधानियों में मथुरा एवं गांधार थीं । गांधार क्षेत्र मुख्यत: बौद्ध कला से सम्बंधित था वहीं मथुरा की कला बौद्ध धर्म, जैन धर्म एवं ब्राह्मण धर्म तीनों से ही सम्बंधित रही। इस काल में मूर्तिकारों को न केवल मूर्ति निर्माण हेतु नवीन विषय मिले, अपितु उन्होंने कला कर्म में भी अपनी गहरी रुचि भी दिखाई। इसी काल में विष्णु, सरस्वती, बोधिसत्व, बुद्ध, तीर्थकर, नाग, यक्ष तथा अन्य देवताओं की विशालकाय प्रतिमाओं का निर्माण हुआ तथा उन्हें साँची, सारनाथ, कोशाम्बी, अवस्ती, पंजाब इत्यादि स्थलों पर भेजा गया। मूर्ति निर्माण की इस परंपरा में मथुरा के शिल्पियों ने पूर्वकालिक साँची एवं भरहुत कला की बारीकियाँ पकड़ी तथा उसमें आध्यात्मिक तत्त्वों का समावेश किया। इस प्रकार हम देखते है कि मथुरा की तात्कालीन मूर्तिकला रूपमाधुर्य, भावभंगिमाएँ, वस्त्रालंकरण से सुशोभित होने के साथ-साथ उनके मुखमंडल पर आध्यात्मिक भाव की नितांत प्रस्तुति प्राप्त होती है।

तदुपरान्त वास्तुकला के क्षेत्र में मथुरा से दो प्राचीन जैन स्तूपों के अवशेष प्राप्त हुए हैं जिनमें पहला शुंगकालीन तथा दूसरा कुषाणकालीन है। शुंगकालीन स्तूप पूर्णत: नष्ट हैं जबकि कुषाणकालीन स्तूप के अवशेष कंकाली टीला नामक स्थल से प्राप्त हुए हैं। ग्रंथों में इसी कंकाली टीले को देव निर्मित स्तूप की संज्ञा दी गयी है जिससे इसकी तत्कालीन प्रसिद्धि का प्रमाण मिलता है। वस्तुत: प्राचीन काल में स्तूप निर्माण एक विशेष प्रकार की धार्मिक वास्तु संरचना थी जिसे विशिष्ट संतों एवं महान पुरुषों की अस्थियों को संरक्षित करने तथा उन पर धार्मिक कर्म करने हेतु बनवाया जाता था। ह्वेनसांग, जो कि एक चीनी यात्री था तथा 627-643 ई. तक भारत में रहा, ने अपने यात्रा विवरण में मथुरा के अंतर्गत 20 बौद्ध विहारों तथा 5 मंदिरों का विवरण दिया है।

मथुरा के अन्य भवनों में मध्यकालीन मंदिरों की संरचना प्रमुख है जिन्हें मुगल शासकों के संरक्षण में बनाया गया। इस प्रकार के विशाल मंदिरों में 'गोविन्द देव मंदिर' तथा 'श्रीजी मंदिर' प्रमुख हैं। यह दोनों ही मंदिर मुगल शासक अकबर के समकालीन है। गोविन्द देव मंदिर जिसे राधा गोविन्द मंदिर नाम से भी जाना जाता है, लाल प्रस्तर से निर्मित है। मंदिर का निर्माण राजा मानसिंह ने बादशाह अकबर के सहयोग से 1590 ई. में करवाया। यह मंदिर नागर शैली का एक अद्‌भुत उदाहरण है तथा अपने मूल स्वरूप में गुजराती तथा मुस्लिम वास्तु शैली से प्रभावित है।

इस क्रम में दूसरा मंदिर 'श्रीजी' या राधारानी का है जिसे पहले राजा वीर सिंह ने तथा बाद में नारायण भट्ट ने राजा तोडर मल (जो कि अकबर बादशाह के दरबार में गवर्नर था) की सहायता से बनवाया। यह मंदिर लाल प्रस्तर से निर्मित है तथा इसमें हिन्दू एवं मुस्लिम वास्तु कला का सुंदर समन्वय स्थापित है।

इसी क्रम में अन्य भवनों के अंतर्गत 'जुगल किशोर मंदिर', 'मदन मोहन मंदिर' तथा 'राधा रमण मंदिर' प्रमुख है। जुगल किशोर मंदिर बादशाह जहाँगीर के समय 1627 ई. में बना। मंदिर का सम्मुख भाग व दरवाजा मुगल वास्तु कला से प्रभावित है तथा मेहराब युक्त है। मंदिर की दोनों भुजाओं में आले तथा उनके ऊपरी भाग में एक अलंकृत रेखा है। जुगल किशोर मंदिर की मुख्य विशेषता इसका शिखर है जो कि मुगल कालीन मीनारों की तकनीक तथा उनके अलंकरण से प्रभावित है। शिखर के ऊपरी भाग में आम्लक स्थित है तथा यह मीनारों के सदृश्य कई खंडों में विभक्त है।

'मदन मोहन मंदिर' औरंगजेब के समय मुल्तान के एक व्यापारी रामदास ने बनवाया था। वास्तु की संपूर्ण संरचना लाल प्रस्तर की है तथा यह मुख्यत: तीन भागों में विभक्त है, इसके पहले भाग में शिखरयुक्त संरचना है जो क्रमश: मंडप एवं गर्भगृह हैं तथा एक कक्षनुमा मंडप इसकी विपरीत दिशा में द्रविड़ शैली में निर्मित है। मदन मोहन मंदिर का शिखर भी उपरोक्त जुगल किशोर मंदिर के समान आगरा की मुस्लिम वास्तु कला से प्रभावित है। इसके शिखर भाग में आम्लक तथा मूल शिखर मीनारों के समान पांच भागों में विभक्त है। मंदिर की मूल संरचना में मुस्लिम तत्वों के साथ-साथ उड़ीसा वास्तु शैली का भी समन्वय स्थापित है। इन मंदिरों के अतिरिक्त 'हरिदेव मंदिर' तथा 'कुसुम सरोवर' इत्यादि भवन भी इस शृंखला में महत्वपूर्ण भूमिका निभाते हैं।

निष्कर्षत: भारतीय कला की अविछिन्न परंपरा में मथुरा शिल्प एवं वास्तुकला का महत्वपूर्ण योगदान है। वहाँ के प्रवीण कला साधकों ने प्राचीन धर्मों से सम्बंधित अनेक देवी- देवताओं की प्रारंभिक प्रतिमाओं का निर्माण किया तथा भारतीय कला के पूर्वकालिक कठोर तत्वों को त्यागकर उसमें सरल एवं सजीव रूपाकारों का विकास किया। इसी प्रकार मध्यकाल में भी जिन मंदिरों का निर्माण मथुरा क्षेत्र के अंतर्गत हुआ उनमें प्राचीन हिन्दू वास्तु शैली के साथ-साथ मुस्लिम तत्वों का प्रभाव भी स्पष्टत: दिखाई देता है जिस कारण ये मंदिर वास्तु सम्पूर्ण भारत के मंदिरों से पृथक रूप धारण किये हुए हैं। अर्थात् भारतीय कला इतिहास से सम्बंधित अध्ययन की मूल सामग्री प्रकट करने तथा इतिहास के शुद्ध तत्वों को जानने में सहायक मथुरा के शिल्प एवं भवन महत्त्वपूर्ण हैं। उनका का संरक्षण अत्यंत ही आवश्यक है।

1. गोविन्द देव मंदिर (वृन्दावन, मथुरा)
2. मदन मोहन मंदिर (वृन्दावन, मथुरा)
3. कुसुम सरोवर (गोवर्धन, मथुरा)
4. जुगल किशोर मंदिर (वृन्दावन, मथुरा)

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Is Environment a Rallying Point in the Election Manifestos?

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Abstract

Environmental Sustainability is significant to the health of natural cycles on earth. India can prove to be pivotal in addressing a slew of global environmental issues by acting locally. Therefore, understanding of the commitments of the National Political Parties of India as informed by their election manifestos is important. The manifestos apprise the voters of the promises and are deemed to report the aspirations of the voters. Drawing inspiration from these facts, the paper aims to study the issues and environment-related commitments in the Indian political landscape through a time-series, qualitative, secondary-data analysis of the election manifestos of the National Political Parties of India over five electoral seasons (1999, 2004, 2009, 2014, 2019). It was observed that issues related to environment have grown in volume in the manifestos through the years, but inconsistency of issues is rampant from one season to the next. The data over the years has been divided into several categories for ease of study. Newer environmental issues have found feet but the lack of systemic integration only goes to show the inadequacy of the promises to foster sustainability. Increased focus on environment, expressed as public sentiment and greater inclusion of environmental concerns and promises in the election manifestos, can help develop at least a theoretical environmental outlook for India, which can prove to be an initial step towards actual growth of environmental sustainability.

Keywords: Environmental Sustainability; National Political Parties of India.

Introduction

Anthropogenic climate change has threatened the sustainability of the natural cycles as well as the existence of many organisms on earth. This is a direct consequence of the environmental cause being sacrificed for attaining economic prosperity (Brooke, Bevis, & Rissing, 2019). The balancing of the two is important to attain social sustainability and sustainability of the ecological systems globally, in which India can play a significant role. India is a vast country with 2.4% of the land surface, the second most populated country after China and one of the fastest growing economies of the world (Bajpai, 2019). Therefore, India's environmental policies and actions would not only have a physical impact on the global environmental sustainability landscape but also be a model for developing countries to follow.

The policies of any country are guided by national and international issues, perceptions and movements. To gauge the commitment of political parties to influence and change the policies to protect the environment and promote environmental sustainability, the election manifestos are an important resource. Many scholarly works have used the data sets from various manifestos to look at "growing importance of issue competition" (Green-Pedersen, 2007). Election manifesto is a document adumbrating the ideology, election promises, intentions and views of a political entity for informing and drawing attention of its voters (Election Commission of India, 2020). Election manifestos had their birth in the verbal promises made by the leaders as part of the hustings. These promises have now come to be documented by the political entities in the shape of election manifestos.

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The manifestos are awarded significant importance in the economically-developed democracies, where the manifestos are published and distributed widely. The wheeling out of manifestos in India, however, has not caught on with the pace of the developed democracies. If election manifestos are read and awarded the due share of importance by masses in India is also debatable but 'Lokniti Survey' for Assembly election of 2016, answers in the negative for Kerala and Tamil Nadu, which have among the highest literacy rates in India (Rai, 2019). While the promises and policies are unenforceable in a court of law, political parties honour at least a few, if not most of their promises and the promises delivered are low in number in case of coalition governments (The Week, 2019). The extent of fulfilment of the promises might vary from a case-to-case as well as country-to-country basis, but the importance of manifestos as documents indicative of the actions of the political parties if elected to power, cannot be easily dismissed.

The study elaborates on the environmental issues and proposed policies which have been recorded in the election manifestos of the National Political Parties of India[2] over five electoral seasons (1999, 2004, 2009, 2014, 2019). It has been observed from an analysis of the OECD countries that "the number of environmental outputs increased if the government parties adopted more pro-environmentalist positions" (Knill, Debrus, & Heichel, 2010). The election manifestos also give a sense of the policy preferences of the voters or the voter base a political entity is appealing (Budge, Klingeman, Volkens, Bara, & Tanenbaum, 2001). Therefore, the study also gives a picture of the extent to which the environmental issues are a rallying point, as manifestos are indicative of – the extent of impact on environment effected through government policies and the expectations of the voters in the environmental domain.

Methodology

The study involved qualitative secondary analysis of the election manifestos, which are published in English, of 7 National Political Parties of India (as of 1st January 2019) from the national elections since 1999. The manifestos available online and in the DELNET libraries were perused. The parties or period for which the manifestos are not available were not included. The information on environment, in the manifestos, were colour-coded according to categories. All the information was sought to be accommodated in the categories, which emerged out by grouping of the information. This sorted information is presented in the study according to the timeline without differentiating the issues according to political parties, along with the issues which have not found any mention in the manifestos. The study also briefly comments on the voters' expectations for protection and conservation of environment in India.

Findings & Discussion

Election manifesto during late 20th century was unusually succinct, for the few political parties which released it. The space given to matters concerning environment, in the manifestos, has since increased through the years. In 1999 electoral season, promises made were of revitalizing the river cleaning programmes (focussing mainly on Ganga and Yamuna), anchoring a relevant legal framework in the shape of National Environmental Policy, strict punitive action against illegal lumbering, discouraging poaching of wildlife by establishing a Wildlife Anti-Poaching Authority, curbing vehicular pollution and activities beneficial to the forest-dwellers. This has in 2019 electoral season grown into expansive and wide-ranging environmental promises (Figure 1).

Figure 1: Environment-related promises through the years (in green).

Category	1999	2004	2009	2014	2019
Biodiversity and Ecosystem Protection					
Clean Technology					
Costal and Wetland Conservation					
Curbing Pollution and Audits					
Environmental Legislation					
Forest Produce Support					
Global Warming and Climate Change					
Green Budgeting					
Himalayas					
Rights of Forest Dwellers					
River Revitalization					
Wasteland Restoration					
Waterbody Restoration					
Watertable Management					

Source : Author's analysis.

Any mention of an environmental issue or plans related to a category in any of the manifestos for a given year have been marked as promises for that

The National Political Parties of India on 1st January, 2019 (All India Trinamool Congress (AITC), Bahujan Samaj Party (BSP), Bharatiya Janata Party (BJP), Communist Party of India (CPI), Communist Party of India (Marxist) (CPI (M)), Indian National Congress (INC) and Nationalist Congress Party (NCP)).

year.

In 2004, the issues had graduated to a variety of promised initiatives for waterbody restoration, plans for rainwater harvesting and groundwater recharge, community participation for cleaning rivers, strengthening of environmental protection laws, rights of forest dwellers, wasteland development and management, addressing erosion and pollution and use of clean technology. Likewise, in 2009 the issues remained broadly similar with introduction of Himalayas and its sustainability and bolstering costal protection laws. However, one of the most important issues included in 2009 was the emphasis on the fact that India should not yield to international pressure to reduce emissions at the cost of economic enrichment, in light of Copenhagen Summit. Several additions to environmental issues in the form of Green budgeting and forest produce support, took place in 2014. All these issues have continued in 2019 manifesto, much in the same spirit although the party-specific manifesto analysis would not reveal the same trend.

Issues under 'Biodiversity and Ecosystem Protection' have over the years encompassed setting of Wildlife Anti-Poaching Authority (1999), constitution of separate Taskforces for protection of wild cats, elephants and bird sanctuaries (2009), preservation of bio-resources (2014, 2019), stringent punitive action against destruction of forests and poachers (1999, 2009, 2014), anchorage of a comprehensive plan for fragmented ecosystems of Wester Ghats (2014), formulation of land and water use policy with measures for ecosystem conservation (2019) and management and minimization of human-wildlife conflict, awarding adequate compensation for loss of human lives (2019) and punishment for cruelty towards animals (2019). 'Clean Technology' as a term finds mention since 2004, but it has not been much elaborated. Fostering technology to reduce carbon emissions (2009), promotion of Carbon Credit system (2014), encouraging R&D in Environment Technology (2014) and bringing awareness about carbon foot print (2019) have been the promises towards 'Clean Technology'. With regard to 'Costal and Wetland conservation', strengthening of laws (2009) and revoking of the recent changes in Coastal zone regulations (2019) seem to be the major promises.

In light of 'Curbing Pollution and audits', development of mass transit and public-transport system (1999, 2004, 2014), checking water pollution in rivers and other water bodies (2009, 2014, 2019), indexing pollution in cities (2014, 2019), making Environmental Impact Assessment (EIA) transparent (2004, 2009) and strengthening of National Clean Air Programme (2019) were the basic promises. 'Environmental legislation' has issues related to strengthening of laws concerning environment like illegal lumbering and mining, conducting environmental appraisals, etc. (1999, 2004, 2009, 2014, 2019) and giving more responsibility to the locals (municipalities, gram sabha and tribals) (2019). While supporting the economic and environmental sustainability of Forest-based produce has been added to the agenda in 2014, the welfare of forest dwellers (or the settlements close to the forests) has been promised through the years, although in varying degrees.

The promises towards prevention of global warning have been 'the unveiled National Plan for Climate Change' (2009, 2014), control of emissions through efficient technologies and regulations (2009, 2014, 2019) and promising emissions cuts internationally in line with Indian Economic considerations (2009). The concept of 'Green Budgeting' which would be critical to look at the country's triple bottom line was introduced in 2014 and was promised in 2019 also.

'Himalayas' entered the manifestos through focus on melting glaciers (2009, 2014), National Mission on Himalayas (2014), Himalayan Sustainability Fund (2014), creation of a central university for studies in Himalayan Technology (2014) and financial assistance as 'green bonus' for conserving forests in the Himalayan states (2019). "River Revitalization' has had its focus around cleaning rivers (1999, 2004, 2009, 2014, 2019), checking soil erosion (2004, 2014, 2019), setting up or revamping river authorities (2009, 2014) and addressing the problems of floods and harnessing the water with focus on Brahmaputra (2019). 'Wasteland restoration' related promises are afforestation and social/farm forestry (2004, 2014) and wasteland regeneration missions (2019). 'Waterbody restoration' promises have mainly revolved around rejuvenation of local water bodies by community participation/ unemployed farmers (2004, 2019). 'Rainwater harvesting' has been emphasised since 2004 and legislation has been the only suggested means.

The evolution of issues in recent years is

attributable to increased understanding of development and its sustenance which are related to many environmental facets like clean water availability, decreasing pollution, etc. The understanding of the issues from analysis of the manifestos, however, suggests a grave absence of continuity in promises in respective party manifestos and the lack of innovation and integration in the whole system. While the environmental issues have been flagged, the issues are wanting in contextualization on a pan-India level according to local needs. Community participation has found mention at various instances but robust steps leading to such a participation are not elaborated. Smart cities have been mentioned in the latest years without any mention of integrating biodiversity and systemic sustainability. Energy Policy has also not been aligned with the environmental policy. Energy in India has a huge environmental cost as polluting fossil fuels like Diesel and Petrol are backbone of road transport and electricity is overwhelmingly reliant on coal for energy production; this demands an increasingly expansive environmental cost in energy and allied sectors to be checked. Also, surprising is the fact that Sustainable Development Goals (SDGs) do not find any mention in any of the manifestos in relation to environmental sustainability. Although, India has come thus far since its independence in 1947, no Green Party has emerged in India unlike in Europe. Also, the environment-related movements in India have not percolated into the daily lives of the people and environment continues to be a far under-rated subject.

For a systemic integration of environmental sustainability, participation of private players in the environmental domain must be incorporated in the agenda along with amalgamation of environmental legislation with non-environmental legislations. Designing of indices to track progress on all the actions undertaken, biodiversity and ecological studies for afforested tracts, calculation of economic costs of ecosystem services, offsetting of negative environmental externalities through contextualised and localised programs, increased innovation in planning and implementation, 33% of forest cover for all districts, invoking traditional motifs for increased environmental action and promotion of urban biodiversity programs, could be a few steps towards increased focus on environment.

Conclusion

Election manifestos are an important resource for understanding the waves of change and policy reform both through the perspectives of political parties and the voter base. The importance given to environment in the election manifestos of National Political Parties of India since the break of 21st century has gradually increased. This growth, unfortunately, is accompanied by the inconsistency in issues, which appear in an election and disappear the following season. Also, environmental prosperity as a concept has not taken root and is in no measure given precedence over economic prosperity. Although, many new ideas and promises appear regularly, only a few are continuously pursued. Therefore, consistency with the promises as also inclusion of new ideas and policies from other countries would go a long way in ensuring attention towards environmental sustainability in the manifestos of political parties. The study has attempted to give qualitative aspects of the environment-related aspects of manifestos without differentiating the issues according to political parties and holds potential for further work by quantification of data and differentiation and reporting on the basis of political parties and their respective ideologies.

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Self Help Groups - Empowering Rural India

Kanika Mittal*

Abstract

The Self- Help Groups (SHGs) play a crucial role in empowering the rural poor women who are the paradigm of rural development thereby eradicating the poverty in Indian villages. The SHGs have become widespread and have proved that rural empowerment is possible through empowering women component in the process of development of an economy. Women come together in groups to pool their savings thereby motivating each other to build new opportunities for generation of income. SHG-Bank Linkage Programme (SHG-BLP) is programme for extending financial services to the poor in India and facilitate in building financial capabilities and self-confidence in the rural poor, through internal savings by pooling of funds and lending from own funds of the SHGs. It was started by the National Bank for Agriculture and Rural Development (NABARD) in 1992. This paper focuses on the pivotal role of SHGs in developing the rural economy. Secondary data has been used to present the progress report of SHG-BLP in the last three financial years.

Keywords: Self Help Groups, Integrated Rural Development Programme, Microfinance, Bank Linkage, Women Empowerment.

INTRODUCTION

Poverty has been a major concern to all the planners of India. Various anti-poverty programmers have been introduced quite often through different successive plans however in terms of absolute numbers, the poverty still continues to grow at a faster pace. Removal of poverty has been one of the significant objectives of planning in India; despite this fact the attainment has been a dream for the country. Various target group approach programmes such as Marginal Farmers and Agriculture Labourers (MFAL) programme, Small Farmers Development Agency (SFDA), Command Area Development Programme and Drought Prone Area Development Programme (DPAP) being implemented, suggested a need for an integrated approach to rural development thereby taking a step towards eradication of poverty to a considerable extent. Though, this approach is followed through the introduction of Integrated Rural Development Programme (IRDP) and its sub programmes however none of it helped to redress the situation. Such programmes need to be revitalized to ensure that the desired linkages were established for a meaningful impact.

Also Self- help groups (SHGs) play crucial role in eradication of poverty in Indian villages. A large number of poor and unemployed women engage themselves in self sufficient activities which actually becomes an important source of their livelihood. They enthusiastically participate in occupy in savings and credit, as well as activities like income creation, natural resources management, literacy, child care, etc thereby manages to save and utilize . The savings and credit hub in the SHG acts as a major component and offers the ability to generate some control over capital and other investments. This article portrays a picture of how this scheme has proven to be very successful for women empowerment and offering to break slowly away from exploitation and isolation.

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Objectives

1. To study the concept of Self Help Group (SHGs) and its structure.
2. To study the objectives and evolution of SHGs.
3. To study the Self Help Group Bank Linkage programme (SHG-BLP).
4. To analyze and interpret the Progress of SHG-BLP in the past three financial years.

Methodology

This study is descriptive in nature and is based on the secondary data. The data is taken from authentic and reliable source i.e. **National Bank For Agriculture & Rural Development (NABARD)**, well renowned journals & reports, and various other articles. Relevant websites have been consulted in order to make the study more effective.

Concept of Self Help Group

NABARD defines SHGs as "small, economically homogenous affinity groups of rural poor, voluntarily formed to save and mutually contribute to a common fund to be lent to its members as per the group members' decision". It is a financial intermediary generally composed of 10 to 20 local women or men. SHG is actually a group of people on daily wages, who form a group and pool their savings together into capital thereby helping each other by lending whenever required.

Structure of Self Help Group

The Self Help Groups (SHGs) have become widespread, successful part of India specially the rural areas. Women from alike economic and social backgrounds, voluntarily come together to pool small amount of money, on a regular basis thereby motivating each other to build new opportunities for income generation. After a stage of regular savings which is 6 months to a year generally, the self help groups start to extend loans from savings in the form of small in-house loans for micro enterprise activities and other small scale activities.

The members of the group ensure proper end-use of credit and timely repayment of the same through the collective wisdom. According to the RBI regulations the banks need to offer financial services, including collateral free loans to these groups on very low interest rates.

Objectives of SHG:

- One of the most important objectives of SHGs is to build confidence and mutual trust between the rural poor people (especially women) and bankers.
- It encourages banking activities in a segment of the population in which formal financial institutions fell difficult to cover.
- SHGs equip to enhance and maintain the confidence and capabilities of the women in rural areas.
- It enables them to do collective decision making among women thereby creating group feeling among them.
- SHGs motivate women to take up the social responsibilities particularly related to women development.
- It acts as the forum for members to provide space and support to each other.
- It enables the women to avail the credit facility for productive purposes.
- SHGs inculcate the savings and banking habits among members.

EVOLUTION OF SELF-HELP GROUPS

Generally every SHG evolves through various stages which can be stated as follows :-

- ***Group Formation***: formation, development and strengthening of the groups to evolve into self-managed people's organizations at grass roots level.
- ***Group Stabilization***: through thrift and credit activity amongst the members, they build their Group Corpus.
- ***Micro Finance***: the Group Corpus is supplemented with a Revolving Fund sanctioned as cash credit limit by the banks or under SHG-Bank linkage programme of NABARD.
- ***Micro Enterprise Development***: Groups take up Economic Activities of their choice for income generation. They include development of entrepreneurship as well as other skills of the group members to enable them to successfully implement the chosen activity.

The minimum number of members in a group can be even five in complex areas like hills, deserts and areas with scattered and meager population. No group should consist of more than one member from the same family, nor should a person be a member of more than one group.

In general, all members of the group should belong to the families below the poverty line (BPL). However in certain exceptional cases and also where it is considered necessary, a maximum of 20% and where it is essentially required, up to a maximum of

30% of the members in a group could be taken from families marginally above the poverty line (APL) living contiguously with BPL families, provided they are acceptable to the BPL members of the group. APL members, however, will not be eligible for the subsidy under the scheme.

Self Help Group Bank Linkage programme

Self Help Group Bank Linkage programme (SHG-BLP) is a milestone programme started by the National Bank for Agriculture and Rural Development (NABARD) in 1992 to extend reasonable banking services at a door step. It was started to link the unorganized sector of the economy with the banking sector.

Under this programme, banks open savings accounts for Self-Help Groups. SHGs collect savings from its members and utilize the same to grant loans to the deprived members. Also banks provide loans to the SHGs against group guarantee. The loan amount can be numerous times the deposits placed by such SHGs with the banks. Banks are required to consider complete credit requirements of the members of SHGs, such as need for education, marriage, housing, activities related to generation of to income etc.

Initially SHGs were concentrated in the southern parts of the country, however gradually they reached the other parts of India specially the eastern and northeastern regions where the coverage of financial exclusion is greater. There have been various subsidy-linked credit schemes for the poor initiated by the Indian government. NABARD also plays a crucial role in financing the micro and small scale enterprises like NGOs, SHGs etc.

The progress of this programme can be highlighted using the following table and graph:-

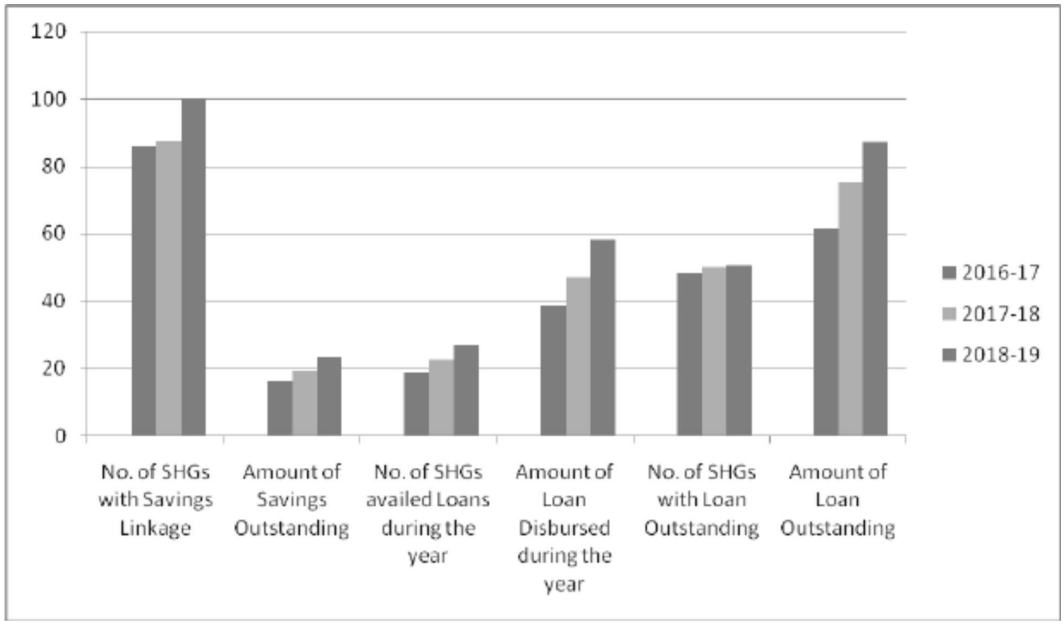

Figure 4.1: Progress of SHG-BLP (2016-17 to 2018-19)

No. of SHGs in lakhs

Amount in Rs.000 crore

Year	No. of SHGs with Savings Linkage	Amount of Savings Outstanding	No. of SHGs availed Loans during the year	Amount of Loan Disbursed during the year	No. of SHGs with Loan Outstanding	Amount of Loan Outstanding
2016-17	85.77	16.11	18.98	38.78	48.48	61.58
2017-18	87.44	19.59	22.61	47.18	50.20	75.60
2018-19	100.14	23.32	26.98	58.32	50.77	87.10

Source: Report on Status of Microfinance in India, 2018 – 19 by NABARD.

Analysis and interpretation

From the above table and graph, following inferences can be drawn:

No. of SHGs with savings linkage was 85.77 lakh in the year 2016-17 which rises subsequently to 87.44 lakh in the year 2017-18, and further to 100.14 lakh registering a growth of 14.5 per cent during the year 2018-19.

Savings Outstanding with SHGs A vigorous savings outstanding of an SHG helps to meet contingencies of its members through internal lending as well as can source a bank loan for an appropriate investment plan. The savings outstanding of SHGs as on 31 March 2019 has reached Rs 23,324 core, registering a growth of 19.1 percent over the year 2017-18.

No. of SHGs availed Loans during the year again there is a sharp rise in utilization of credit facility from the bank, thereby registering a growth of 42.14% over the year 2018-19.

Amount of Loan Disbursed during the year The financial institutions mainly the banks also reciprocated positively thereby disbursing the loan to the SHGs. It has reached to 58.32 crore in the year 2018-19, compared to 47.18 crore in the year 2017-18.

However, along with this the No. of SHGs with Loan Outstanding and the corresponding amounts have also increased to a considerable extend, due to the increased in the credit disbursement over the years.

Conclusion

In most of the developing countries today, more and more emphasis is laid on the need for women's active participation in the process of development. It is also extensively acknowledged that a women can not only manage household and bear children, but also can bring income from productive activities. Infact they have proven that they can be even better entrepreneurs. Self-Help Group (SHGs) plays an important role in the socio-economic upliftment of women thereby empowering them. The Self-Help Group (SHGs) is feasible stand in to achieve the objectives of rural development and to get community participation in all rural development programmes. Pandit Jawaharlal Nehru said, "To awaken the people, it is women who must be awakened, once she is on the move, the family moves, the village moves and nation moves." Hence now the women are awakened by the self help groups.

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Fundamental Analysis: A Study of FMCG Sector in India

Akshat Arora[1*], Aisha Zaheer[2], Kushangi Singh[3]

Abstract

Fundamental Analysis is the keystone of investing. It is all about understanding the financial position of a firm, the environment in which it operates and its prospects. It involves looking into both financial and non-financial aspects of a firm to get an idea of its future performance. The main objective of fundamental analysis is to find underpriced or overpriced securities by calculating its intrinsic value or real value and comparing it with the market price so that the investment decision of buying selling can take place. To carry out Fundamental analysis EIC (Economy, Industry, and Company) approach has been used. It is also known as a Top-Down approach. From the study, it is analyzed that EMAMILTD, GODREJCP, ITC, JUBLFOOD, MARICO & UBL has an intrinsic value greater than market value and is suggested to buy & hold the shares. Earnings of BRITANNIA, GODREJCP, JUBLFOOD, ITC & MARICO belong to shareholders only as these companies don't have any debt portion. GODREJCP has a maximum net profit ratio in the year 2019 as compared to other companies.

Keywords: FMCG Sector, Fundamental Analysis, Intrinsic Value, Market Value, Shares

I.I. INTRODUCTION

Fundamental analysis is analysis of firm's financial statements to find out their intrinsic value. Stocks with higher or lower value than their real value has been looked by analysts so that they can suggest investors to invest in the stock which gives higher returns. It provides logical and systematic approach to estimate future profits. Mostly fundamental analysis is good for long term investments based on long term trends. It also helps us to know that industry and economic factors also affects companies' performance.

Fundamental analysis can be useful in various ways but it should be approached carefully, sometimes the analysis done but not utilized with care or without knowing the behind scene of the report may yield a negative return and this implies that the motive of increased future funds is not achieved. Therefore, investment decision should be taken with due care and expertise.

FMCG i.e. Fast Moving Consumer Goods sector is the 4th Largest Sector in Indian Economy. This sector has witnessed a notable growth over the years. Demand for goods and services in FMCG sector are stable because this sector is considered as defensive as earnings of these firms are not highly affected by the poor market conditions.

I.II. OBJECTIVES

1. To overview Economy and Industry aspects.
2. To analyze the performance of FMCG companies through Ratio Analysis.
3. To estimate Intrinsic Value of shares.

I.III. LITERATURE REVIEW

Fundamental Analysis is an approach to arrive

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at correct price of a share or stock by estimating its current and future earning capacity based on Economy, Industry and Company. Its main objective is to find out the intrinsic value of share so as to take investment decision.

Jean Paul Gettay, one of the most successful stock market operators of all time said, "Do not buy stock until you know all about it."

According to Pandya and Pandya (2013), the purpose of fundamental analysis is not to enter and exit the market very often, for switching securities or to have speculative gains, instead it is for long term investment.

Yee and Cheah (2006), from there study analyzed that large firms which are having greater resources and have great skills, are not guaranteed to be more profitable.

According to Bonga (2015), it does not matter whether fundamental analysis or technical analysis or both is used by investor as it only explains investor's risk appetite. Moreover, what is important is to rely on analysis rather than making blind investment, which will turn the objective of saving funds to increase value and wealth.

I.IV. RESEARCH METHODOLOGY

Data-Based research was conducted using secondary data and published data collected from financial statements of Companies undertaken for analysis, Research Publications of individuals and Institutions, money control, NSE, etc. The financial data of FMCG companies listed under the National Stock Exchange (NSE) for the period 2013-14 to 2018-19 has been collected. There are fifteen Companies under NSE out of which twelve has been taken for analysis. Various factors of economy and industry are analyzed. Accounting ratios and intrinsic value have been calculated to analyze the performance of companies. The statistical tool average has been used for calculation. Bar graphs have been used for presenting data.

I.V. ECONOMY ANALYSIS

Investments are an integral part of our economy, it not only creates and increases the wealth of a country and investors but also leads to economic development but before investing in any company one should research and study various factors. Hence economic analysis comes into role. Economic analysis proves to be a very strong and helpful tool for investors. It creates a clear and comparative view on which company/sector to invest in.

A country's growth is analyzed to make the positive investment decision since income distribution in every country differs, say per capita income of the US economy cannot be compared with per capita income of the Indian economy. Hence economic analysis creates a base to identify investment opportunities in underdeveloped and developing countries.

Investors desire high returns and economic development. There are various tools like slope, optimization technique and economic variables by which weakness and strength of the economy can be determined.

Finance is the backbone of any economy. Inadequate or wrong financial/ investment decisions can lead to recession/ inflation for a healthy economy. Investors need to analyze and invest at the correct time. The economic analysis involves the study of the economy by analyzing the opportunities.

Aspects of Economy Analysis:

- **GDP is** the most widely used economic indicators that can help in determining the health of an economy. Rising GDP indicates a boom period and good health of the economy whereas declining GDP indicates economic slowdown and recession. As in the current scenario, the GDP of our country rose to 8% in 2018 from 6.6% in 2016. Rising GDP boosts investor's confidence in the economy and leads to an upward trend in FDI and Nifty Index Price.
- **Inflation** is the rise in the prices of goods and services. Inflation not only increases the prices but also impacts the standard of living, cost of doing business, etc. The business became less profitable as the cost of input increase. Currently, inflation in India rose to 5.24% from 4%. However, the inflation rate has drastically declined from 2012 when it was 11.17% and today it's almost half about 5.24%. Inflation has an inverse relationship with the index. An increase in inflation leads to a bullish market and a decrease in inflation has a positive impact on a country's economic health. Due to a decline in inflation since 8 years had a positive impact on Markets.

- **Tax Structure** in an economy plays a very important role in framing investors decision, FDI is very important for any economy, when taxes are too high, FDI tends to withdraw from such economy and would like to invest in such economy where taxes are lower. The government has taken many initiatives to boost economic growth. The government has slashed corporate tax rates from 30% to 22% for existing companies and for manufacturing companies' taxes have been reduced from 25% to 15%. With the introduction of GST, lots of taxes have been subsumed and single tax structure has been adopted by the government like service charge was earlier 18% that have been removed, restaurant taxes were 18% that have been bought down to 5%. A very small taxpayer has been benefited due to composition schemes, items of necessity like milk, bread, eggs, fresh fish, vegetables, etc have become tax-free. This has brought down inflation in the economy.
- **Political Factors** have great importance in an economy and market, near the budget announcement market sees lots of fluctuations like before budget announcement 10-year bond was trading at 7.27% which short up to 7.37%. however, many shares boost up like DABUR, ITC, reliance, etc.
- **Ease of Doing Business** rank of India has improved to 63 in 2019 from 77 in 2018. Ease of Doing Business in India averaged 119.67 from 2008 until 2019, reaching an all-time high of 139 in 2010 and a record low of 63 in 2019! The major portion of the improvement in rank has been seen after the year 2016.

I.VI. INDUSTRY ANALYSIS

The growth and progress of industry depend upon the situation of the economy in which it exists which in turn has an impact on the market price of securities. The purpose of industry analysis is to understand that irrespective of economic growth some industries might perform better or worst.

FMCG i.e. Fast Moving Consumer Goods sector is the 4th Largest Sector in India, it constitutes approximately 50% of household products, 30% for health care and 20% for food and beverages. It has grown from 31.6 billion US$ in 2011 to 52.8 billion US$ in 2018.

Investing decisions in FMCG's can depend on company to company. Some companies under FMCG sectors are so much better than other reasons may vary, some are performing better due to quality some due to quantity and some due to competitive prices. FMCG sector is dealing with consumer products in which some products are a necessity due to which their demand becomes inelastic and a reason to perform better than other industries.

Aspects of Industry Analysis:

- **Porters Five Forces**
  - § **Ease of entry:** Root (1994) and Buckley and Casson (1998) have identified 15-20 modes of market entry. These can be broadly classified into five main categories which are export, licensing & franchising, strategic alliance, joint venture, and wholly-owned Subsidiary.
  - § **Power of suppliers:** Large suppliers have greater power than those of small suppliers.
  - § **Power of buyers:** It depends upon their spending capacity.
  - § **Availability of substitute:** Within the industries, there are many competitors. Therefore, the substitute for the products is easily available.
  - § **Competitor:** There is no such competitor of FMCG.

Understanding the industry is an important component of effective strategic planning.

- **Demand and Supply**

FMCG sector deals in products that are of daily needs and necessity, buying and selling is done on a continuous basis. Demand for these products will not decline too much during the recession. Therefore, it will not hamper the profits to a large extent. Though this sector also deals with products that are not a necessity but somewhat luxurious, their demand will also not decline too much during inflation or depression because they are not so much costly as compared to the products of other industries. **Demand and supply for these goods are continuous in nature which is clear from the name Fast Moving Consumer Goods(FMCG).**

- SWOT Analysis
  - § **Strengths:** Low operational cost, presence of established distribution channel, presence of well-known brands in FMCG, e-commerce.
  - § **Weakness:** Low scope of investment in

technology, low export level, counterfeit product.

§ **Opportunities:** Untapped rural market, rising income level, large domestic market.

§ **Threat:** Removal of import restrictions, tax, and regulations, bargaining powers of buyers and suppliers.

• **Key Players**

DABUR, COLPAL, ITC, MARICO, BRITANNIA, HUL, etc.

• **Rules and Regulations**

There are so many legal compliances for food industries in India. Law governs that the consumable products should be safe and secure to be consumed by the public and should not affect the health of a person.

• **Tax Structure**

GST is beneficial for FMCG Sector because many products like soap, toothpaste, etc., which were taxed between 23-24% are now taxed at 18%. Basic food products like wheat, milk, rice, and fresh vegetables are kept under the nil bracket. Other food products come under 5% or 12% bracket. Approximately 81% of items are kept under 18% or below tax bracket and the remaining 19% fall in a 28% tax rate.

• **Investments and Developments[2]**

§ 100% FDI allowed in food processing & single-brand retailing and 50% in multi-brand retailing. From April 2000 to March 2019 this sector witnessed an FDI inflow of US$ 14.67 billion.

§ The number of mega food parks ready increased from 2 between 2008-14 to 13 between 2014-18.

§ Preservation and processing capacity increased from 308,000 during 2008-14 to 1.41 million during 2014-18.

§ The number of food labs increased from 31 from 2008-14 to 42 during 2014-18.

I.VII. COMPANY ANALYSIS

Company Analysis involves looking into financial statements like Profit & Loss A/C, Cash Flows, Balance Sheet to ascertain the earning capacity, profitability, efficiency and financial position of a firm with respect to earnings of shareholders. Company analysis not only considers financial factors but non-financial factors too which includes the nature of business, competitive advantage, technology, efficiency of management, Corporate Social Responsibility (CSR), Research and Development, etc. which are important for an investor to analyze before making an investment. Through company analysis, one can analyze how a company performs as compared to previous years as well as from other similar companies. It consists of Ratio analysis and finding out the intrinsic value of a share.

The following 12 FMCG companies has been selected for the purpose of research:

Table 1: Name of Companies and their Symbol

S.No	Name of Company	Symbol
1	Britannia Industries Ltd.	BRITANNIA
2	Colgate Palmolive (India) Ltd.	COLPAL
3	Dabur India Ltd.	DABUR
4	Emami Ltd.	EMAMILTD
5	Godrej Consumer Products Ltd.	GODREJCP
6	Hindustan Unilever Ltd.	HINDUNILVR
7	ITC Ltd.	ITC
8	Jubilant Foodworks Ltd.	JUBLFOOD
9	Marico Ltd.	MARICO
10	Tata Global Beverages Ltd.	TATAGLOBAL
11	United Breweries Ltd.	UBL
12	United Spirits Ltd.	MCDOWELL-N

Source: www.nse.com

A.A. Ratio Analysis

"Ratio analysis is a study of the relationship among various financial factors in a business."
Bhardwaj and Garg (2018)

It helps in making comparisons, simplifying complex numbers, locating weak points in business, and establishing relationships. It is an important tool for financial analysis and financial management. Financial Ratios help in analyzing the financial performance of a firm.

Following are the aspects of Ratio Analysis:

1. Liquidity Ratios

It measures the company's ability to pay current liabilities within one year.

· **Current Ratio** = Current Assets/ Current Liabilities

It tells about whether current assets are enough to meet current liabilities. 2:1 is considered as an ideal ratio. This states that the company should have at least 2 times current assets as compared to liabilities. If it is less than 1 it means a company has not enough funds to meets current liabilities and if it is more than 2 it means a company has invested more in current assets which can invest for some other productive purpose.

Table 2 shows that BRITANNIA has an ideal current ratio. TATAGLOBAL, ITC & MARICO have invested more in current assets than required and others have that much current assets which can be used to meet current liabilities.

Table 2: Current Ratio

S.No	Symbol	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
1	BRITANNIA	0.9	1.2	1.1	1.8	2.0	1.9
2	COLPAL	0.8	0.8	0.9	0.9	1.1	1.0
3	DABUR	1.7	1.2	1.3	1.5	1.6	1.4
4	EMAMILTD	2.9	3.6	0.5	0.5	1.0	1.4
5	GODREJCP	0.7	0.9	1.0	1.0	1.3	1.1
6	HINDUNILVR	0.7	1.1	1.0	1.3	1.3	1.4
7	ITC	1.8	2.1	1.7	3.6	2.8	3.1
8	JUBLFOOD	0.7	0.5	0.5	0.6	1.1	1.5
9	MARICO	1.4	2.0	1.9	2.5	2.5	2.4
10	TATAGLOBAL	1.5	1.6	1.4	2.2	3.7	5.0
11	UBL	1.3	1.2	1.1	1.2	1.5	1.4
12	MCDOWELL-N	0.9	0.9	0.9	1.0	1.0	1.0

Source: Authors' Calculation

· **Quick Ratio** = (Current Assets – Inventories – Prepaid Expenses)/ Current Liabilities

It is also known as a liquid ratio or acid test ratio. It shows the instant debt-paying capacity of a firm which means liquid assets are immediately available to pay current liabilities. 1:1 is an ideal ratio.

Table 3 shows that EMAMILTD, HINDUNILVR, JUBL, MARICO & BRITANNIA have enough liquid assets to meet current liabilities. ITC & TATAGLOBAL have too many liquid assets to meets current liabilities and others have a quick ratio of less than 1 which means they are not in a position to pay current liabilities immediately.

Table 3: Quick Ratio

S.No	Symbol	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
1	BRITANNIA	0.10	0.10	0.00	0.00	0.30	0.00
2	COLPAL	0.04	0.08	0.06	0.02	0.01	0.07
3	DABUR	0.02	0.02	0.02	0.07	0.06	0.02
4	EMAMILTD	0.05	0.03	0.25	0.01	0.02	0.02
5	GODREJCP	0.00	0.00	0.00	0.00	0.00	0.00
6	HINDUNILVR	0.34	0.30	0.36	0.12	0.15	0.18
7	ITC	0.01	0.00	0.00	0.00	0.00	0.00
8	JUBLFOOD	0.02	0.02	0.02	0.00	0.00	0.00
9	MARICO	0.19	0.10	0.00	0.00	0.00	0.00
10	TATAGLOBAL	0.19	0.20	0.06	0.04	0.03	0.03
11	UBL	0.31	0.28	0.10	0.08	0.08	0.03
12	MCDOWELL-N	0.39	0.83	0.28	0.46	0.32	0.26

Source: Authors' Calculation

1.2. Solvency Ratios

It measures the company's ability to meet its long term obligation.

· **Debt Equity Ratio** = Long Terms Debt / Shareholders Fund

It shows how much debt the company is using to finance fixed assets as compared to shareholders' funds. 2:1is ideal ratio. A higher ratio is not good because if business shut down it may incur a loss to shareholders because at the time of winding up outside

liabilities are paid first and left out is distributed among shareholders. A lower ratio is also not good because it shows the company is not taking advantage of trading on equity.

Table 4: Debt Equity Ratio

S.No	Symbol	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
1	BRITANNIA	0.5	0.9	0.8	1.3	1.6	1.5
2	COLPAL	0.5	0.5	0.6	0.6	0.8	0.7
3	DABUR	1.2	0.8	0.9	1.0	1.0	0.9
4	EMAMILTD	2.4	3.2	0.3	0.3	0.6	1.0
5	GODREJCP	0.4	0.6	0.5	0.7	0.9	0.7
6	HINDUNILVR	0.7	0.8	0.7	0.9	1.0	1.1
7	ITC	1.2	1.4	1.1	2.4	1.9	2.3
8	JUBLFOOD	0.6	0.4	0.4	0.4	0.9	1.3
9	MARICO	0.7	0.9	1.0	1.2	1.1	1.3
10	TATAGLOBAL	0.5	0.3	0.5	0.5	2.4	3.0
11	UBL	0.9	0.8	0.8	0.8	1.0	0.9
12	MCDOWELL-N	0.6	0.6	0.6	0.6	0.7	0.6

Source: Authors' Calculation

Table 4 shows that BRITANNIA, GODREJCP, JUBLFOOD, ITC & MARICO have no debt portion in 2018-19 and in previous years they have very little debt portion. HINDUNILVR & MCDOWELL-N has the highest D/E ratio in 2018-19 as compared to others and has been declined from preceding years. Other companies have a very less D/E ratio.

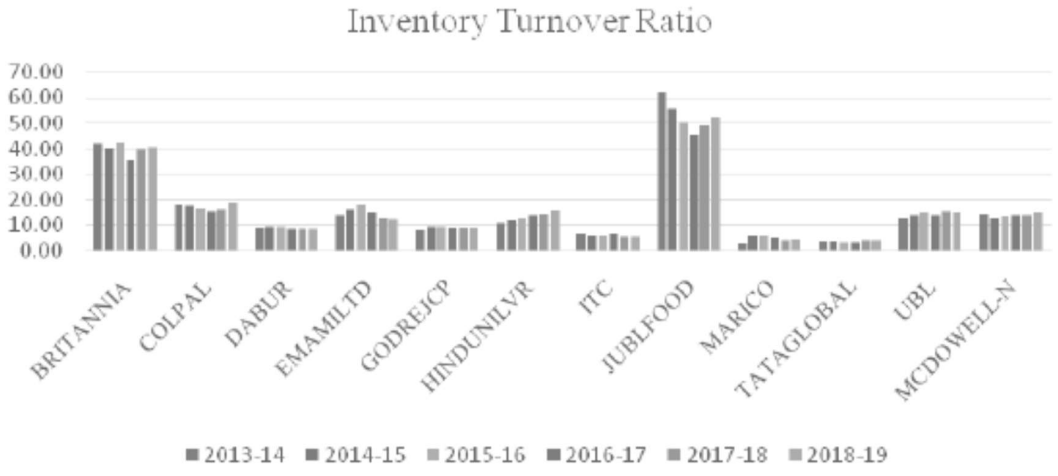
3. Turnover Ratio

It helps to analyze how efficiently the firm is utilizing its resources.

· **Inventory Turnover Ratio** = Cost of Revenue from operations / Average Inventory

This ratio shows how fast inventory is converted into sales that generate revenue from operations. Higher the ratio is better because it shows a firm's inventory is selling at a higher pace leading to profitability. On the other hand, a lower ratio signifies inventory is not selling at a higher pace thereby affecting the profitability of the firm.

Figure 1: Inventory Turnover Ratio



Source: Authors' Creation

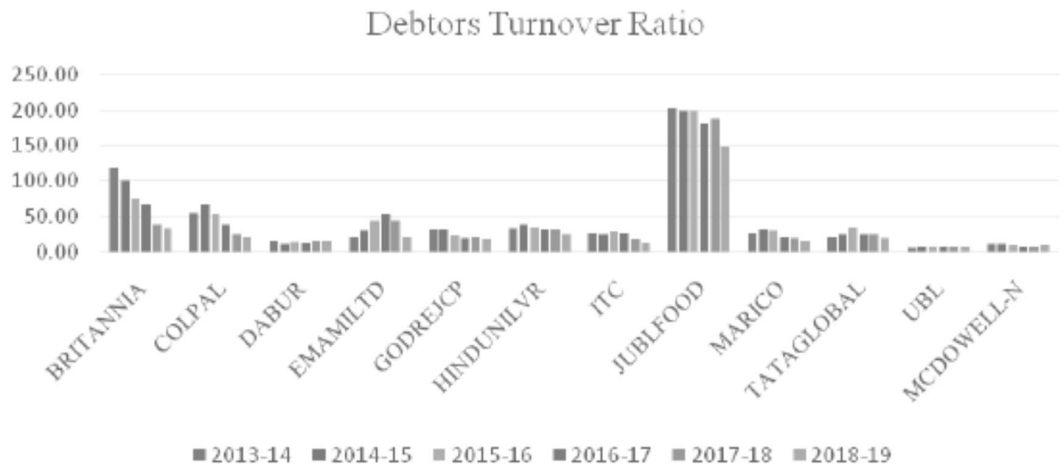
Figure 1 shows that BRITANNIA & JUBLFOOD has a higher inventory turnover ratio. MARICO, TATAGLOBAL & ITC has a lower ratio as compared to other companies. Inventory Turnover

Ratio of other firms lies between 10 to 20 which is also good.

· **Debtors Turnover Ratio** = Sale of Products / Trade Receivables

This ratio indicates the number of times debtors (receivables) are converted into cash and shows how efficient the company is in collecting its debt. Higher the ratio is better, as it shows credit sales are converted into cash speedily and thus, reflects better credit management of a company.

Figure 2: Debtors Turnover Ratio



Source: Authors' Creation

Figure 2 shows that JUBLFOOD has a high ratio which shows the company is very good at converting credit sales into cash in a very short span of time. The ratio for BRITANNIA, EMAMILTD, and COLPAL has been reduced over the years which is not good for the company. Other Companies have an almost consistent ratio over the years.

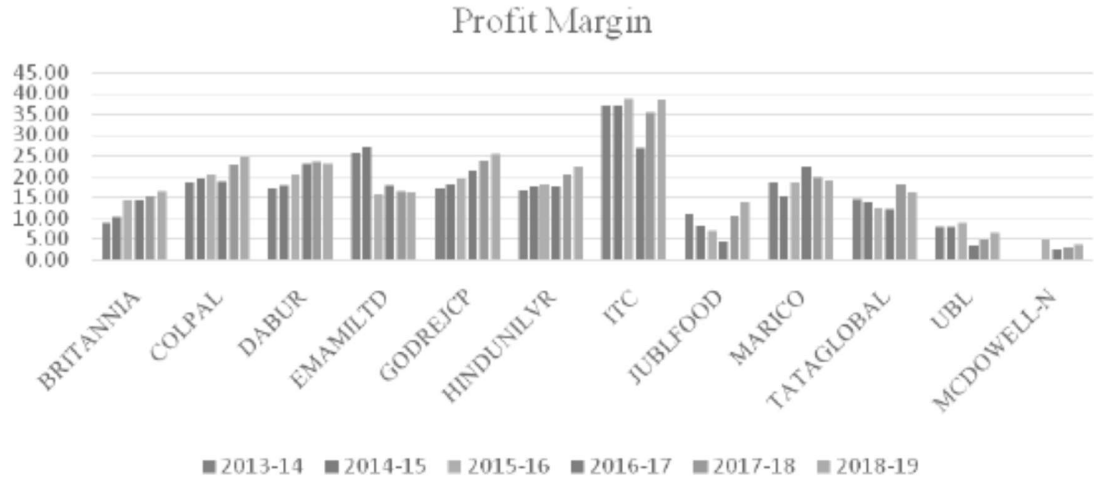
4. Profitability Ratio

It is an important indicator of analyzing the overall efficiency of a firm.

· **Profit Margin (%) =** PBT & Exceptional items / (Revenue from operations + other income)

This ratio shows the extent to which a company has a sufficient margin to cover its operating and non-operating expenses (Bhardwaj and Garg, 2018). Changes in the cost of goods sold or selling price have also impact on profit margin. This change does not reflect any improvement in the efficiency of the firm. Therefore, other factors are also important while doing company analysis. Higher the ratio is better because it shows the company has enough funds to meet its non-production expenses and more would be left for proprietors and shareholders.

Figure 3: Profit Margin



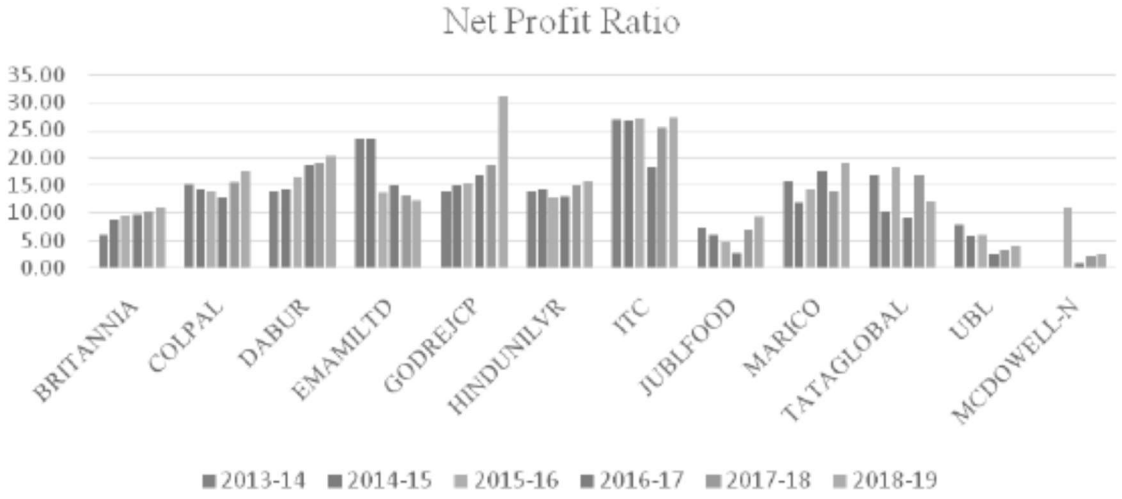
Source: Authors' Creation

Figure 3 shows that ITC has more profit margin as compared to other companies. The profit margin for BRITANNIA, COLPAL, GODREJCP & HINDUNILVR has been increasing over the years. JUBLFOOD shows the v-shaped graph, its profit margin declined gradually and the start increasing which is a very good sign. EMAMILTD's profit margin declined in 2015-16 and afterward, it has been almost consistent. DABUR, MARICO & TATAGLOBAL profit margin is not so consistent and also not increasing. It is some time increasing and sometimes decreasing. UBL has not too much profit margin. MCDOWELL-N has a very less profit margin.

· **Net Profit Ratio** = Profit after Tax/Revenue from Operation

It indicates the overall efficiency of business organization as it considers all operating and non-operating income and expenses of a particular period and these are compared to net revenue from operations (Bhardwaj and Garg, 2018). Higher the percentage is better because good returns are available for shareholders for bearing risk.

Figure 4: Net Profit Ratio



Source: Authors' CreationFigure 4 reflects that the GODREJCP net profit ratio is highest in 2018-19. ITC has an almost consistent Net Profit ratio except for the year 2016-17. COLPAL, DABUR, HINDUNILVR & BRITANNIA net profit ratio has been increasing over the years. EMAMILTD NPR has reduced in 2015-16 and has been reducing. JUBLFOOD NPR is v-shaped, it reduced till 2016-17 and then start increasing. MCDOWELL-N has very poor NPR. Other companies NPR is like zig-zag first decreased then increased and so on.

Though ITC has the highest profit margin during 2018-19 but npr of GODREJCP was highest which means it has more to give to its shareholders.

VIII. Estimation of Intrinsic Value

Every share has intrinsic value at a period. This value keeps on changing from time to time because of various internal and external factors. Intrinsic value is the true or fair or real value of an asset which is not necessarily equal to its market value as an asset may be overvalued or undervalued. It is carried out to predict a company's future performance. In the short run, an asset or stock may be undervalued or overvalued but in the long run, it will graviate towards its real value.

The rule for taking investment decision:

- If the market value is greater than intrinsic value then, the stock should be sold out or should not be purchased as its price will move towards its lower intrinsic value. If a stock is purchased at this time it may lead to a loss.
- If the market value is less than intrinsic value then, the stock should be purchased or should not be sold because its market value will increase in the future and will lead to profit.

A. Calculation of Intrinsic Value:

- Intrinsic Value = Projected EPS × Average P/E Ratio
- Projected EPS = Current EPS × (1 + Growth in Equity)
- Growth in Equity = Average Retention Ratio × Average ROE

- Return on Equity (ROE) = (PAT / Shareholders Fund) × 100
- Average Retention Ratio = 1– Average DPR
- Dividend Payout Ratio (DPR) = (DPS/EPS) × 100
- P/E Ratio = Market Value / EPS
- Price Earning (P/E) Ratio shows the price, the investors are willing to pay for every rupee of earning per share. High P/E ratio reflects high earning potential and vice versa.

A. Table 5: Intrinsic Value and Market Value

S.No	BRITANNIA	COLPAL	DABUR	EMAMI LTD	GODREJCP	HINDUNILVR	ITC	JUBLFOOD	MARICO	TATAGLOBAL	UBL	MCDOWELL-N
Average DPR	0.33	0.66	0.56	0.46	0.46	0.79	0.58	0.13	0.55	0.38	0.12	0.00
Average Retention Ratio	0.67	0.34	0.44	0.54	0.54	0.21	0.42	0.87	0.45	0.62	0.88	1.00
Average ROE	0.38	0.60	0.31	0.26	0.22	0.94	0.27	0.18	0.31	0.13	0.14	-0.25
Growth in Equity	0.25	0.20	0.14	0.14	0.12	0.20	0.11	0.16	0.14	0.08	0.12	-0.25
Projected EPS	58.59	34.30	8.13	7.66	19.22	33.43	11.32	28.26	9.98	7.04	23.90	6.84
Average P/E Ratio	48.17	42.75	52.44	57.54	58.52	47.25	29.39	74.84	42.87	27.08	81.79	55.07
Intrinsic Value	2822.19	1466.29	426.57	441.07	1124.90	1579.36	332.82	2114.99	427.60	190.65	1954.43	376.57
Market Value as on 31.12.2019	3027.80	1462.90	458.40	309.90	684.55	1923.00	237.70	1652.30	341.60	321.35	1270.05	599.55

Source: Authors' Creation

B. Decision

- **BRITANNIA, DABUR, HINDUNILVR, TATAGLOBAL & MCDOWELL-N:** Intrinsic Value < Market Value, the value of a share is overpriced and is expected to decline. Therefore, it would be recommended to sell a share at current market price.
- **COLPAL:** Intrinsic Value > Market Value, the difference between intrinsic value and market value is approx. three rupees, so it is recommended to hold the stock as selling would not result in much profit.
- **EMAMILTD, GODREJCP, ITC, JUBLFOOD, MARICO & UBL:** Intrinsic value > Market Value, the value of a share is underpriced and is expected to increase. Therefore, it would be recommended to purchase a share at current market value.

IX. Limitations

Since the approach is considered as a useful approach to take investment decision but it has some drawbacks like it is a very lengthy and time-consuming process and involves various tools which may not be understood by a normal investor, it is not useful for short-run investment decision, etc.

As the study involves 12 companies & it is not possible to explain each and everything in detail but briefing has been given to every factor. Fundamental analysis is itself a wider term and covers too many factors and to explain every factor is not possible in research.

X. Conclusion

FMCG sector has significantly shown contribution towards GDP, Inflation Rate, consumer spending & saving, etc. Reduction in tax rates results in manufactures passing on the benefit to end consumers. Make in India Campaign and improvement in ease of doing business rank leads to increased FDI. It is a type of industry where the profit margin is not affecting much by inflation due to the difference between the products i.e. some products are necessary products and others are a luxury product and there's no comparison between product.

From the study, it is analyzed that shares of BRITANNIA, DABUR, HINDUNILVR, TATAGLOBAL & MCDOWELL-N are overpriced, which means the intrinsic value is less than market value. Thus share price can fall. So at this time investor should sell their shares and should invest in other profitable options. MCDOWELL-N has a higher debt-equity ratio as compared to others and its net profit ratio & profit margin is very less and the dividend payout ratio is nil which suggests the company's performance is not up to mark. As can be inferred from the intrinsic value table BRITANNIA has maximum EPS as compared to other firms. It also came to know that FMCG is doing great in present and throughout the period, it can be said that

it might grow furthermore in the future as this industry does not just look into sales by also understand its social responsibility by showing concerned towards the consumer. In India, there's a large market for consumer goods with demanding customers. Therefore, from the study, it can be said that all three analysis is essential before taking investment decision because the company's performance depends not only on its own efforts but also on industry and economic factors.

XI. Acknowledgement

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Footnotes

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COVID-19's Impact on the Stock Markets

Ms. Ritika Seth[1*], Shruti Daliya[2], Shivam Goenka[2]

ABSTRACT

In this paper, we analyse and study the impact of novel coronavirus on the stock markets of six different economies of the world, China being the epicentreof the disease and other countries being those that are majorly affected by COVID-19.We look at the difference in the market situation before and after the outbreak of COVID-19 in the chosen countries. The past studies suggest that such pandemic shows a worse effect on the stock market in the short-run but the markets eventually stabilizes in the long run.We have usedstatistical techniques to quantify our results and compare the effect.

For the chosen countries the data has been derived for three different timelines: pre COVID, initial stage, and post COVID. The pandemic has forcefully impacted the stock market.The findings indicate that the lockdown due to the spread of COVID-19 did have a significant impact onthe stock markets. Moreover, a spill-over effect of the outbreak in China could be seen in the other countries and later the indirect effects of the restrictions in the other countries across the world were seen in China.

Keywords: pandemic, China, spill-over, returns, indices

INTRODUCTION

The world was struck by the worst pandemic (COVID-19) in decades caused by a novel coronavirus in late 2019 that has shaken the entire humanity to its core. The first traces of coronavirus in a human was found on 17th November last year in the Hubei Province of Wuhan, China. Being a highly communicable disease, it spread like wildfire across the globe affecting more than 8 million people with more than 350 thousand deaths as on 15th June 2020 as per the data available on www.worldometers.info. The mass movements of the people during the Christmas and New Year led the virus to spread rapidly to other provinces of China. As a precautionary step, the Chinese government suspended all forms of transportation from 23rd January. The World Health Organization issued its first alert on 30th January and declared it a pandemic on 11thMarch.

Since the restrictions levied on 23rd January, various Media outlets across the world have reported how the economies worldwide have been affected by the virus. Reports titled 'Spread and Shutter' in The Economist[1] and 'Sneezy Money'[2] points states that COVID-19 is a major threat to the financial markets and the disturbance being caused to the economy due to the interference with the supply of labour, goods, and services. The World Economic Outlook[3] has predicted the global growth to be -4.9% in 2020.

The financial markets have fallen to significant low-levels in the wake of the spread of the virus with some countries seeing a fall of up to 30%. In the words of the UN Deputy Secretary-General Amina J. Mohammed, "We have moved into a recession that will be worse than the one we experienced in 2008."[4]

This study aims at analysing the impact of COVID-19 on the stock markets of the major

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economies across the globe. It brings forth the changes and deviations caused in the returns of the major indices of these countries. The readers of this research paper will be able to understand if this pandemic had a significant effect on the financial markets of the economies and to what extent and during which stage of the spread of the virus.

REVIEW OF LITERATURE

Scott et al. (2020) did a study to study market volatility, economic uncertainty, and subjective uncertainty in business expectation surveys. They used these as indicators to document and quantify the enormous increase in economic uncertainty in the past few weeks. The exercise says that about half of the forecasted output contraction reflects a negative effect of COVID-19 induced uncertainty.

Al-Awadhi et al. (2020) performed a study and investigated whether contagious infectious diseases affect stock market outcomes. As a natural experiment, they used panel data analysis to test the effect of the COVID-19, on the Chinese stock market. The findings show that both the daily rise in the number of total confirmed cases and the number of total deaths caused by COVID-19 have significant negative effects on stock returns across all companies.

Zhang, Hu and Ji (2020) conducted a study that aimed to find the general patterns of country-specific risks and systemic risks in the global financial markets. It also analysed the potential consequence of policy interventions, and to what extent these policies may introduce further uncertainties into global financial markets.

Ashraf (2020) report on Stock markets' reaction to COVID-19 examined the stock markets' response to the COVID-19 outbreak. They used daily COVID-19 confirmed cases and deaths and stock market returns data from 64 countries. The study founded that the stock market reacted negatively concerning the growth in COVID-19 confirmed cases and this response differed over time depending on the stage of the pandemic.

Ozili and Arun (2020) conducted a study on the spill-over impact of COVID-19 on the global economy. They observed the impact of social-distancing norms on the economic activities as well as the stock market indices. Their results suggest that increasing number of lockdown days, monetary policy decisions and several international travel restrictions critically impacted the economic activities as well as the share prices.

Gormsen and Koijen (2020) performed a research on the impact of coronavirus on stock prices and its growth expectations used data from the aggregate stock market which was future dividend to quantify how investors' expectations about economic growth evolved across horizons in reaction to the pandemic and eventual policy responses until June 2020. They analysed the joint dynamics of short-term dividend futures and stock markets.

Zerenand Hizarci (2020) report on the impact of COVID-19 on the stock market where they took evidence by selecting a few countries was directed towards revealing the possible effects of the COVID-19 epidemic on stock markets. The study used daily data between 23 January 2020 and 13 March 2020 and possible reactions on stock markets has been found with Maki (2012). The results obtained suggested that all stock markets examined with total death act together in the long run.

In our study, we have used the data of the stock indices of a long period from 1st October to 15th June and divided it into timelines and phases to achieve more accurate results. We have not only taken into account the initial stages of the COVID-19 outbreak but also the later stages. We have even compared our results with the Global Index which makes our research paper unique and different from the others already existing in this topic.

DATA AND METHODOLOGY

In order to analyse the impact of COVID-19 on different economies of the world due to the lockdown and restrictions imposed, we have chosen the following countries:

India, The US, The UK, Russia, Brazil, and China

The first five countries are chosen as they stood among the top five most affected countries based on the number of COVID-19 cases as on 15th June 2020 whereas china is selected as it was the first country to be affected by the outbreak.

For the chosen countries, the following stock indices are chosen as these are considered to be the best representatives of the stock market in the given countries. In our study the Shanghai SE Composite represents China, NIFTY 50 represents India, S&P 500 represents. TheUS, FTSE 100 represents the UK, and BOVESPA represents Brazil. The Global Index

S & P 1200 is also taken into account to study the effect on the global market conditions.

Since the outbreak took place in China in late 2019, and then eventually spread to other countries in Asia, Europe, and other Continents in early 2020, we have divided our study into two timelines namely: 'China Timeline' and 'Other countries timeline'. Further, the 'China Timeline' has been segregated into four different phases depending upon the rise in the number of cases. The phases being the Pre-COVID phase (1st October 2019- 31st December 2019) where there was no cluster of cases reported officially, the initial phase (1st January-12th February 2020) when a cluster of cases was reported, the number of cases started to rise and WHO formed a Research and Innovation Forum to study the virus, the Main Phase (13th February- 10th March 2020) when WHO declared it as a Pandemic and the number of cases reached its peak in China and lastly the Recovery Phase (11th March - 15th June) when most of the affected cases recovered.

Similarly the 'Other countries Timeline' has been divided into three phases namely The Pre COVID phase(1st October 2019- 29th January 2020) when the affected cases were limited to china, The initial phase (30th January 2020- 10th March 2020) when the people started being affected worldwide, and lastly The Main Phase (11th March -15th June 2020) when there was a steep rise in the number of cases which continues to increase even after 15th June when this paper is being written.

The daily returns of the above-mentioned stock indices from 1st October 2019 to 15th June 2020 are analysed. In both the timelines the initial, main, and recovery phase has been compared to the pre-COVID phase. Simple heteroscedastic t-tests are conducted. The T-test is a type of statistical test commonly used to find out if there is a significant mean difference between the two groups of data that might be related to each other. The data source of the closing values for the chosen indices is yahoofinance.com and investing.com.

HYPOTHESIS TESTING

Null Hypothesis

- ð COVID 19 has no impact on the stock market i.e. there is no significant difference between the mean stock returns across periods

Alternative Hypothesis

- ð COVID 19 has impacted the stock market i.e. there is a significant difference between the mean stock returns across periods

The null hypothesis will be rejected if t (calculated)> t (critical)

The change in daily return is calculated using the formula:

= (Present Day's Closing Value – Last Day's Closing Value) / Last Day's Closing Value * 100

RESULTS AND DISCUSSIONS

CHINA'S TIMELINE

Table No. -1: Results of China's Timeline

Phases / Countries	Pre-COVID Phase	Initial Phase			Main Phase			Recovery Phase		
	Mean	Mean	T-values	P-values	Mean	T-values	P-values	Mean	T-values	P-values
China	0.08	-0.02	0.591	0.56	0.138	-0.144	0.887	-0.05	0.76	0.428
India	0.127	0.009	0.062	0.537	-0.89	2.574*	0.019	-0.04	0.373	0.71
US	0.151	0.134	0.11	0.931	-0.87	1.277	0.219	0.154	-0.007	0.994
UK	0.042	-0.01	2.238*	0.049	-1.21	2.346*	0.03	0.067	0.068	0.946
Russia	0.162	0.092	0.391	0.698	-1.27	2.318*	0.033	0.157	0.016	0.988
Brazil	0.185	0.028	0.599	0.552	-1.36	1.338	0.201	0.107	0.135	0.893
S and P Global 1200	0.155	0.136	0.14	0.889	-0.01	2.356*	0.036	0.19	0.02	0.984

Note: * represents 5% Level Significance

CHINA

The Pre-COVID Phase represents a small positive change as against the Initial Phase which shows some decline in the mean returns. The Main Phase shows marginal growth with the Recovery Phase showing insignificant fall. The above data shows that there is no significant difference caused to China's stock market due to COVID-19 which establishes the fact the Chinese economy is quite resilient to exigencies.

INDIA

A positive daily average return is found in the Pre-COVID Phase whereas almost no change in return was noticed in the Initial phase. The main phase witnessed a sharp decline in the daily mean return at 5% level significance. The recovery phase shows a marginally low fall in the mean return. This establishes the fact that the indirect effect of the coronavirus outbreak in China was seen in the Indian stocks in the main phase because of the interdependence between countries whereas no effect was seen in the other phases.

UNITED STATES OF INDIA

Initially, a positive daily average return is found in the pre-COVIDphase which slightly falls in the initial phase. There is a steep decline in the main phase to a certain extent which eventually takes a positive sign in the recovery phase. The results prove the fact that the spill-over effect of the coronavirus outbreak in China was not seen in the US stocks.

UNITED KINGDOM

A stable daily average return is seen in the pre-COVID phase. The decline in the daily return starts in the initial phase continuing to fall to a greater extent in the main phase as well. The returns again take a stabilized form in the recovery phase, a 5 percent level significant difference is found in both the initial and the main stage which shows that the UK faced significant effects because of the virus outbreak in China.

RUSSIA

As we have seen in the other countries, there is normal growth in the mean return in the pre-COVID phase, slightly declining in the initial phase, furthermore giving negative returns in the main phase. The recovery phase witnesses the growth of returns to a limited extent. The decline in the main phase caused by the spill-over effect of COVID 19 in China is significant enough to affect the economy of Russia.

BRAZIL

At first, stabilized positive daily average returns are observed in the first two phases which further sharply declines in the main phase recovering to some extent delivering positive returns in the recovery phase. Although there is a decline in the main phase, it is not significant enough.

S AND P GLOBAL 1200

The S & P Global 1200 is a weighted stock market index of global equities that sums up the performance of the major stock markets across the globe. It includes 31 countries and over 70% of global stock market capitalisation.

Hereit shows that there were stabilized positive returns in the first two phases and the main phase facing a huge drop in the mean returns. The last phase experiences a small growth. As the restrictions were imposed by the Chinese government on all economic activities caused by the increase in the number of COVID 19 cases, it led to the fall in the financial markets not only in China but also across the world especially between 13th February to 10th March.

OTHER COUNTRIES' TIMELINE

Table No. 2: Results of Other Countries' Timeline

Phases / Countries	Pre-COVID Phase	Initial Phase			Main Phase		
	Mean	Mean	T-values	P-values	Mean	T-values	P-values
India	0.089	-0.52	2.048*	0.049	-0.039	0.288	0.774
China	0.031	0.048	-0.04	0.969	-0.05	0.50	0.618
US	0.132	-0.42	1.093	0.283	0.154	-0.05	0.96
UK	0.023	-0.762	2.070*	0.046	0.066	-0.12	0.904
Russia	0.16	-0.806	2.320*	0.027	0.157	0.009	0.992
Brazil	0.134	-0.79	1.256	0.220	0.107	0.047	0.962
S and P Global-1200	0.134	-0.556	1.84	0.077	0.15	-0.06	0.952

Note: * represents 5% Level Significance

INDIA

A stable daily average return is seen in thepre-COVID phase. The sharp decline in the mean returncan be seen in the initial phase which improves in the main phase but still remains negative. A 5% level significant difference is found in the initial phase which shows that the Indian stock market faced significant effects because of the virus outbreak and the Indian economy took a huge downturn.

CHINA

The statistical tests applied to China show that it had only marginal growth in the mean returns in the pre-COVID phase which is when it had started facing the increase in the number of COVID-19 cases in its territory. The returns remain constant in the initial phase. The main phase shows that the indirect effects of the spread of the virus across the globe can be found in its indices in terms of the negative returns.

UNITED STATES OF AMERICA

Initially, a positive daily average return is found in the pre-COVID phase which falls in the initial phase eventually taking a positive sign in the main phase. The results prove the fact that COVID 19 had an impact on the US stocks in the initial phase and the stock market further stabilized in the main phase. There was no significant difference in the returns found.

UNITED KINGDOM

As we have seen in the results of other countries, the UK in the pre-COVIDphase experiences small but positive returns. The United Kingdom's stock markets faced a huge shock in the initial phase when the restrictions were imposed and economic activities were brought down to minimise social contact to restrict the spread of the virus. After going through a significant change towards a negative side, it showed signs of recovery in the main phase.

RUSSIA

Before the pandemic struck in Russia in the early February, it was experiencing a significant growth in its pre-COVID phase. The initial phase, similar to the other major economies faced a huge plunge and reached a 5% Level Significance and led to huge losses for the investors. The main phase showed signs of recovery but only to a certain extent.

BRAZIL

At first, stabilized positive daily average returns are observed in the pre-COVID phases which sharply declines in the initial phase further recovering to some extent and delivering positive returns in the main phase. The decline in the initial phase caused by COVID-19 is not very significant enough to affect the economy of Brazil badly.

S AND P GLOBAL 1200

The Global Index shows correctly shows the summary of the results of all the major economies of the world. A positive daily average return initially turned into a steep decline in the initial phase when the pandemic spread everywhere. It turned out to be a major downfall but most of the economies can be seen recovering at a steady pace which is proved by the results of the main phase.

CONCLUSION

The COVID-19 pandemic has economically affected almost all the countries around the world. Though the virus continues to affect more and more people and the 'Other Countries' Timeline' has extended beyond 15th June, yet the following conclusions can be drawn.

In the case of the china timeline, we see that the impact on most of the countries is limited and short term. China, being the epicentre, holds his fort and proves to be quite resilient towards being drastically affected by the COVID-19 outbreak. With regards to the UK, India, and Russia, we can see that impact can be seen in their financial markets to a significant level whereas the US and Brazil face only limited impact. According to the Global Index, the spill-over effect of the pandemic in China can be seen in other countries in Asia, America, and Europe where the virus has just started to spread.

In the case of the Other Countries' Timeline, the results show that almost all the countries except China faced a significant downfall in the Initial Phase which ultimately took the road to recovery in the next phase. Both, the developed and the developing economies went through tough times. Whereas China faces small negative growth which can be seen as the indirect effect of the impact on the financial markets of all the other countries.

To conclude, we see that a bidirectional spill-over effect is seen between the countries of Asia, Europe, and America. When all the indices are compared to the Global Index, we see that almost the same level of fall and then a small recovery is seen. No economy is spared from the clutches of the pandemic and while this paper is being written, the

countries continue to fight their way through the recovery phase.

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COVID-19- BLACKOUT FOR THE INDIAN INDUSTRIES?

Ritika Seth[1*], Muskan Gupta[2], Manan Jain[2]

ABSTRACT

The purpose of this paper is to analyze and study the impact of coronavirus pandemic on three different sectors of Indian economy i.e. pharmaceutical, automobile and tourism sector. The lockdown has broken the back of these sectors and has given an unprecedented shock across the country. The past studies have emphasized upon such unprecedented worse effect that epidemics have brought to the economies of the countries whenever they have occurred but at the same time, these effects are short-run and the markets eventually stabilizes in the long run. Apart from studying the impact of Covid-19 on selected sectors, we have also tried to analyze the policies that have been announced so far by the Central Government to ameliorate the economic shock.

Keywords: Covid-19, Pharmaceutical, Tourism, Automobile, Lockdown

INTRODUCTION

It is a wide acknowledged fact now that the coronavirus (Covid-19) is a recently diagnosed infectious disease that has shook the entire humanity to its core. It was first tested in Wuhan, China in Dec 2019 and was recognized as novel corona virus in January 2020. World Health Organization declared this as Public Health Emergency of International Concern and declared it as Pandemic. Most countries have already undertaken extreme measures to restrict movements and impose lockdowns to control further transmission and minimize spread of infection, but by the time it had already crossed borders and territories. India also started with its Covid-19 confirmed cases byMarch which impacted the human population in almost every possible way.

Pharmaceutical, Automobile and Tourism are some of the sectors which were jeopardized because of restrictions which are further discussed in this report. The country's economy is facing challenges and is in a vulnerable state with sluggish growth and high debt levels. The financial markets have fallen to significant low levels in the wake of the spread of virus. The effect of this pandemic on these sectors is multidimensional.

This study aims at analyzing the impact of the pandemic on the pharmaceutical, tourism and automobile industry across the country. The readers of this research paper will be able to understand how this outbreak had a significant effect on these sectors as compared to PreCovid-19 era. We have also included the statements of famous economists, leading CEO's of the organizations and Indian Ministry regarding the concern topics. For more clarification, we have also given our analysis about the prospective future of these sectors which makes our research article unique and different from others already existing on this topic.

PHARMACEUTICAL INDUSTRY

The Indian pharmaceutical industry is the world's third-largest drug producer by volume, thirteenth by value and the country's market manufactures 60 per cent of vaccines globally. India is the largest supplier of generic drugs that accounts

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for 20 per cent of global exports in terms of volume. Domestic pharmaceutical market turnover reached US$18.12 billion in 2018, growing 9.4% year-on-year and US $20.03 billion in 2019, growing 9.8% year-on-year from 18.12 billion.[1]While the market has gained confidence, it is also facing a period of flux due to the global Covid-19 pandemic. Fulfilling the necessity for several key drugs, medications and preventive medical supplies has ascended as a major concern in many countries. API (ACTIVE PHARMACEUTICAL INGREDIENTS) is the most important raw material to produce a finished medicine in the pharmaceutical industry. However, Indian manufactures depend intensely on APIs from China for the production of their medications, securing around 70 per cent from China, the top worldwide maker and exporter of APIs by volume.

The import of raw materials from China was halted for over 2 months due to global and domestic lockdown. The continuous coronavirus emergency in China has constrained pharmaceutical and chemical companies to shut their manufacturing units from mid-January. This slowed production of APIs resulted in less availability and higher costs which is another major concern that impacts the cost of production as well as margins of Indian companies. The outbreak of Covid-19 causes potential disruptions to supply or shortages of vital medical products also. According to a note of the Ministry of Commerce, between March and May this year, there has been a 20 per cent increase in prices. As per the current data, the cost of paracetamol has gone up from Rs.250-300 per kg to 400-450 per kg. Similarly, the prices of vitamins and penicillin have also inflated to some great extent.[2]

Inter-state transport challenges are also a major issue. There is a lot of medicine stock that comes from Goa, Baddi, and Sikkim(Sharma, 2020). Due to the lockdown, it has become difficult to reach retailers.The administration has excluded private labs from the lockdown to guarantee that lab specialists and the transportation of tests, just as the opening of a temporary collection center, are unobstructed. Subsequent to posting double-digit growth rates for a quarter of a year straight, pharmaceutical deals in India moved to a slower pace in March 2020. Pharma stocks have seen a huge run-up. This is not just true for India, but globally too pharma companies have performed well. The pharma sector is up ~1% YTD and has outperformed the Nifty Index by 28%.[3]

The Indian government undertook applaudable steps by proposing an incentive package of 13.76 billion Indian Rupees (approximately $181 million) for the promotion of domestic manufacturing of critical key starting materials, drug intermediates, APIs, and medical devices(Dadhich, 2020).

During recent times, the way to purchase products and services has changed and basically the internet has taken over the market and customersare buying medications online frequently. E-Pharmacy adds value in the health care system because it is more convenient and easily approachable services due to transparency of price, medicine reminder, and will be working with other healthcare organizations, professionals and government agencies to address in that panic situation for customers.

E-pharmacies slog as "Evolving as a One Stop Solution for All Healthcare Needs".

They are expected to grow 7 times to $3.7 billion by 2022 in this pandemic situation which can be a boon for the pharmaceutical industry said by Rajnath Singh in Pharma times.[4] E-pharmacies provide information and awareness about various medical conditions to increase patient education and awareness. With more and more people opting to stay indoors,web medications are ensuring that patients do not forego their necessary diagnostics tests by sending their phlebotomists to the patients' doorsteps.

B L Mittal, founder and executive chairman of SastaSundar.com, a leading e-pharmacy company, told TOI that the demand for delivery of medicines has clocked a 10-15% spike in the city in order to maintain social distancing norms. Another online medical store PharmEasy recorded a staggering growth rate of 50% in orders in the last one month, the co-founder of the company, DharmilSheth, told TOI.[5]

As we realize, Pharmaceutical Sector has various advantages and degree increment in web-based business with the goal that the Indian Government must think about the better guidelines which can be helpful for the general public. The Ministry of Health and Family Welfare has embraced different activities utilizing Information & Communication Technologies (ICT) for improving the proficiency and adequacy of the open medicinal services framework. Some of the government initiatives and schemes for e-pharmacy are Ayushman

Bharat Health Insurance Scheme and the Jan Aushadhi Program (Singh, H., Majumdar, A., Malviya, N., 2020). Moreover, the government of India has allowed 100% Foreign Direct Investment (FDI) under the automatic route for greenfieldpharma. Also, with the introduction of product patents, companies are spending nearly 8-13 per cent of their total turnover on R&D to develop new drugs to boost sales. Therefore, government is striving towards "Pharma Vision 2020" aimed at making India a global leader in end to end drug manufacture.

AUTOMOBILE INDUSTRY

Automobile industry includes all those organizations and activities associated with the production of engine vehicles, including most parts, for example, motors and bodies, however excluding tires, batteries, and fuel. The business vital items are two-wheeler, four-wheeler, passenger vehicle and commercial vehicles. As of 2019, India is the 4th largest automobile market in the world. The vehicle area as of now contributes around 50 per cent of the assembling total national output (GDP) in India, 26 per cent of the industry GDP and 7.1 per cent of overall GDP.[6]The investment in this segment is around $40 billion in the most recent decade.

From a very long time, we are seeing automotive industry saw its fortunes fluctuate from month to month, from segment to segment which is dependent on various factors like raw material cost, tax rates and of course, the policies. These indicators had both a positive as well as a negative impact on the Automobile industry. The auto sector had just experienced a slowdown in the course of the last 12-18 months because of changes starting with the Goods and Services Tax, move to Shared Mobility, Axle-load changes, the Bharat Stage-IV (BS-IV) to Bharat Stage-VI (BS-VI) progress, Liquidity Crunch, etc.

With the World Health Organization announced the COVID-19 flare-up a pandemic, an extraordinary worldwide disturbance is close by.Car and segment producing plants were shuttered around the world, purchaser footfalls in showrooms have fallen forcefully, and vehicle sales started dropping. The business has nearly been at a total halt since 24th March. A delayed truncation of customer request because of the lockdown is seen fundamentally influencing vehicle manufacturer incomes and cash flows. Society of Indian Automobile Manufacturers (SIAM) proclaimed that the plant closure of auto original gear makers and part producers will lead to loss of INR 2,300 crore for every day and an in total three-week shut down of the car business will convert into a complete income loss of INR 48,300 crore.(Joshi, 2020)[7]

TVS has reported NIL sales for the month of April 2020, having stopped production earlier on March 23 due to the ensuing nationwide lockdown.[8] BAJAJ has also reported zero domestic sales in April this year. However, the company managed to export 32,009 units during the same period.An investigation has demonstrated that worldwide vehicle sales in March 2020 saw a 39 per cent decrease to 55.5 lakh units, contrasted with 90.3 lakh units a year prior, because of the across the nation lockdowns implemented in different nations for capturing the spread of coronavirus.TATA MOTORS has reported a nearly 82% dip in total sales during Q1 as compared to in the same period a year ago.MARUTI SUZUKI, another automobile company, has reported a 54% drop in total sales in June as compared to the units sold in the previous year. Meanwhile, the company's exports fell by 56.4%. This company has also reduced its production capacity by 97.4% in May amid coronavirus pandemic.

Indian carmakers suggested several steps to revive the industry like an impermanent tax reduction on cars, trucks and motorbikes as well as motivating forces to scrap old vehicles. In an announcement prior, SIAM had said that carmakers need a transitory, 10% cut in tax on the sale of all automobiles and gear parts and incentives, like tax rebates, for vehicle proprietors to scrap their old vehicles. Also, some of the companies are helping the nation to revive in this pandemic.

Force Motors supplied to the Government of Andhra Pradesh over one thousand ambulances including 130 advanced life support ambulances, 282 basic life support ambulances and over 656 mobile medical units that will significantly upgrade the healthcare infrastructure, improve reach and reduce response time.[9]Automakers like Tesla and Mahindra coming out with their own versions of ventilators using their expertise to help the medical industry.

There is a high dependence on *Chinese* parts *of* the *Indian* auto industry. About 27% of the roughly $4.8 billion worth of component imports into India comes from China. Some of these components are

critical and hard to source elsewhere immediately. Cheap infrastructure support, such as cheap electricity, hidden subsidies and economies of scale, make China profitable and competitive in the export market(Bhardwaj, 2020).

The effect is assessed to be higher for high value-added and customized parts, while commoditized items could move to alternate suppliers."We don't import because we like to, but because we have no choice," said RC Bhargava, chairman of Maruti Suzuki India Ltd, the country's biggest carmaker. [10]

Considering the serious invasion of our territory and the unjustifiable assault of the Chinese armed force on our military, our government took several steps to protectsovereignty and integrity of India, defense of India, the security of state and public order. Analyzing the grievousness of the situation, there seems to be considerable anger against China in the country. This anger is reflected in a survey which shows that the majority i.e. 87% of the countrymen favour boycott of china-made goods. Under the Aatmanirbhar Bharat Missionand Make in India Initiative, when the government is promoting the campaign to make India self-sufficient, the call to boycott 'Made in China' products takes a surge. Moreover, importing products overtime is expensive as the rupees get weaker. This has provided this industry to take steps towards "Deep Localisation" to de-risk business from Chinese imports. Ease of doing business, availability of capital at lower rates, and globally competitive logistics and energy costs are some of the pre-requisites that the government should look into to ensure the growth of domestic auto component.

The impacts of this health crisis will have lasting implications for the economy; revised consumer choices, demand changes for most public services, fixed monetary conditions, and obviously, slamming commodity prices. The viewpoint for FY21, particularly the first half, stays weak given the macroeconomic factors. Rating agency CRISIL has estimated that this sector would see sales drop in double-digits for next year. It predicts that the maximum amount of fall will be seen in passenger vehicles with a lesser decline in the two-wheeler segment and tractors. With two-wheeler sales spread out more equally the nation over than different classes and expected to ascend to almost 47 million units constantly 2030, this is the ideal opportunity for stakeholders to push for more electric alternatives.[11]However, a planned and deliberate reaction, both prompt and medium to long term, will guarantee a V shape recovery.

TOURISM INDUSTRY

India's tourism industry has significant potential taking into account the rich cultural and historical heritage, assortment in ecology, territories and places of natural beauty spread all over the country. India offers astounding decent variety in the travel industry, ranging from 38 UNESCO World Heritage sites to the different physiographic features to medical and Wildlife Tourism. According to World Travel & Tourism Council (WTTC), India ranked third among 185 countries in terms of travel & tourism's total contribution to GDP in 2018. The World Travel and Tourism Council calculated that tourism generated 16.91 lakh crore (US$240 billion) or 9.2% of India's GDP in 2018 and supported 42.673 million jobs, 8.1% of its total employment.[12]The tourism and hospitality sector comprises of accommodation and category industry (hotels, motels, apartments, house boats, restaurants, and cafeterias), transportation industry (cruises, aviation, railways and car rentals).

The travel industry is entering an incredible emergency because of the overall panic of the coronavirus, duration and scope still unknown, which is prompting the stock market exchange crash. The effect of the coronavirus on organizations is as of now worldwide with cancellations of outings, public events, staff changes, and falls in revenue. This industry as a whole will suffer huge damages across the globe as this was the first industry to get affected and it may well be the last to recover.The whole tourism value chain including hotels, travel agents, tour operations, destinations, restaurants, family entertainment venues and air, land and sea transportation have suffered a huge blow.[13]As the updates on the infection started picking up from November, the level of cancellations started going up in this fragment exponentially and is arriving at a pinnacle of just about 80 percent now in March in numerous Indian areas. The Indian tourism industry, travel and accommodation segment impacts almost around 10 percent of GDP.

There have been various instances reported in the country that describes the worsening of the sector-

Pandemic dries up Rajasthan's tourism sector-

The state is suffering from nationwide lockdown with tourism sector taking a hit. The locals had earlier also sought government intervention to help them.[14]According to a report, 81 per cent travel and tourism companies have lost their revenue up to 100 per cent while 15 per cent of the companies have witnessed it slide up to 75 per cent.[15]Make My Trip fires 350 employees as the coronavirus outbreak has ravaged the tourism industry.Uberlays off around 14 per cent of its global workforce. In addition, Uber CEO DaraKhosrowshahi will forgo his salary for the rest of the year as the company continues to struggle in response to the COVID-19 pandemic.[16]Oyo Hotels & Homes said that CEO RiteshAgarwal has decided to forego 100 percent of his salary for the rest of the year and will fire around 5,000 employess globally.

The hotels across the nation are virtually closed now for a long time, profiting them essentially zero revenues. "The impact of COVID-19 has severely impacted the domestic hotel and hospitality sector in Q1 2020," property consultant JLL India said in a report. The key issue with the hospitality industry in India is that the number of employers working in these industries are either on contract basis or on easygoing working which accounts to around 30-40% of the staff and they all come from a weaker background so shutting down the chains and other services has influenced them financially. As per Federation of Associations in Indian Tourism and Hospitality (FAITH), around 70 per cent out of a total estimated workforce of 5.5 crore (direct and indirect) could get unemployed (around 3.8 crore).[17]

"While the industry has received the moratorium for three months, however, it needs a minimum of one year moratorium on all working capital, principal, interest payments, loans and overdrafts. Collateral and interest free loans up to five years for SMEs (small and medium enterprises) in tourism, which will help them, sustain and rebuild," JK Mohanty, co-chairman of FICCI national tourism council and secretary, Hotel Association of India, wrote to Finance Minister NirmalaSitharaman.[18] On June 8, 2020, according to the source, the year-over-year decline of seated diners in restaurants worldwide was a staggering 76.39 percent.The sector has seen a negative hiring pattern of upto 91% which has made the aspiring students and the job seekers in this field anxious. (Tamanna, 2020)[19]By the time placements were about to take place, the pandemic struck the nation and now the recruiting is left in hold.

Flight network, the order of financial plans, and client confidence are for the vital factors in choosing what the future resembles. Business travel will lessen since individuals are getting settled and familiar with working together on video conferencing. VFR (visiting friends and relatives) and recreation travel will get once travel is resolved as sheltered in light of the fact that there will be a repressed interest for holidaying and meeting their family (Dean, 2020).

Considering the present situations, the Ministry of Travel and Tourism of India urged people to focus on domestic travel rather than traveling overseas. In this respect an initiative was also launched last year "DekhoApnaDesh" as there as so many incredible places to explore on our doorsteps afterall it depends on the political framework conditions. The re-designing of interactions and processes will be accompanied by a new look and feel for travel and tourism. This sector will take time for it to return to normal scenario and business education that will prepare us not only to face the challenges affecting the sector but to create the change that we want to see.

CONCLUSION

While the world is still battling with the pandemic and the number of cases is rising at an unprecedented rate, we can draw some conclusions on the basis of the research we have done above. History shows that irresistible ailments, epidemics and pandemics, have been the enemies of individuals, outflanking even natural events and wars and event like COVID-19 is not too rare. Without a doubt, history is loaded with such occasions, for e.g. – Spanish flu, Influenza, Financial Crisis 2007-2008 etc. There have been various warnings from numerous sources, and the mathematical odds of an event are not too remote. Therefore, Covid-19 cannot be termed as BLACK SWAN. However, a planned and deliberate reaction would guarantee a V Shape recovery. The past studies have revealed that such an outbreak does have a worse impact on the economy in the short run but the market eventually stabilizes in the long run. Government is promoting the already growing pharma sector by allowing 100% FDI and spending on R&D along with the promotion of e-pharma. Similarly, the government has launched various schemes to promote domestic travel to revive the tourism industry with the planning of various exemptions for the people

connected to this sector. Additionally, for the critical automobile industry, various political frameworks have been designed. After all, the current circumstances are a call for activity by one and all in these troubled times and the countries continue to fight their way through the recovery phase.

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EFFECT OF PAP INTERVENTION DURING WARM-UP ON THE PERFORMANCE OF COUNTERMOVEMENT JUMP OF VOLLEYBALL PLAYER

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Abstract

Modern volleyball is now considered to be a power game. The player who was able to perform the movement explosively got better chance to get success over the opponent. The Volleyball player has to perform the squat jump, countermovement jump and drop jump in the varied situation during the game. A total of 15 inter university players agreed to participate in the study and were present during the familiarization and anthropometric measurements. (Mean±SD; age 21±1.2 years; height 1.7±8.2m; body mass 66.8±7 kg; fat %10.2±2.4 %) One familiarization session was conducted for the participants with the PAP and test protocols to avoid possible interferences in the results as a function of learning and coordination of movements. the subjects first underwent a 10-minute warm-up, followed by baseline assessments, PAP intervention and countermovement jump. Subjects performed 5 sets of Counter Movement jump with a rest period of 10 seconds between repetitions and 60 seconds between sets with the help of G-Sensor. Statistical analysis of the acquired data was performed using IBM SPSS (version 20.0.0). Shapiro–Wilk test was conducted to check the violations of the assumptions of normality. Non-parametric tests equivalent to its parametric counterpart were used for the analysis of non-normal data. Post-hoc paired t-test with a bonoferroni adjustment p= 0.01 was used to see the effect of PAP. It was clearly indicated that parameters of counter movement jump namely , jump height(t_{14}= -3.340, p = .005), take off force (t_{14}= –3.350, p=.005), impact force (t_{14}= -2.529, p=.024), maximum concentric force (t_{14}= –2.502, p=.005) and take off speed (t_{14}= – 3.17, p= .002) showed significant effect of post activation potentiation at 0.05 level of significance. The post activation potentiation helps to recruit more number of muscle fiber and make more number of cross bridges during action which enhances the performance of countermovement jump.

Keywords: Post Activation Potentiation, countermovement jump, G-Sensor

Introduction

The Vertical jump is considered to be the prime factor in achieving success in volleyball (Zoran Grgantov, Mirjana Miliæ, 2013). The height of action above the net is the deciding factor for victory or defeat in modern top volleyball(Horst, Baacke, 2019; Riggs & Sheppard, 2009). The Volleyball player has to perform the squat jump, countermovement jump and drop jump in the varied situation during the game (Reeser C. Jonathan, 2003). The frequency of jumps also depends on their specific positions as the setter, attacker, and blocker have varied repeated jumping frequencies(Sheppard et al., 2009). For achieving the greater reach at the moment of ball contact during a spike, block and in jump serve the player should increase the recruitment velocity of motor units and also the good coordination among motor units to increase the explosiveness(Nemec et al., 2016). The study indicated that greater ability of counter movement jump has better agility times which helps the volleyball player to change the direction in a quicker way (Barnes et al., 2007).

Dynamic warm-up plays a great role in the performance of vertical jump, as it increases the muscular blood flow and body temperature which mobilize the joints. Various studies conducted on various protocols of warm up to see the effect on Countermovement jump. (Fattahi et al., 2015; Gelen, 2011).

Post activation potentiation is a physiological

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process, which used to perform before the main activity to increase the stimulation of motor units by increasing the firing rate of the motor unit, calcium concentration and also to increase the cross-link between actin and myosin filament. (Costa et al., 2017).

There were various studies on post-activation potentiation (PAP) for various main activities and almost all the main activities results were positively significant after PAP Activities(Costa et al., 2017). The spike in volleyball is an excellent example of a countermovement jump (CMJ) (Reeser C. Jonathan, 2003), which is the combination of the stretch-shortening cycle (Cheraghi et al., 2017). In the CMJ the quadriceps get eccentrically pre-loaded before concentric contraction, preactivation of the tibialis anterior required for a powerful and efficient transition from eccentric to the concentric phase(Reeser C. Jonathan, 2003). In drop jump, an excessive amount of eccentric contraction takes place as there is more strain than normal vertical jump which give a positive impact on the kinetic parameter. The effectiveness of the explosiveness depends upon the amortization phase(Davies et al., 2015). Drop jump training has a positive impact on countermovement jump, squat jump and drop jump performance (Aboodarda Saied Jalal, Phillip A. Page, 2015; Gehri et al., 1998). None of the studies were conducted on the weighted drop jump as post-activation potentiation protocol in the warm-up (As per the Author's knowledge). As the weighted drop jump puts more strain in eccentric contraction and may enhance the performance of a vertical jump (Makaruk & Sacewicz, 2011).

Experimental Approach to the Problem

A design with a controlled condition was used to investigate the effect of PAP protocol after a warm-up on MAT and countermovement performance. The participants were evaluated on 2 separate days with a minimum interval of 48 hours between sessions to avoid carry-over effect.

After 3 minutes of baseline assessments, subjects have to follow PAP protocol. The post-intervention assessment was done at approximately 3 minutes, as the PAP effect in ballistic exercise has been observed with recovery duration ranging from 1 to 3 minutes.

Subjects

A total of 15 subjects agreed to participate in the study and were present during the familiarization and anthropometric measurements. (Mean±SD; age 21±1.2 years; height 1.7±8.2m; body mass 66.8±7 kg; fat %10.2±2.4 %) . The study was conducted during the off-season after completion of the university games. Inclusion criteria for the study werethe absence of major lower limb injury in the past 6 months, any other recent injury, or neuromuscular disorder which could potentially limit performing sprints and jumps. Subjects reported participation in plyometric training in the past. After the explanation of the procedures, players signed the informed consent form, confirming their voluntary participation in the study.

Procedure

One familiarization session was conducted for the participants with the PAP and test protocols to avoid possible interferences in the results as a function of learning and coordination of movements. Player's fitness characterization by anthropometric measures was obtained the same day. Height, body mass, and body fat percentage (20) were recorded (Table 1). The mean daily temperature during data collection was 28ÚC (82.4Ú F). The participants were asked to avoid alcohol for 24 hours, caffeine for 6 hours, food for 3 hours before the assessment and any strenuous exercise 24 hours prior, or between the assessment days.

On the assessment day, the subjects first underwent a 10-minute warm-up, followed by baseline assessments, PAP intervention and countermovement jump. Warm-up started with dynamic stretching exercises in a full kinematic range for hamstrings, quadriceps, adductors, hip flexors and soleus. Baseline assessment for pre data and it was followed by PAP intervention which includes jogging and 5 drop jump (65 cm height) and 3 repeated sprints performed thrice by the participants.

CMJ Protocol

Subjects performed 5 sets of Counter Movement jump with a rest period of 10 seconds between repetitions and 60 seconds between sets with the help of G-Sensor. BTS G-Sensor (S.P.A., Italy) which has tri-axial accelerometer with multiple sensitivity (±1.5 g, ±6 g), tri-axial magnetometer and tri-axial gyroscope with multiple sensitivity (±300 gps, ±1200 gps) was used to measure the outcomes of the drop jump. The protocol was set to drop jump in G Studio's (ver. 3.3.22.0) jump protocol section. Jump height, take-off force, impact force, maximum concentric power, peak speed, and take-off speed were the outcome variables of drop jump using the G-sensor and G-studio software.

Fig-1. Subject Performing Counter movement Jump

Statistical analysis

Statistical analysis of the acquired data was performed using IBM SPSS (version 20.0.0). Shapiro–Wilk test was conducted to check the violations of the assumptions of normality. Non-parametric tests equivalent to its parametric counterpart were used for the analysis of non-normal data. Post-hoc paired t-test with a bonoferroni adjustment p= 0.01 was used to see the effect of PAP.

Effect of PAP test on Parameters of Countermovement Jump using G- Sensor
Table-1

S.No	*Pair*	*Variable*	*Mean*	*Std. Dev*	*df*	*t*	*p value*
1.	Pair 1	Jump Height Pre	38.1933	1.47526	14	-3.340	.005
		Jump Height Post	39.4933	1.91888			
2.	Pair 2	Take off Force Pre	.6613	.02264	14	-3.350	.005
		Take off Force Post	.6900	.02138			
3.	Pair 3	Impact Force Pre	.8867	.02769	14	-2.529	.024
		Impact Force Post	.9047	.01922			
4.	Pair 4	Max. Concentric Power Pre	3.1140	.05527	14	-2.502	.025
		Max. Concentric Power Post	3.1567	.05512			
5.	Pair 5	Take off Speed Pre	2.6807	.02492	14	-3.917	.002
		Take off Speed Post	2.7073	.01944			

Results

Table-1 shows the value of all measured variables. The outcome of the PAP on parameters of countermovement paired – t test was significant. It was clearly indicated that parameters of counter movement jump namely, jump height ($t_{14} = -3.340, p = .005$), take off force ($t_{14} = -3.350, p = .005$), impact force ($t_{14} = -2.529, p = .024$), maximum concentric force ($t_{14} = -2.502, p = .005$) and take off speed ($t_{14} = -3.17, p = .002$) showed significant effect of post activation potentiation at 0.05 level of significance. The post activation potentiation helps to recruit more number of muscle fiber and make more number of cross bridges during action which enhances the

performance of countermovement jump. Hence it is advisable to perform appropriate technique of post activation potentiation before the competition to get maximum advantage.

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The Appraisal study of NADA and WADA in relation to Therapeutic Use Exemptions (TUE)

Dr. Mahesh Singh Dhapola[1*], Dr. Sujay Bisht[2], Debabrata Sarkar[3]

Abstract

Athletes, like all people, may have illnesses or conditions that require them to take a particular medication or undergo certain procedures or methods. For athletes, the substance/ method may appear on World Anti-Doping Agency (WADA)'s List of Prohibited Substances and Methods in 2004 to the escalating challenge of drug misuse in contemporary sport. In such instances, they may be granted a TUE, which gives them permission to take a substance or use a method. The mechanisms of the TUE process are carefully defined and described in a specific WADA "international standard" (IS). As a consequence, anti-doping organizations (ADOs) were empowered to establish "Therapeutic Use Exemption Committees" (TUECs) whose membership and responsibilities were clearly delineated in the IS, and to whom an athlete and treating physician(s) could make appropriate application for a TUE. TUE approval protects athletes from receiving a sanction if a prohibited substance is found in their sample. In 2017-18 annual report of NADA, 97 proceedings were initiated on the grounds of possible anti-doping violations. 64 cases originated in a positive finding and the presence of a prohibited substance (Art. 2.1 NADC): 56 of these findings result from in-competition tests (44 federations/12 NADA) and eight originated in out-of-competition controls organized by NADA. 21 of the 64 proceedings were closed because of a valid therapeutic use exemption (TUE) or a medical certificate. During the result management process, it turned out in four cases that there was no anti-doping rule violation due to the presence of allowed inhalation of corticosteroid asthma sprays. Nine cases were forwarded to the international federation or WADA as there was no jurisdiction of NADA. When checking NADA's in-house data collection in the Medical Department, it was found that it contained more data records on applicants than therapeutic use exemptions (TUEs) had been granted. This is due to TUE applications that are no longer required by the new regulation.

Keywords: Anti Doping, Prohibited Substance, TUECS, ADO, IS.

Introduction

Therapeutic Use Exemptions maintained by World Anti-Doping Agency and maintained by local governing body. The WADA provides Code for TUE is a mandatory International Standard developed as part of the World Anti-Doping Program. The International Standard for Therapeutic Use Exemptions was first adopted in 2004 and came into effect 1 January 2005. Further revisions were made in 2009, 2010, 2011 and 2015. The enclosed ISTUE incorporates revisions approved by the WADA Executive Committee on 18 November 2015. It come into effect on 1 January 2016. The official text of the International Standard for TUE published in English and French.

The WADA purpose of the TUE are:

(*a*) The conditions that must be satisfied in order for a TUE to be granted, permitting the presence of

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a Prohibited Substance in an Athlete's Sample or Use/ Attempted Use, Possession/Administration or Attempted Administration of a Prohibited Substance/ Prohibited Method for therapeutic reasons.

(b) The responsibilities imposed on ADO in making and communicating TUE decisions.

(c) The process for an Athlete to apply for a TUE.

(d) The process for an Athlete to get a TUE granted by one ADO recognized by another ADO.

(e) The process for WADA to review TUE decisions. and

(f) The strict confidentiality provisions

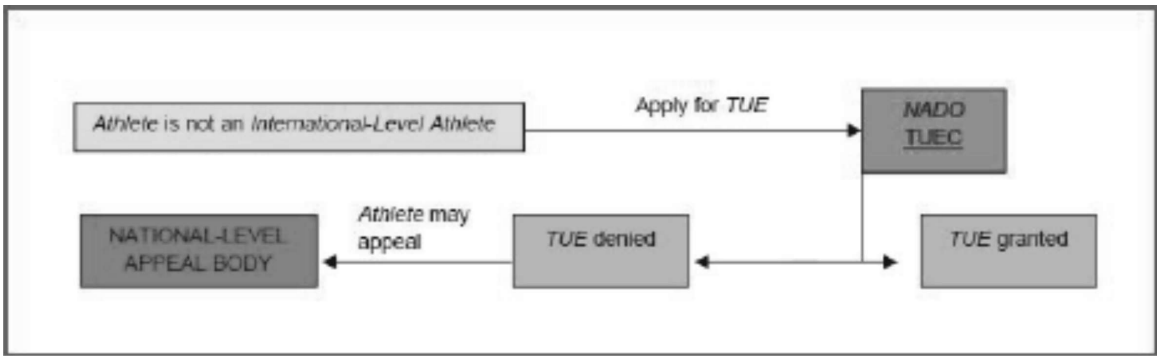
TUE Provisions

The code of provision of TUE mentioned Article 4.4 (4.4.1 to 4.4.9), has 9 code. WADA divide cade as according to national, International, MEO (Major Event Organization) level athlete's.

Ø National-Level athletes

The athletes participating in National Events shall obtain a TUE from NADA, unless they have previously received a TUE from an IF and such TUE is still valid and its granting has been reported to the NADA.

FLOW-CHART 1.0

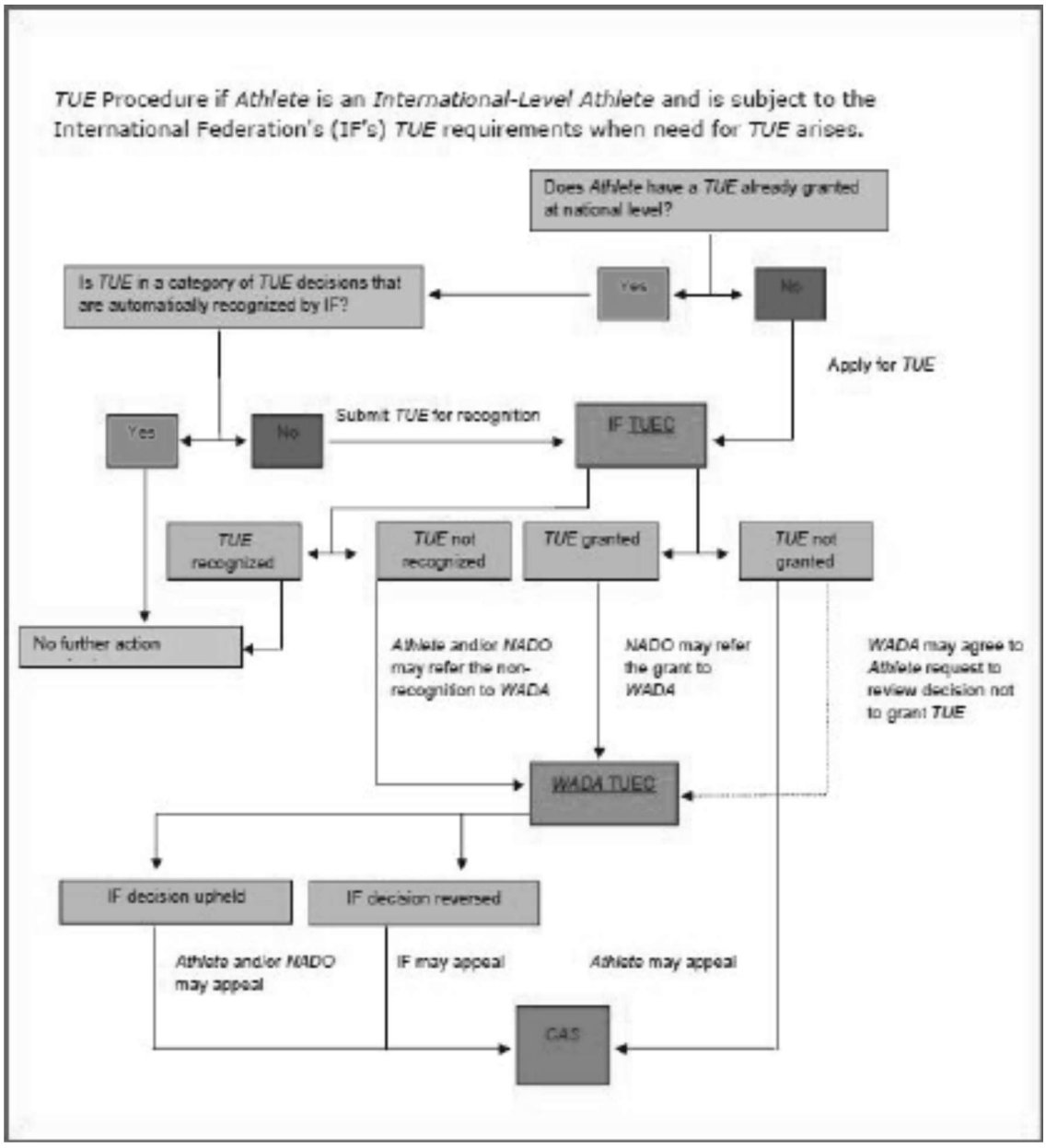


See:- https://www.wada-ama.org/sites/default/files/resources/files/wada-2016-istue-final-en_0.pdf

Ø International-Level Athletes

Athletes included by an IF in its Registered Testing Pool and other athletes prior to their participation in any International Event must obtain a TUE from their relevant. An IF can recognize a TUE delivered by NADA under its own authority. But if an Athletes who already have a TUE at the national level but are participating in an International Event and do not already have a TUE registered with their IF must request a TUE from the IF not later than 30 days before the athlete's participation at an International Event. Athletes may be required by a MEO to apply for a TUE if the Athlete wants to Use a Prohibited Substance or Method in connection with the Event.

FLOW-CHART 2.0



See:- https://www.wada-ama.org/sites/default/files/resources/files/wada-2016-istue-final-en_0.pdf

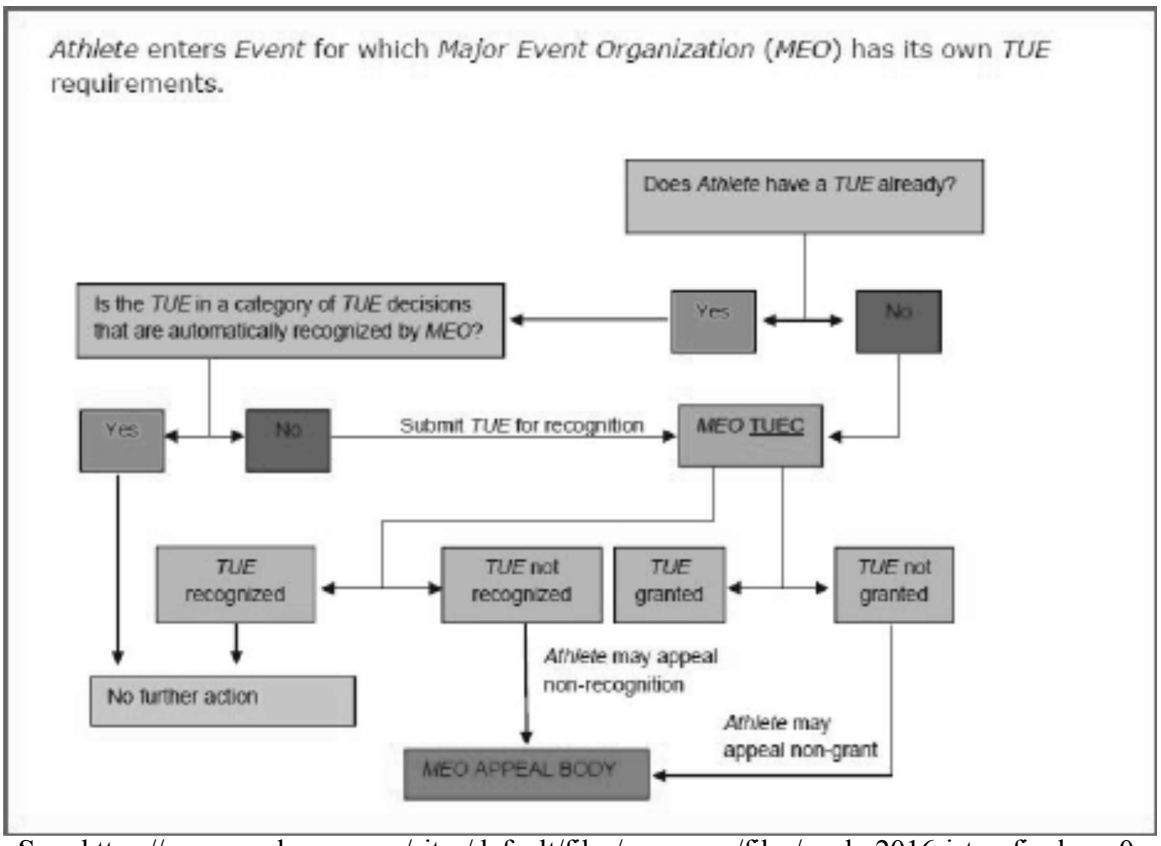
Ø Major Event Organizers

A Major Event Organization may require Athletes to apply to it for a TUE if they wish to Use a Prohibited Substance or a Prohibited Method in connection with the Event. In that case:

The MEO ensures a process is available for an athlete to apply for a TUE if:

- Athlete doesn't already have any.
- If the TUE is granted, it is effective for its event only.
- A decision by a MEOs not to grant a TUE may be appealed by the Athlete exclusively to an independent body appointed by the MEO for that purpose.

FLOW-CHART 3.0



See: https://www.wada-ama.org/sites/default/files/resources/files/wada-2016-istue-final-en_0.pdf

Time Frame for TUE submission

A TUE for any Substances and Methods that are prohibited In-competition, has to be submitted by the athlete no less than 30 days before participating in an Event. In order to make sure that the Athlete has the TUE before participating in a competition all Athletes are strongly advised to send in their applications at least 30 days before participating in an event as the TUECs have 21 days to render their decision.

For substances, which are prohibited In-Competition as well as out-of-competition, the TUE application has to be submitted as soon as the medical condition requiring the use of prohibited Substances or Methods has been diagnosed.

Retroactive TUEs

There are some situations when retroactive approval can be accepted. Even if a potential retroactive case is given consideration, this in no way guarantees that the TUE will be accepted. The evaluation procedure is the same as for a normal TUE request. The request will be considered by the relevant TUEC who will then render its decision.

Review of TUE Decisions by WADA

WADA in certain cases, must review TUE decisions of International Federations, and that it may review any other TUE decisions. Each request for review must be submitted to WADA in writing and must be copied to the party whose decision would be the subject of the review. Where the request is for review of a TUE decision that WADA is not obliged to review, WADA may nevertheless refer the decision back to the International Federation for clarification or for re-consideration by the International Federation. The WADA TUEC shall reverse any grant of a TUE that does not comply. Where the TUE reversed was a prospective TUE such reversal shall take effect upon the date specified by WADA shall communicate the reasoned decision of the WADA TUEC promptly to the Athlete and to his/her National Anti-Doping Organization and International Federation.

Conclusion

Therapeutic Use Exemption (TUE) Athletes may at times need to use a prohibited medication to treat a legitimate medical condition. A TUE is an exemption that allows an athlete to use, for therapeutic

purposes only, otherwise it will be prohibited substance or method. TUE approval may protect athletes from receiving a sanction if a prohibited substance is found in their sample. So TUE has a positive Impact on the various sports field. But must prefer the medical condition as according toInternational Standard for Therapeutic Use Exemptions (ISTUE) and TUE Physician Guidelines.

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Study of Physical Fitness Status and Mode of Exercise Pursued by Citizens of Delhi: A Qualitative Analysis

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Abstract

The purpose of the present study was to analyse the Physical activity modes pursued by citizens of Delhi to achieve the Fitness. The sub-objective of the study was to also gauge the awareness amongst the citizens of Delhi with reference to the Outdoor Gyms, Government Yoga Centres and DDA Sports Complexes in Delhi and NCR. The variables selected for the present study were Physical fitness and modes of Physical activity. A self-developed questionnaire was designed to collect the information. The study was delimited to 201 subjects (Male & Female), who engage in any physical activity i.e. Walkers from nearby parks, open and Indoor Gym, Yoga centres, Dance and aerobics classes, etc. in Delhi. The data was collected from Delhi Parks, Aerobics and Yoga centres. The data was further computed and analysed by descriptive and percentage method. 24.87% of the Delhi population pursued activities in the indoor and outdoor Gym, 23.88% have adopted brisk walking and jogging and exercise at home, 9.95% use the Running & Bhangra Aerobics/Dance/Cross fit or other programme, 5.97% follow Yoga and other exercise, 2.97% are engaging in particular sports (Cricket, Tennis and Badminton etc.). However only 1.49% are engaging in Weight Training/Cuts & Curve. Surprisingly 30.87% of the population do not pursue in any physical activity. Further, 37.31% respondents were actively involved in Physical activity programme from last 5 years, 11.94% since last one year, 19.90% involved from last six months, and 17.91% involved from last one month. However 12.94% of population do not pursue in any physical activity. In respect to awareness about open Gym and Morarji Desai National Institute of Yoga, majority of the population are aware about them but for open gym they all wants one qualified trainer who can guide them correctly and also help to maintain the open Gym machines of all outdoor gyms. For significance of the study, the data of the present study will help to construct the Policies for new planning in the Community Services in regard to Physical fitness and Health for Delhi and NCR.

Key words: Brisk walking, walkers, Outdoor Gym, and Shooting ball

Introduction

In contemporary India, there is an increase in the life expectancy age of Indians and a comparative decrease in incidences of early-death which can also be attributed to timely medical intervention. WHO World Statistics Report 2016 found that in 2015, life expectancy at birth was 68.3 years in India which breaks down to 66.9 years for men and 69.9 for women as compared with an average age of 66 years in 2013 and 58 years in 1990.

Life expectancy at birth improved in India from 59.7 years in 1990 to 70.3 years in 2016 for females, and from 58.3 years to 66.9 years for males. (C, 1991)There were, however, continuing inequalities between states, with a range of 66.8 years in Uttar Pradesh to 78.7 years in Kerala for females, and from 63.6 years in Assam to 73.8 years in Kerala for males in 2016. (Caspersen C J)

The per person disease burden measured as DALYs (Disease-Affected Life Years) rate dropped

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by 36% from 1990 to 2016 in India, after adjusting for the changes in the population age structure during this period. But there was an almost two-fold difference in this disease burden rate between the states in 2016, with Assam, Uttar Pradesh, and Chhattisgarh having the highest rates, and Kerala and Goa the lowest rates. While the disease burden rate in India has improved since 1990, it was 72% higher per person than in Sri Lanka or China in 2016. (Hamasaki, 2016) The under-5 mortality rate has reduced substantially from 1990 in all states, but there was a four-fold difference in this rate between the highest in Assam and Uttar Pradesh as compared with the lowest in Kerala in 2016, highlighting the vast health inequalities between the states. (Femke De Meester., 2008)

Objectives of the study:

1. To know the present picture of Delhi heights in respect to Physical activity.
2. To know the means adopted by Delhi heights for improve their Physical fitness.
3. To know the awareness among the Delhi heights about Outdoor Gym, Government Yoga Centres and DDA Sports Complex in Delhi and NCR.

Delimitation of the study:

The study was delimited to Delhi and NCR region only.

§ The study was further delimited to 201 subjects (Male & Female), who engage in any physical activity i.e. Park, open and Indoor Gym, Yoga centres, Dance and aerobics classes, Walker from nearby park etc.

Procedure

For purpose of the study, 201 (Male and Female) sample, age ranging from 19-60 years were selected randomly from Delhi and NCR open park Gym, Yoga centres and stadiums. The data was collected by self-developed questionnaire. The questionnaire was design into two parts one is multi-optional questions format and other one is open ended category. The data was computed and analysis by percentage statistics method.

Result and analyses

Table No. 1 Have you been diagnosed with or advised of any of the following:

S.No.	*Statements*	*N*	*Yes*	*No*	*No response*
a.	History of heart problems, chest pain or stroke?	201	5	192	04
b.	Increased blood pressure (hypertension) or low blood pressure (hypotension)	201	36	164	01
c.	Difficulty with physical exercise	201	34	166	01
d.	History of breathing/lung problems (asthma, COPD, emphysema)	201	10	190	01
e.	Muscle, ligament, tendon, joint (shoulder, knee, hip, ankle, wrist)	201	30	170	01
f.	Arthritis, Rheumatoid arthritis, osteoporosis	201	23	177	01
g.	Diabetes (type I or II), thyroid disorder or hypo/ hyperglycaemia	201	15	184	02
h.	Cigarette smoking habit / Alcohol Consumption	201	23	177	01
i.	Obesity (more than 20 percent over ideal weight)	201	13	187	01
j.	Frequent headaches (migraine, cluster)	201	28	170	01
k.	Depression, bipolar disorder, undue stress	201	43	157	01
l.	Any other	Lack of sleep and concentration problem, Spine problem, Hypertension, Joint stiffness, Suffering from thyroid etc.			

In table no. 1, when asked about the diagnosis status from heart problems, chest pain or stroke 192 said no/05 said yes and 04 didn't responded, for increased blood pressure (hypertension) or low blood pressure (hypotension) 164 said no/36 said yes and 01 didn't responded, for Difficulty with physical exercise 166 said no/34 said yes and 01 didn't responded, for History of breathing/lung problems (asthma, COPD, emphysema) 190 said no/10 said yes and 01 didn't responded, for Muscle, ligament, tendon, joint (shoulder, knee, hip, ankle, wrist) injury 170 said no/30 said yes and 01 didn't responded, for injury or any previous injury still affecting, for Arthritis, Rheumatoid arthritis, osteoporosis 177 said no/23 said yes and 01 didn't responded, for Diabetes (type I or II), thyroid disorder or hypo/hyperglycaemia 184 said no/15 said yes and 02 didn't responded, for Cigarette smoking habit / Alcohol Consumption 177 said no/23 said yes and 01 didn't responded, for Obesity (more than 20 percent over ideal weight) 187 said no/13 said yes and 01 didn't responded, for Frequent headaches (migraine, cluster)170 said no/28 said yes and 01 didn't responded.

Table No. 2 Are you taking any medications at this point in time?

N	Yes	No	No response
201	39	158	04

In table no. 2, when asked about procuring any medication at this time, out of 201 subjects a maximum of 153 said no, 39 replied Yes, 04 didn't responded to any of the options.

Table No. 3. How many of the following characterise you?

Over-consumption of fast foods (like Pizza, Burger, Donut, Cola) Fried/Fatty items, Sweets	Less intake of healthy food items (Green Vegetables, Dal, Nuts, Eggs etc.)	Reduced activity level	Feeling tired quickly	Brain 'fog' instances (not able to think clearly all the time)
30	46	63	67	11

In table no. 3, when asked about their characterization a maximum frequency was observed on 67 believed that they feel tired quickly, 63 believed that they have reduced activity level, 46 considered that they have Less intake of healthy food items (Green Vegetables, Dal, Nuts, Eggs etc.) and finally 11 believed that Brain 'fog' instances (not able to think clearly all the time) happens to them.

Table No. 4 You have been actively involved in physical activities since:

Particulars	Past month	Six months	Past Year	Past two-five years	Past ten years	Any other
N	36	40	24	44	31	24

In table no. 4, when asked about their physical activity involvement status, out of 201 subjects a maximum of 44 said from past two years, 40 said from six months, 31 from past ten years, 24 from past one year and 24 responded to any other option.

Table No. 5 What is the Physical Fitness Programme that you are engaged with presently and where?

Running & Bhangra Aerobics/ Dance/Cross fit or other programme	Gym (Open & Indoor)	Walking/ Jogging/ Exercise by Self at Home	Weight Training/Cuts & Curve	Sports Participation Cricket Tennis Badminton etc.	Yoga	No activity
20	50	48	03	6	12	62

In table no. 5, when asked about the present status of physical fitness programme been carried out, out of 201, 50 replied as they are going to Gym (Open & Indoor), 48 said Walking/ Jogging/ Exercise by Self at Home, 39 were not doing any activity, 20 are doing Running & Bhangra Aerobics/ Dance/Cross fit or other

programme, 12 are engaged in yoga, 06 are doing Sports Participation Cricket, Tennis, Badminton etc, 03 are doing Weight Training/Cuts & Curve and 62 did not pursue in any physical activity.

Table 6 Are you aware that the following are activities that can improve fitness levels at varying intensities?

S. No.	*Particulars*	*Yes*	*No*
a.	Brisk Walking	160	37
b.	Jogging	186	11
c.	Skipping	168	29
d.	Dancing	167	30
e.	Freehand Exercise	152	45
f.	Household chores	143	54

In table no. 6, when asked whether they are aware about the activities that can improve fitness levels at varying intensities, for brisk walking 160 said yes and 37 said no, for jogging 186 said yes and 11 said no, for skipping 168 said yes and 29 said no, for dancing 167 said yes and 30 said no, for freehand exercise 152 said yes and 45 said no and finally for household chores 143 said yes and 54 said no.

Table No. 7 Are you aware that the government has installed outdoor gyms in several public parks for all?

N	Yes	No	Uncertain	Do not know	No response
201	178	15	3	2	3

In table no. 7, when asked about the level of awareness about the government installed outdoor gyms in several public parks, out of 201 subjects a maximum of 178 said yes, 15 said no, 03 were uncertain, 02 did not know and 03 does not responded.

Table No. 8 Do you know that authorised government yoga centres like Morarji Desai National Institute of Yoga is running in Delhi?

N	Yes	No	Uncertain	Do not know	No response
201	86	95	7	10	3

In table no. 8, when asked about the authorised government yoga centres like Morarji Desai National Institute of Yoga been present in Delhi, out of 201 subjects a maximum of 95 said no, 86 said yes, 10do not know, 07were uncertain and 03 does not responded.

Table No. 9 Do you know that authorised Delhi Development Authority centres, running playing facilities on the basis of pay-and-play, are available in Delhi?

N	Yes	No	Uncertain	Do not know	No response
201	95	78	19	6	3

In table no. 9, when asked about the authorised Delhi Development Authority centres, running playing facilities on the basis of pay-and-play been available in Delhi, out of 201 subjects a maximum of 95 said yes, 78 said no, 19 were uncertain, 06 did not know and 03 does not responded.

Table No. 10 Do you know that it is important to participate in a moderately-intense activity, for at least 30 minutes-five times a week, for any fitness benefit to accrue?

N	Yes	No	Uncertain	Do not know	No response
201	145	40	9	2	5

In table no. 10, when asked about the importance of participating in a moderately-intense activity, for at least 30 minutes-five times a week, for any fitness benefit to accrue, out of 201 subjects a maximum of 145 said yes, 40 said no, 09 were uncertain, 02 did not know and 05 does not responded.

Q11. Suggest improvements/inclusions in the intervention methods vis-à-vis specific programmes, equipment, guidance or any other that you feel is important to achieve the goal of a 'Fit You'.

This is an open ended question, and the following suggestion was recorded:-

i. Guidance should be provided in park & open gym.
ii. Open gym should be covered by roof or any other type of shades.
iii. They can recruit trainer in outdoor gyms.
iv. Equipment of open gym should be more maintained.
v. Maintenance is required to use outdoor gym equipment.
vi. Some suitable programme for youngsters should be brought up like the open gym concept. Open gyms are good but not suitable for us. Same concept of free gym should be considered for youth.
vii. I feel there should be more equipment introduce in all the open gym, so that ladies & other family members who can't allowed, can use the facility.
viii. It is important to keep the equipment's placed in a park in professional trainer, because without knowledge of equipment is harmful.
ix. More equipment is installed in public parks.
x. Doing exercise daily keeps you fit and healthy open gyms are convenient and easily available in nearby parks.
xi. Outdoor gyms are easily available now days one should spend at least 90 minutes in exercise daily to be healthy and fit.
xii. Open Gyms should be installed in more and more in park.
xiii. Guidance in an open park Gym.
xiv. Guidance in a yoga open gym in nearby parks.
xv. For outdoor gyms supervised equipment as required.
xvi. The outdoor gyms are good but they don't provide exercise for all the body parts, so keeping in my mind the full body equipment more machines need to be installed.
xvii. Adding some instructor will be beneficial, also providing outdoors gym in more near parks to our home.
xviii. Outdoor Gym is the best physical fitness if we can broad and maintain the machine and provide yoga classes in park it should be fruitful for the all groups of people low as well as medical class people It is the best park of the people.
xix. Access to these programme like outdoor gyms pay and play, government yoga centres etc should be eased for general public.
xx. Guidance should be provided in park & open gym.
xxi. Government should provide more parks, because there is no park nearby my home.
xxii. Washroom must be available.
xxiii. Paper, dustbin and washroom should be provided.

Discussion on findings

The study is a survey study aiming towards analyzing the awareness among the people regarding the need of physical activeness and the means adopted by them to keep them physical fit. A self-developed questionnaire was employed to gather data on the set objectives of the study and the result revealed that majority of the population are aware about the physical activity module like Open Gym, Indoor Gym, walking, running, aerobics, bhangra, dance, yoga and other exercise. In respect to health and fitness, most of the sample are fit in terms of Disease and injury, but in few of them are struggling with Chest pain, heart disease, cholesterol problem, arthritis, back pain, joints pain, obesity and stress, this could be the reason for their sports participation. In contraction of disease and injuries, a very few are taking the medication for their treatment, rest of them are indulging in physical activity. Research also shows that almost half population actively involved in physical activity since 5-10 years, however, maximum number of subjects do not indulge in any physical activity which could be a point of concern. Research also shows that majority of population like the outdoor gym as a tool of the fitness exercise but they want some guidance and help from government sector to maintain and execute the gym in proper manner.

Conclusion

- A majority of the respondents were not on medication which proves that they are healthy individuals who are not advised to take up physical activity.
- A major characteristic of the respondents was that they felt tired quickly followed by having reduced activity level and less intake of healthy food items, thus proving that their fitness level

is not really up to the mark.

- Only a few indicated their medical conditions some of which were: Diabetes, mental illness, hypertension, acidity, asthma, hyperthyroidism, pain, lack of vitamins and minerals etc.
- It was seen that all of the respondents have been regularly engaged in physical activities at various points of time ranging from past month to past ten years, which augurs well for a Fit India.
- This was an open question where the respondents were required to specify the physical fitness programme that they were engaged in. A majority of respondents were engaged in Gym exercises, both open and indoor, followed by walking/jogging/exercise at home. Almost 1/4th of respondents were not engaged in any activity. A majority of the respondents know that open gyms have been installed at several parks for the general public and also aware about the pay and play facilities in Delhi.

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COMPARISON OF EMOTIONAL INTELLIGENCE AND ACADEMIC PERFORMANCE BETWEEN SPORTS AND NON-SPORTS GROUP

Dr. Gaurav Sanotra[1]*, Mr. Shubham Pal[2]

ABSTRACT

The purpose of this study was to make comparison between sports and non-sports groups. Two independent variables Emotional intelligence and academic achievement were chosen as the basis of differentiation. A total of 200 (100sports + 100 non-sports) male subjects from Gwalior district took part under this study voluntarily. Their age were ranging from 15-18 years. They were told about the objectives of the study after getting the consent form signed by their parents. The SGFI national level participation in any game or sports was the deciding criteria for identification of sports group. To test emotional intelligence a questionnaire developed by A.K. Singh in the year 2014 was used. This questionnaire consists of 60 items. The reliability and validity of questionnaire are 0.86 and 0.86 respectively. The academic achievement was measured as the average marks obtained by the student in last two calendar years in previous standards. Independent sample t-test was applied for statistical analysis and the level of significance was set at 0.05. The results of the study shows that sports group performed significantly better than non-sports group on both the parameters.

INTRODUCTION

There is old saying in Hindi literature "Kheloge kudoge banoge kharab, Padhoge likhoge banoge nawab" looks like old enough as it does not fits to the situation of present day. Very luckily we have witnessed so many extraordinary sportspersons who excelled in academics too. Why humans loss their tail? Why snakes lost their legs? There are so many clues have been found that humans were having a tail, but now we don't have now. The roots of this question are hidden in principle of use and disuse. We grew the part of body that we use the most and what we do not use is getting shorter day by day. i.e. brain and size of the limbs. In today's era where science and technology have made our life easy and convenient. The chief disadvantage of growing in science and technology is that we became idle and perform very less physical activity in our daily routine. We can observe that the children of present day are born with very sharp mind and less physically fit than we were in our childhood.

According to Charles Darwin's (1864) principle "Survival of the fittest" only the fittest can survive on this earth. This line means a lot in terms of providing good health and healthy brains to our next generations. So many species have come and gone from this earth but we the humans have survived till day. If we do not engage ourselves in physical activity our future generation may suffer from ill health condition with low level of strength and a shorter life span. Physical activities are very important part of life that we cannot ignore for long. In ancient days the humans were rely on hunting for their survival. Running, jumping, throwing like activities was the part of their regular life this way they made themselves strongest species on this earth. To counter the attacks of wild animals the humans used the best of their mind and body, and someday they managed to hunt the bigger and stronger animals of jungle. This happened because they had used the combination of mind and body.

In today's era we all became civilized and lives in homes made up of brick, wood, cement and iron. We use motor operated vehicles for locomotion. In conclusion we can say that we are not that much

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physically active as like our ancestors. For us it is not feasible to climb on trees, run on the rough roads or swim in the river. To compensate that we are provided with advanced physical training equipment. We need to understand the necessity of being engaged in physical exercise. The overall development of child does require the equal engagement in study and sports. To check the fact that if physical activity and sports contribute to growth and development of child, in the present study we selected two variables emotional intelligence and academic performance for comparing the sports and non-sports groups.

METHODOLOGY

A sample of 200 male (100sports+ 100 non-sports) subjects have been selected randomly from various government schools of Gwalior. The subject's age ranges from 15-18 years. A written consent form duly signed by the parents on the behalf of their son's was taken before collection of data. The performance of Sports and non-sports group was measured on two parameters one is emotional intelligence and another is academic performance. The emotional intelligence was measured with the help of questionnaire developed by A.K. Singh (2014) comprised of 60 items. The academic achievement was measured by average marks obtained by the students in two consecutive years. The data collected on two variables was analyzed with the help of MS Office excel. The subject's data was first cleaned for the elimination of outliers. Then the data was analyzed with Excel and Descriptive statistics, Independent sample t-test was employed for the statistical analysis of data. The level of significance was set at 0.05.

RESULTS

Table 1 showing various descriptive statistics (combined) for sports and non-sports group

S.N.	Statistics	Emotional Intelligence	Academic Achievement
1	N	200	200
2	Mean	21.76	62.16
3	Median	24.10	63.20
4	Mode	24.08	64.00
5	Std. Deviation	4.61	6.22
6	Skewness	-0.12	0.48
7	Kurtosis	-0.88	1.01

Combined scores of sports and non-sports group have been presented in table 1. The mean score of both the groups on emotional intelligence is 21.76 with SD 4.61. The mean score of both the groups on academic achievement in 62.16 with SD 6.22. Since the data collected on both the parameters qualifies for the application of parametric test and no outliers were found in dataset only Mean and Standard deviation need to be noticed.

Table 2 t-table for emotional intelligence

Group		N	Mean	Std. Deviation	t-value	p-value
Emotional Intelligence	Non-Sports	100	18.82	3.34	14.962	.0001**
	Sports	100	24.01	2.10		

According to table-2 it is evident that the significant difference does exists between the two group means. The mean reported for non–sports group is 18.82 which is less than the sports group's mean score 24.01.

Figure-1
Graphical representation of mean scores of Non-sports and sports groups

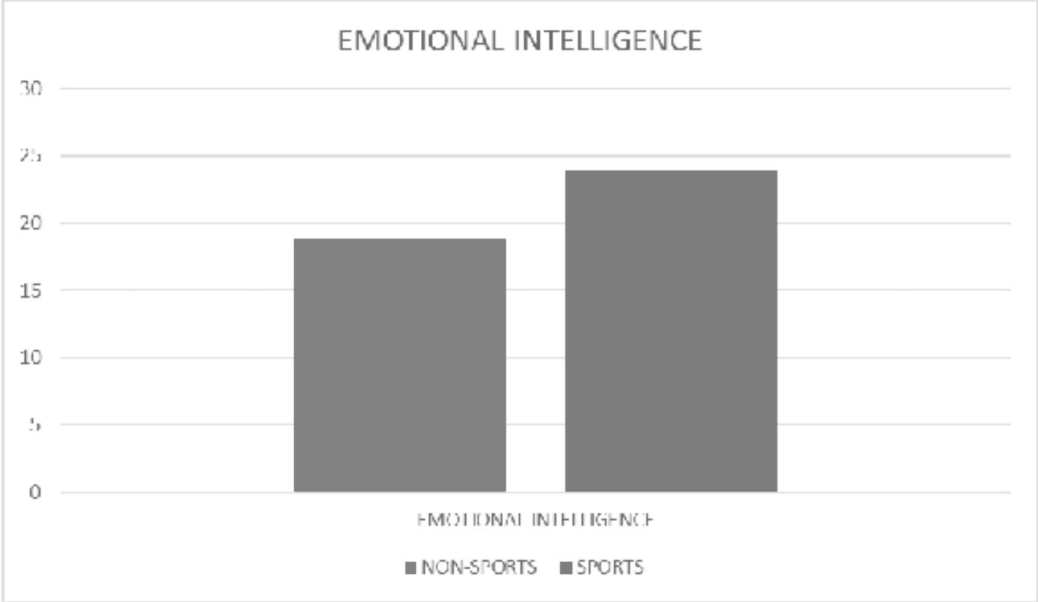
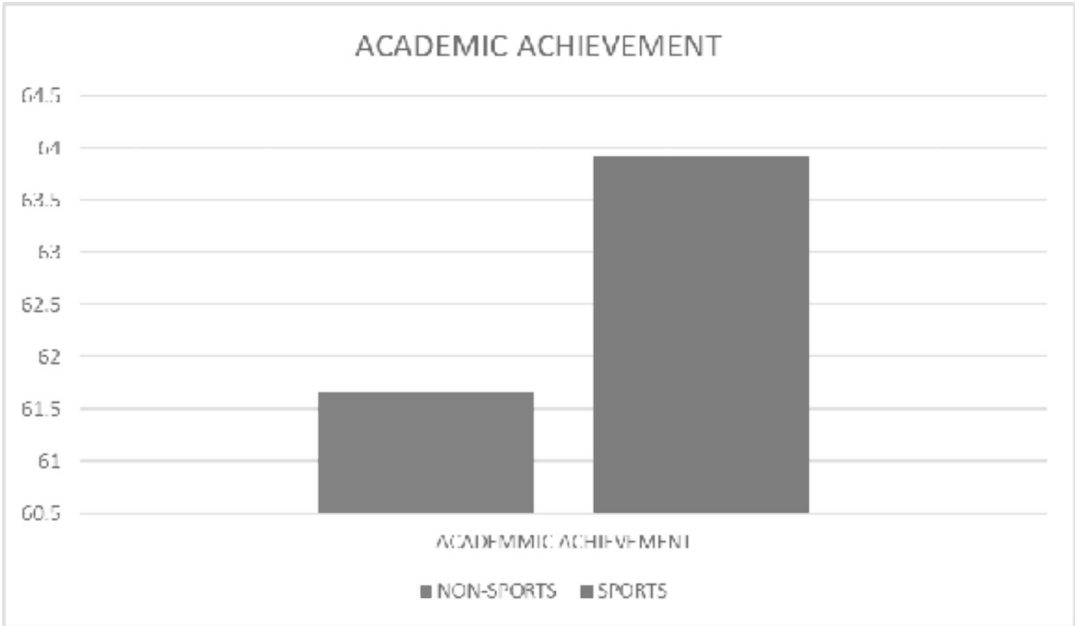


Table 3 t-table for academic achievement

Group		N	Mean	Std. Deviation	t-value	p-value
Academic Achievement	Non-Sports	100	61.66	7.70	2.210	.027*
	Sports	100	63.92	7.05		

The analysis of the data in table-3 pertaining to comparison of sports and non-sports group on academic achievement shows that sports group performed better than non-sports group as the mean value is high for sports group. Both the groups differ from each other significantly because the p-value associated with test statistics is less than 0.05.

Figure-2
Graphical representation of mean scores of Academic achievement



DISCUSSION OF FINDINGS

In this research study the researchers were interested in finding the difference between sports and non-sports subjects among the selected independent variables. Certain situation in playing sports require immediate attention and control over strong emotions. A player learns these skills after a long period of time. Sports may provide more number of chances to make the student emotionally strong. Gradually they learns: how to accept faliure? How to control performance anxiety? How to remain unchanged in victory? The student learns to do well in many Psychological states through sports participation.

"A sound mind lives in a sound body" if we believe this philosophy then participation in sports can actually work as mile stone for developing mind. In the present study the sports group has performed better than non-sports group, this could be the because of greater level of strength which can assist student for long hours of study. The sports group is more likely to be fit for tackling metal fatigue as they are acclimatized to opt this load under the playing situation.

CONCLUSIONS

Within the limitations of the study following conclusions were drawn.

1. Sports group performed significantly better than non-sports subjects in terms of Emotional intelligence.
2. Sports group shown better performance in academic achievement than non-sports subjects.
3. The parents should encourage their children to take part in sports.
4. The students who are playing sports should regularly take part in sports competition.
5. The sports students can do better in academics too if proper care is taken off.

The conclusions made in research work done by Khajehpour (2011) also supports the results of this study. Under his study, conducted upon 300 high school students of Tehran, Iran he concluded that the academic achievement and emotional intelligence are significantly positively correlated with each other. One more study by Kumari and Chamudeswari (2015) supports the findings of the present study. Under the purview of their research work they conducted a study on 300 students of higher secondary level and concluded that academic achievement is significantly correlated with emotional intelligence and school environment.

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Comparison of Different Weight training Variation on Extracellular Water and Fat Free Mass

Dr. Sujay Bisht[1]*, Avinash Kharel[2]

Abstract:

Purpose: The purpose of the study was to compare the different weight training variation on fat free mass and extracellular fluid. **Method**: Total 40 male served as subject for this study and they were divided into four groups, comprising of 10 subject in each group. They were categorized in four different group i.e. Sub maximal, Maximal, Supra Maximal and Controlled group and were selected randomly through simple random sampling methods. The entire subject ranged between 18 to 21 years and enrolled in first semester of undergraduate program of L.N.I.P.E, Guwahati. The data pertaining the Fat free Mass and extracellular fluid were examined by ANCOVA statistical tool applied with the level of significance 0.05 for testing the hypothesis.**Result**: The selected variable fat free mass were found significant difference between all the three group compared to control group and insignificant difference were found for the Extracellular Fluid between the three training group.

Key Words:

Sub maximal training, Maximal training, Supra Maximal training & Maltros bio scan.

Introduction:

The body composition is a factor contributing to the sports performance. The body varies with age and sex and the desirable body composition of athletes can vary depending on the sport, training level and energy intake. At non-athletes, the assessment of body composition is important in order to appreciate the nutritional status and monitoring the treatment. The assessment of human body composition has played an important role in the determination of nutritional status in clinical and metabolic settings as well as an indicator of muscle mass in professional and amateur sports. For a variety of reasons, body fat analysis is a very popular practice in contemporary Western culture. Professional and amateur athletes care about body fat for aesthetic and health reasons and perhaps, most importantly, to gain a competitive edge. Athletes often try to achieve a certain level of body fat, depending on the demands of the sport (Nash, 1985). The measurement of body composition provides additional information for counseling clients on diet and exercise programs. If the percentage body fat is known, it is possible to calculate the desired weight: Desired weight = current weight – [(current weight x (% fat/100)] / [1.00 – (ideal % fat/100)] (Jackson & Pollock, 1985. Optimal percentage body fat varies with the goal of the client.

The Major components of body composition are adipose, skeletal muscle, bone, visceral, and brain tissues. In particular, whole body fat-free mass (FFM) is of interest in the field of sports science as a component of body composition and has been found to be associated with talent identification, athletic performance, and body mass management. Prediction models use the circumferences of arm, thigh, calf, skin fold, and body height as independent variables. The accuracy of the developed equations for predicting FFM has previously been established. In addition, anthropometric variables derived from body height and mass are associated with FFM in athletes. Furthermore, body mass-to-waist ratio (BM/W) has been shown to be a strong indicator for whole body skeletal muscle volume in children. Body height and mass and waist circumference are conveniently

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determined without a special measurement technique or apparatus. For athletes, if body size and shape indices derived from these anthropometric variables can be predictors for FFM, it could be a more convenient measure for estimating FFM in comparison to traditional anthropometric prediction models.

Weight training intensity basically refers to how much weight you will be lifting and how heavy or light that weight is for you on a given exercise. The lighter the weight, easier it is for you, the lower the intensity. The heavier the weight /harder it is for you, the higher the intensity. It is simply work done with heavy loads that don't require maximal effort .The weight exist in the range between 75% and 90% percent of one Rep. In order to develop maximal strength relatively heavy load must be used greater than 85% of one repetition maximum (1RM). This permits only a small number of repetitions between 1 and 5 per set. Maximal effort is required on each lift and as such this type of training is very taxing. Supra-maximal training means using weight and resistance that is beyond your current strength levels. It is using heavy weights that you normally would not be able to lift at all. One of the benefits of supra-maximal training is that almost any exercise will feel light and easy after you finish a set of supra-maximal holds or negatives. The scope of comparative effect between Sub maximal, maximal and supramaximal intensities on body composition still need to be explored much. If anyone of the three training variation is shown to produce changes in body composition, perhaps that type of program would be more appealing to those who have difficulty adhering to choose the appropriate intensity level of weight training.

Material and Methods

Total 40 Male (N=40) served as subject for this study and they were divided into 4 group, comprising of 10 subject each. They were categorized in four different group i.e. Sub maximal, Maximal, Supra maximal and controlled group and were selected randomly through simple random sampling methods. All the subject age ranged between 18 to 21 years and was the first semester of undergraduate program of L.N.I.P.E, Guwahati. On the basis of the literature available and reviews of the fat free mass selected as a variable of the study. The selected variable Extracellular Water and Fat free Mass were obtained with the instrument and procedure by the researcher on time effect data. The three groups (i.e. sub maximal, Maximal and Supra Maximal) with different intensities performed five exercise on regularly day with duration of one hours per session and five exercise consist of Leg Extension , Leg Press, Leg Flexion , Chest Fly and Abdominal Crunch. For the collection of data of extracellular water and fat free mass "Maltros Bioscan Bioelectrical Impedance "Body composition were used. The data collected pre and post of the training program weeks. To find out the difference or to compare different training program on extracellular water and fat free mass ANCOVA statistical tool applied with the level of significance 0.05.

Result:

Descriptive Statistics like mean, standard deviation for the selected variables were calculated and present in table no 1. The result pertaining to the Analysis of Covariance for the selected variables is presented from Table 2, 3 and 4.

Table-1
Descriptive Statistics of Mean and Standard Deviation of selected Body Compositions

Body Composition	Group	N	Mean	Standard Deviation
Fat-free mass	Supramaximal	10	59.41	3.96
	Maximal	10	59.69	12.86
	Submaximal	10	56.37	7.09
Extracellular fluid	Supramaximal	10	18.20	3.62
	Maximal	10	18.40	2.35
	Submaximal	10	20.10	3.65

Table-2
Analysis of Covariance of different groups obesevation in relation to fat-free mass

Adjusted post test mean				sources of variance	sum of square	df	mean squares	f ratio
supramaximal Group	maximal group	submaximal group	control group					
58.971	59.128	58.716	58.220	between	4.68	3	1.561	3.89*
				within	14.01	35	.400	

*Significant at F0.05 (3, 35) =2.87

It is evident from table 4 that the calculated value of the F- Ratio (3.89) in relation to fat free mass is higher than the tabulated F-Ratio (2.87) at 0.05 level of significance. It revealed that there is significant difference among admitted post Mean difference of different groups. To find out the paired mean difference LSD Post Hoc test was applied and finding pertaining to this has been presented in Table 3.

Table-3
Least Significant difference Post Hoc test of the adjusted post test paired mean of fat free mass different groups.

(I) Treatment	(J) Treatment	Mean Diff.(I-J)	Sig. a (p-value)
Control	Maximal	-.908*	.003
	Submaximal	-.497	.088
	Supramaximal	-.752*	.013
Maximal	Control	.908*	.003
	Submaximal	.412	.155
	Supramaximal	.157	.587
Submaximal	Control	.497	.088
	Maximal	-.412	.155
	Supramaximal	-.255	.380
Supramaximal	Control	.752*	.013
	Maximal	-.157	.587
	Submaximal	.255	.380

Table 3 revealed that since F-statistics is significant, post hoc comparison has been made for the adjusted means of the three treatment groups .It may be noted here that P-value for the mean difference between control and supramaximal is 0.013 and control and maximal is 0.003. Both these p-values are less than 0.05 which is significant at 5% level. After analyzing of post hoc mean comparison that there was a significant difference on Fat-Free Mass between Supramaximal and control groups ; and Maximal and control groups .

Hence it is concluded that Maximal intensity training program is better than Supramaximal training programme, Submaximal training programme and control groups in improving Fat-Free Mass. The graphical representation of mean of fat free mass at different training programme has been presented in figure 1.

Figure 1
Adjusted Post Test Mean comparison Of Fat Free Mass of different training Group

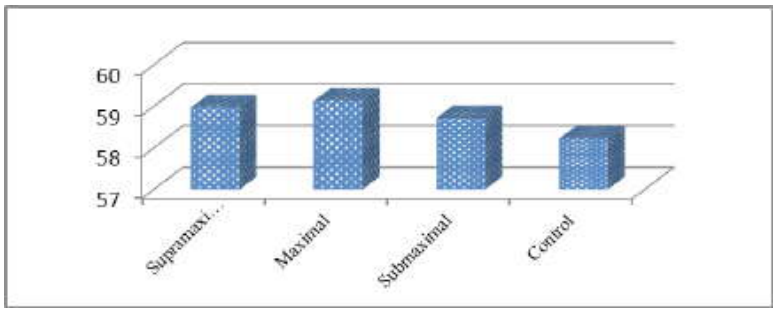

Table 4
Analysis of Covariance of different group observation in relation to Extracellular fluid

Adjusted Post Test Means				Sources Of variance	Sum of Square	Df	Mean Square	F-ratio
Supra maximal Group	Maximal Group	Submaximal Group	Control Group					
19.13	18.80	19.13	20.44	Between	16.10	3	5.369	2.43
				Within	77.18	35	2.205	

***Significant , F0.05(3,35)=2.87**

It is evident from table -8 that the calculated value of F ratio (2.43) in relation to Extracellular fluid in lesser than the tabulated value of F ratio (2.87) at 0.05 level of significant. So, it is evident that there in insignificant difference between estimated adjusted post- test mean of Extracellular cellular fluid in different groups.

Discussion

The objectives of this investigation were that to extent training method and implementation and concept of types of training i.e. Supra maximal, sub maximal and maximal are selected to identify its impact on fat free mass and extra cellular fluid of body composition. To conceptualized the result of the study the researcher try to throw the highlight on variation of training and its impact on selected body composition variables. To access the six week variation of training effect, pre and post data of all groups were taken. The findings of the study indicate that there was significant effect of variation of training on fat free mass and extracellular fluid. Fat free mass in absolute quality of the body composition which is basically understood and learnt as the potential factor and genetically based. In concern of body composition, regular planned and systematic training normally have got three dimension changes. First, the fat mass goes down and lean body mass increases and lastly depend upon the changes in total body weight either increase, decrease or even no changes. High intensity exercise such as supra maximal and maximal program gaining popularity in the context of fat management. More muscles mass involved in exercise, greater the contribution of muscles pump to venous return. Hence, increase in muscles mass help to receive an increased cardiac output. Various studies found positive correlation between the supra maximal and Maximal Training with fat free mass (increase) and fat mass (decrease). This correlation also indicates that increase in fat free mass may be one of the reasons for increased Vo2 max too. From the investigation it is also indicate that these were no significant effect of any Variation of exercise on extracellular fluid. This is because of training influence and position.

Conclusion

On the basis of the analysis and limitation of the study, it was observed that fat free mass were found significant difference between all the three

groups compared to control group. But insignificant difference were found for Extracellular Fluid between all three training group.

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EIGHTEENTH CENTURY JAIPUR CITY: A HISTORICAL PERSPECTIVE

Mayurakshi Kumar

Monumental architectural constructions are closely associated with political manoeuvres and mediums to establish political rule. Historically, in India construction of robust but equally decorative edifices of royalty in form of palaces, temples, idols, *charbaghs* (gardens), mosques, tombs and more importantly city, was one of the most elaborative tool for stamping political supremacy. Through this paper, an attempt will be made to glance at one of this projection of political articulation *i.e.* Jaipur city, which became not only a capital city but also expounded social, political, economic cultural experiments of its builder and ruler Sawai Jai Singh. Historically speaking cities define not only economic worth of the ruler but also showcase the political, social and cultural flare of the time. Erection of Cities and especially the Capital or imperial city, therefore symbolizes the true art of Kingship with all its political paraphernalia.

To understand city's evolution in historical terms it is important to not only look at patterns of state patronage and state sponsored interventions but as Catherine B. Asher, states, it is equally essential to assess the roles of different participants, who may have individual interests which became aligned and mutually reinforced.[1] A City imagined could be connected to immediate cultural and political realities on the basis of motives of individuals and groups, who help in shaping its environment.[2] It is therefore essential to glance at these varied participants without relegating them to obscure representations, as collective memories and representations reveal a more nuanced story.[3]

The Indian buildings across different historical periods especially during the ancient and medieval centuries encompasses not only the ideology of its builder but in fact its gridded pattern is closely influenced by the traditional knowledge of *Vastu Vidya* or *Vastu Shashtra*, which literally translates to 'science of architecture'. The utilization of this science is not only evident in construction of smaller spaces i.e. houses but also even in monumental buildings like temples, cities, palaces and many other. *Vastu* in simpler terms means dwelling and its locational site. The intricacies of this *vastu* is defined by the site and planned articulations in form of units or *mandalams* in the site and where and how they are placed.Thus, dwelling in *Vastu* is ideally a place whose environment is suited for the settlers in that space. In figurative sense buildings under *Vastu Shashtra* are prepared under the principal of *vastupurusamandala*, whereeach segment not only has relative association with nature but even bodily representation of the human being and hence the above term. One can situate the influence specifically in case of Jaipur city.

ESTABLISHMENT OF JAIPUR CITY

While engaging with the architectural construction of Jaipur city, it is essential to learn about the logical motive force which pushed Sawai Jai Singh to undertake such a lavish architectural endeavour. He introduced many significant administrative, economic, social and religious changes, which had a lasting impact during and after his tenure. Of all these introductions most effective yet understated change, is the shifting of capital from Amber and establishment of new capital city of Jaipur. For all practical concerns of the time, the shift in capital was validated at the expense increasing population of Amber city and it's not so very expanding territorial boundary, thereby

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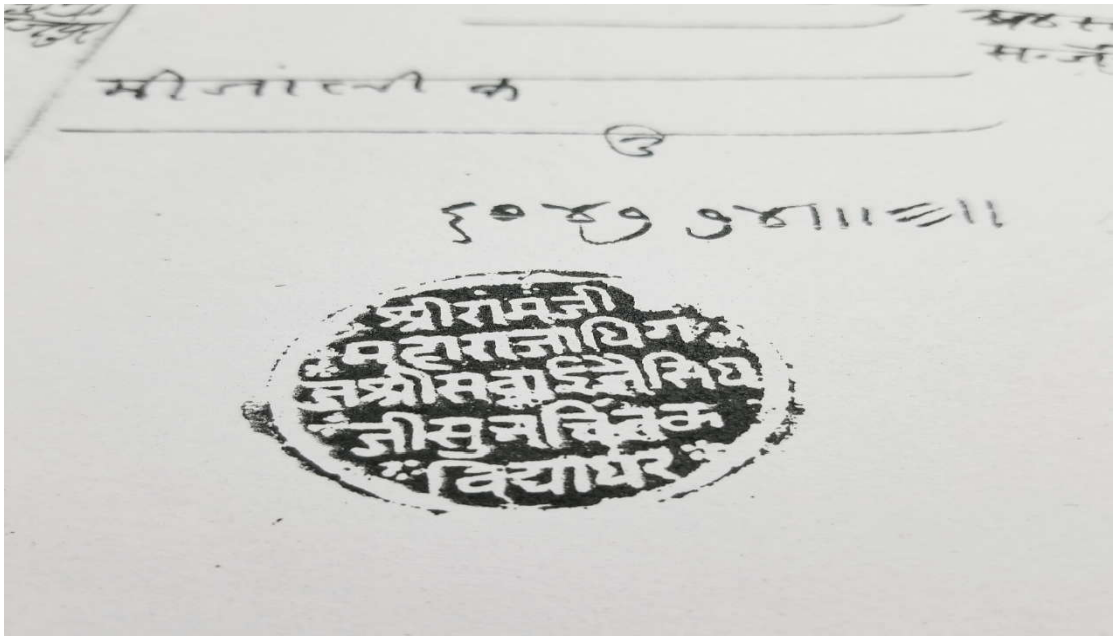
causing a major crunch of space. However, apart from this practical intention, certain other concerns dominated the shift.

The city was a representation of a scared domain, as by establishing close linkages between his political might and religious outlook, Jai Singh managed to provide religious legitimacy to his expansionist endeavours. Evidently Jai Singh, aimed to establish himself as the supreme lord of the Rajputana land and thereby displayed all intentions to get his name recorded in history as a great builder. The naming of the city on his name also marked a step ahead in this direction. Jai Singh's continuous attempt to establish his supremacy were not restricted within the confines of the territorial space of Rajputana, and even flowed out through representational architectural structures especially *vedshalas* (Jantar-Mantar observatories) in regions of Mathura, Delhi, Banaras, Ujjain apart from Jaipur. It can be stated that such constructions having religious and astronomical objectives also served the pragmatic purpose of promoting political control with popular support.Catherine B. Asher and Cynthia Talbot have asserted that the creation of new city by Jai Singh, was one chapter in the long-drawn struggle for independence that was being asserted by the regional powers.[4]

Having addressed the exponential political, social and ideological matrix which pushed Sawai Jai Singh to lay foundations of the new city, further light should be thrown on ideas which stimulated the notional process of planning involved in the structuring of the city. Was it a mere representation of the foresighted-ness of its creator or was it's planning an embodiment of various nuances of external (foreign) and internal (Indian) influences?

Some of the travellers, who visited Jaipur during the 19th and 20th century, highlight that the plan and the layout of the city was influenced by the European prototypes. Even the*pothikhana*(Library) of Jaipur, maintains18th c records of continuous correspondence between Jai Singh and European scholars and architects, and this proves that the former was extensively interested in the European mathematics and astrology. A rich collection of world maps and atlases were procured and secured in the*pothikhana* at the behest of Sawai Jai Singh. The richness of the *pothikhana* is even corroborated by the *Kapad Dwara* documents, which furnish information about a 18th century circular map of the world, painted on cloth with meticulous detailing of longitudes and latitudes. This map was inscribed with *Nagari* characters and was prepared and copied at the behest of Jai Singh, from a European version, which originally dates to 1669.[5]However, European architectural heritage and its intricacies were not the sole influence behind the making of the Jaipur city. In fact, true to the context of such records it can be highlighted that European building tradition may be one of the many, influences, that may have impacted the styling of the Jaipur city. Yadvendra Sahai, has taken a stand in opposition to one represented by the travellers.[6] He argues that the European influence is nowhere visible in the Jaipur city and pushes the case for indigenous origin of the Jaipur city, which he compares with the Indra Puri of Indra, discussed in *Shilpa Shashtra*.[7]

Also, he overlooks even the over-arching role played by the state Diwan Vidyadhar, a Bengali Brahman, in the maintenance of strict vigil over the architectural constructions of the time. He in fact sees the city and its various constructions as the whole sole endeavour of Sawai Jai Singh and brainchild of his architectural prowess. [8]The second level of disagreement highlighted by Sahai, is questionable as all the information relating to layout of buildings, maps and blueprints of city, material purchased and used for the construction, were supplied to Vidya Dhar as chief Diwan and interestingly the *Arsatta (Roznama) Imarti*, the archival notings related to building material purchased was stamped by Vidyadhar himself.



Bhojana Sara written by Girdhari, who worked as the court poet of Jai Singh, quotes the name of Vidya Dhar as the architect of the new city.

पुराकरेंबहुहरषकरि, मनमहिमोदबढ़ाय ।
विद्याधरसोंबोलकहिं, सहरसुएकबसाय ।

Due to completion, we are happy,
our heart is elated.
Vidya Dhar got the city settled.

Thus unlike, Sahai's perception, Vidya Dhar enjoyed supreme powers and was the chief overseer of all the constructional activities taking place in Jaipur city and Jai Singh always sought first-hand information from him, in relation to the progress of work. One of the by lanes named after Vidya Dhar as 'Vidhya Dhara ka Rasta' and leading towardshis *haveli*and another garden named 'Vidya Dhara ka Bagh' (and still located in the present-day Jaipur), also stand testimony to the status of rank enjoyed by the Diwan.

Ashim Kumar Roy and Giles Tillotson, have opined religious fervour and zeal of the ruler, as the main background in which the city was constructed. Accordingly, they argue that the architectural constructions of the Jaipur city clearly fall in line with the status quo of Hindu Kingship and Hindu city model. Their arguments embodies a conception of a city defined in a series of text known as *Vastu Shashtras*, which are canonical treatises, usually in Sanskrit, and guide regarding architecture, design and planning'.[10] However, Tillotson, argues that this science form was only randomly used in the laying of foundations and creation of structures in other cities and in fact it was only in the Jaipur city that it was consistently used in every erected structure.[11]

Apart from the abovementioned frames of study third level of discussion has focused upon the borrowed elements from the Mughal prototypes. It has been stated by this set of scholars that, the Mughals were forerunners, as far as the building activities were concerned and regional states borrowed the knowledge. Also, since they were ruling as imperial heads, they had more resources at their disposal and land to be brought under usage and therefore they could undertake huge architectural constructions, including establishment of new cities. With many learned men of pen, wisdom, scientific understanding flocking the Mughal court from regional as well as international frontiers, spirited discussions on varied issues could take place very easily and decorative engagements and sharing of art and architectural knowledge was one them. Thus, it was no small deal, that the Mughals were the creators of three of the most famed and discussed capital cities of medieval era i.e. Fathepur Sikri, Agra, and Shajahnabad. Focusing on Mughal architectural worth, and its continuum in regional and sub-regional pockets, Catherine B. Asher highlights the associations between the Mughals and the Kachchwahas,

prevalent at the level of sharing of architectural logistics and interests involved in the erection of buildings. She argues that it was because of the support and protection provided by the Mughal rulers that Kachchwaha rulers namely Man Singh and Sawai Jai Singh, were able to carry out their constructional activities peacefully, both within and outside the sphere of their *Watan* Jagir.[12] The outlined patterns of similarities between the architectural heritage of Shahjahanabad and Jaipur stands in opposition with the argument which sees Jaipur as the sovereign turf of kingship postulated by a Hindu ruler, on Shastric and Vaishnavite principles.

Monica Horstmann and James Hastings emphasize that the building of the city of Jaipur as well as the temples within the city were indicators of self-assertions by the Kachchwaha rulers, Sawai Jai Singh against the Mughals. These authors have overemphasized the importance of the *Shastric* model in their portrayals of presenting Jaipur as a 'Hindu City'. Hindu Kingship model was also forwarded by Tillotson along with Sachdev, who focus on the Shastric articulation of statecraft. They opine that the Jaipur rulers, used the Shastric norms and modified it to accommodate the existing building in the city. They compare Jaipur with other so-called Hindu cities, such as Madurai, Dabhoi, Sikar and Sanganer. They trace the Kachchwaha- Mughal alliance and highlight the career of Sawai Jai Singh, but they do not discuss the extent and exact nature of Mughal sovereignty over the Kachchwaha political environment.[13]

Fatima Imam disagreed with the above mentioned Hindu city model and argues that the availability of the archival data in the private collection of Sawai Jai Singh clearly indicates that he used the architectural example of the Mughal cities.[14]She further adds that Sawai Jai Singh enjoyed power and prestige amongst the Mughal mansabdars and therefore was made a collective *Subedar* of many *subas*, a power enjoyed by only select few *Mansab* holders. In these *subas*, too Jai Singh carried out constructional activities and got constructed many residential quarters known as Jai Singh *Puras*. The term *pura* means town and there are references of maintenance of at least five *puras* by Jai Singh, in areas apart from Jaipur. One reference from Kapad-Dwara, clearly furnish first-hand information about such constructions. The recorded plan talks of a Pura at Ujjain, which was prepared in second decade of 18th century. It gives the names of the places, notes about ownership of land, 20 *havelis* of kayasthas, *havelis* of Mahajans, MahvidyaKund, Sita Kund, Maratha Village, Thakur-dwara (temple), house of Trilok Chand, bazar of thatheras (brass merchants), cloth merchants, mosque of Shah Muhammad, *haveli* of Nihal chand and many other details.[15]

Fatima Imam, further says that Sawai Jai Singh's real achievement lies in the successful incorporation of Mughal patterns by making subtle changes to suit the needs of the environs. The cities in India always mushroomed around the forts and rulers always took residence in a capital with difficult access because of natural or artificial barriers such as deserts, ridges or forts. Jaipur possessed all of these advantages. At the same time, this city was different from the other Rajput cities because it was not built on a ridge or mountain, such as the cities of Jaisalmer, Jodhpur and Bharatpur. Jaipur was very accessible and like Shahjahanabad, there was less emphasis on the fortification around the city. The fact that Jaipur was built on an open plain reflected Sawai Jai Singh's confidence, even though he chose an area in vicinity of Amber, so as to continue the traditional relationship in the area.

Jaipur lies 5 miles south of Amber, the old capital city on a small plain. It was surrounded by hills on three sides and a dam was built on northern side. Sawai Jai Singh laid the foundation of his new city in 1727 A.D. and named it after him. Sawai Jaipur or Sawai Jai Nagar is the earliest recorded reference related to the city in the archival records of the time.

नगरबसायोंएकनयो, जयसिंघसवाई ।
जाकीसोभाजगतमै, दसहोंदिसिछाई ।

A new city settled by Jai Singh Sawai.
It is popular in 10 directions.

Kurmvillas written by poet Virachit, furnishes information about the establishment of Jaipur City in 1787 V.S. /1727 C.E., in the month of *Sawan* (August). It talks about different palaces like Pritam niwas, Chandra mahal, Badal mahal, Govind mahal (which was compared with heaven). Writer further states that Jainagar (Jaipur) is a representation of Indrapuri on earth and its houses the domain of all four Varnas.[17]

PLANNING OF THE CITY

Sawai Jai Singh, used the new city as a tool for power and status enhancement, and accordingly he

never separated himself from the imperial control and in fact remained attached to the Mughal head as he sought imperial recognition for his city, an aspect which is well documented in the annals of history. Corroborating information is provided below. Just after the completion of the main wards of the city of Jaipur, Jai Singh applied to the Mughal emperor for the imperial recognition for his newly founded city. In 1733 AD, he sent a 'Parwana', to the emperor Muhammad Shah. Sawai Jai Singh received the following reply from the imperial head, "Maharajadhiraj Sawai Jai Singh had informed that he has founded a new city under the name of Sawai Jaipur in the imperial territory near Amber and has requested the name of Sawai Jaipur instead of Amber may be written in the imperial records. His request has been accepted and it is ordered that Sawai Jaipur may be written instead of Amber in future".[18]

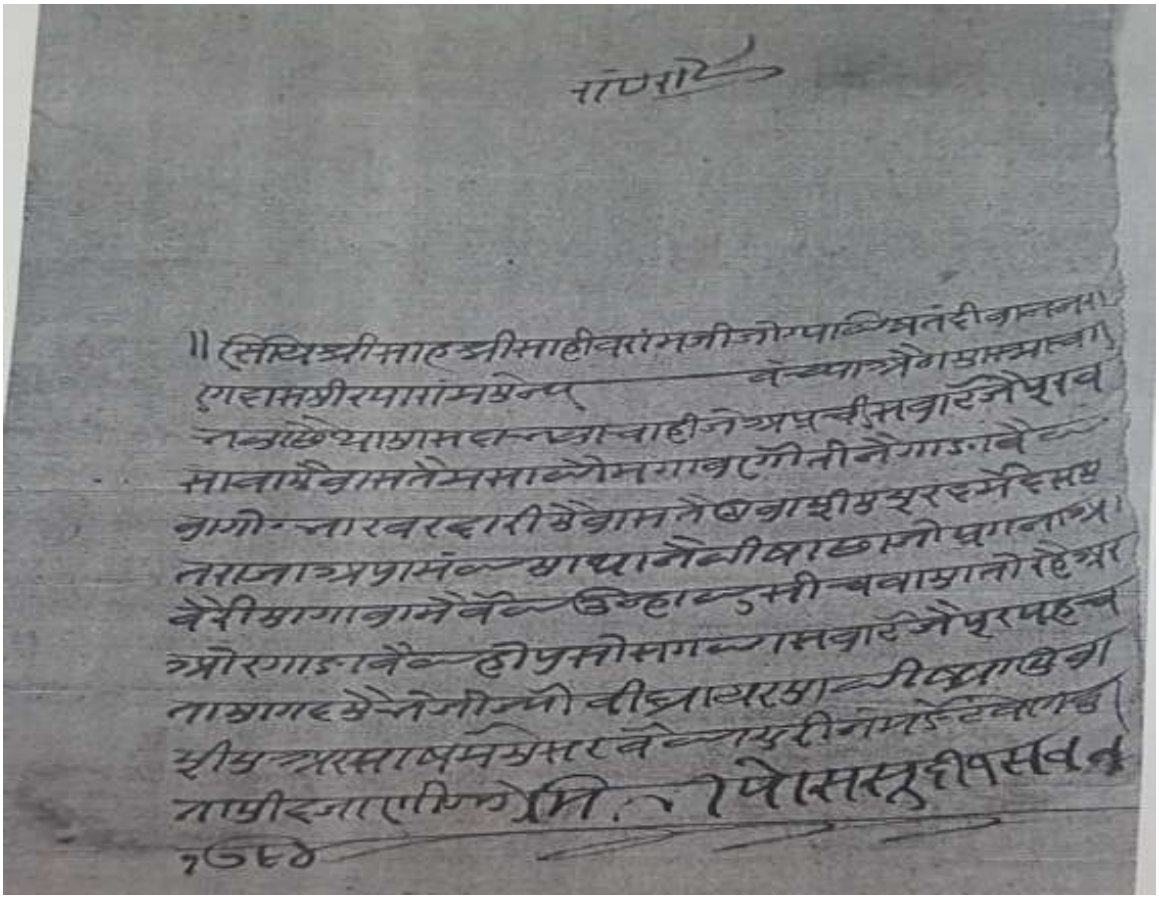


Figure 1: *Arzdast*wrote by Diwan Vidya Dhar, in 1784 V.S./ 1727 C.E., to state official, seeking permission for purchase of three bullock carts of raw material for the construction of the city.

Ashim Kumar Roy, claimed that as originally planned, Jaipur was to have only four rectangular blocks, namely those occupied today by the 1) Palace, 2)Purani Basti, 3)Topkhana, 4) a block combining Modikhana and Visheshvarji.[19]The city of Jaipur was planned not only to have straight and wide roads but also to achieve the almost uniform height and similarity of architecture of the houses built on the main road.

Jaipur City: walls and gates

When we firstly engage in the study of the Jaipur city, its huge walls and gates draw the major attention. Sawai Jai Singh not only focused upon the internal beautification and uniformity of his city but also was equally interested in providing his city and its population the necessary protection through walls and entryways through management of huge gates. The wider expense of these walls and gates not only effectively provided the necessary barricading, but helped Sawai Jai Singh to draw the attention of one and all towards the overall expanse and scaling of the city achieved by him. The wall is on average 6 meters high and 3 meters thick and is pierced by a

total of seven gates, representative of Shastric calculations.[20] The main gates are, Chandra Pol (West Side), Suraj Pol (East side), Jorawar Singh Pol/ Dhruv Pol (North side), Ajmeri Gate, Naya Pol, Sanganeri Gate and Ghut Darwaza (Southern side)

The Chowkries (Wards)

The principal streets of the city define the grid of the mandala and divide the city into Chowkries (wards).[21] The names of these Chowkries from west to east are 1)Topkhana desh, 2) Modikhana, 3)Visheshvarji, 4) Ghat Darwaja, 5) Topkhana Hazuri, 6)Purani Basti, 7)the Palace and 8)Ramchandarji

The division of the city into wards and there subdivisions into sub-wards, by different scales of grid, relates to the system of social distribution, the patterns of settlement of people according to the caste or jati, that is defined by the *shashtras* and now is more commonly known as the '*mohalla* system'. [22] Another interesting account is furnished through the document of 1839 V.S./ 1782 C.E., wherein an order was passed by the state with reference to a Khati (wood-worker), named Koju, living in the Khatiya*Mohalla.* For his good work, prize money of 38 rupees was to be handed over to him by the Daroga *Imarti*, on the behalf of the state and for the same he was asked to present himself in the court, so as to sign on receiving the same amount.

Catherine B. Asher also talks about this feature of the Jaipur and also Amber city. She says that on the order of the ruler, 'a huge map of Amber, about 21 Feet Square was produced'.[23]Inscriptions on the map indicate that members of a single profession occupied neighbourhoods. The similar pattern is evident even in the Shahjahanabad, but over there it was not representative of *Shashtra* based *jati* division of cityscape and more specifically was done to prevent chaotic conditions from prevailing in the city. Working upon the same hypothesis, while understanding the *mohalla* division of Jaipur city, one need to address the question, whether Jai Singh, based himself upon the *Shastric* nuances of city division in accordance to the *Jatis* and their functions and thereby was engrossed in caste based social understanding, or was he merely dividing the city *mohallas* in accordance to occupational as well as *jati* consideration, under the garb of the practical political concern of avoiding any rifts between different communities in near future, especially if they are settled together, instead of different mohallas. Thus, keeping in sight the future issues relating to the social disturbances, Sawai Jai Singh may have induced the systematic caste-based division of Mohallas. Vibhuti Sachdev and Giles Tillotson, have tried to assess this very division of *Mohallas*, but managed to present the case study of only *Brahmapuri*, i.e. the Brahmin *mohalla.* Thus, the exercise undertaken by the two, appears significant but only partially as it did not open up the nature of other mohallas.

City Palace

The strongest base of the city was its palace. According to Stephen P. Blake, who studied the city of Shahjahanabad, 'the palace fortress was the centre of not only the city and the empire but also the universe.[24] The sacredness of capital cities as the centre of universe has been discussed in classical Hindu texts also. The centrality of the palace complex, as sacred or the centre of the universe has specific political dimensions as well. The palace complex functions both as a public space as well as a private residence. Of many visitors to the Jaipur court, the account of Bishop Heber stands out, as he tried to beautifully note the pomp and decorative displays of the palace. As a catholic missionary he visited Jaipur in 1832 and commented on its open pavilions with marble pillars, richly carved. He further asserted that even though these pavilions were inferior in size, in all other respects they were equal to the hall of audience in the castle of Delhi.[25]

The palace complexes

It consists of a series of gates or pals from east Sereh Deorhi, Udaipal, Jaypal, Vijaypal etc, spacious squares, pleasing structures like the *Diwan-i-am* (Sabha Niwas), *Diwan-i-khas*, but the most impressive building in the royal sector is the Chandramahal, the seven-storied palace.[26] According to Vibhuti and Tillotson, 'the Shastric texts specify seven storeys from the palaces of Kshatriya kings and the Chandramahal is one of the few Rajput palaces to achieve this paradigmatic number'.[27]

On the ground floor of this Chandramahal is the Pritam Niwas with a small audience hall in its centre. The next two storeys are occupied by the magnificent Sukh Niwas, above this is Rang Mahal also known as the Sabha Niwas. Apart from that there is Chavi Niwas, Shri Niwas and Mukut Mandir. Poet Krishnadatta in Pratap Prakash, furnishes vivid description of the Chandra Mahal with its spacious halls and numerous *durbars* (courtly meetings), fairs

and festivals organised inside the premises of the famous Mahal.[28]

Sawai Jai Singh constructed the Jai Niwas bag and Nichla bag in the tradition of the Mughal garden.[29]Besides the royal palaces, public halls, courtyards and gardens, this complex also housed the Karkhanas (departments) for various manufacturing and patronage purposes. Over years, during the 18th century many other buildings were added to this complex. In 1749, Ishwari Singh (1743-50) constructed a victory tower, the Ishwar Lat or Swarga Shuli. The tower is seven storeys high. It is one of the conspicuous landmarks in the city. Ashim Kumar Roy also tells a romantic tale about the deadly love of Ishwari Singh and that he built the tower to see her lover[30] and in 1799 Pratap Singh (1778-1803), built the famous building of Jaipur i.e. Hawa Mahal. The designer of this remarkable structure has been identified as Lal Chand Ustad.[31]Poet Krishanadatta written *Pratap Prakash*, provides important information about 18th century Jaipur especially during the reign of Pratap Singh (1764-1803). Poet informs that besides Hawa Mahal, Pratap Singh also got constructed the Badal Mahal, and Mukut Mandir on the 7th floor of Chandra Mahal.[32]

These are some of the features of the palace complex of Jaipur of Jai Niwas, the Royal house of the Kachchwaha rulers of Jaipur.

The planning of the city was governed by geometry and symmetry. The plan divided the city into nine rectangular *nidhis* or sectors. Central axis of the city, which was 3.2 kms in length, was laid from east to west, between the gate of Suraj Pol and Chand Pole, connecting with straight roads. This axis was crossed by three roads at right angle dividing the city into nine blocks, which were further sub-divided by lanes.

Initially, the main roadside area was reserved for markets at Chandpole, Kishanpole, Gangauri, Tripoli, Chaura rasta, Johari Bazar, Sireh Deorhi, Ram Ganj and Ghat bazar. Since the beginning these are the specialized markets dealing with the business of particular commodities.

चौपरिकेकीन्हेहैंबाजार,
विचिवीचिवनाएचौकचार।
ल्याऐनहेरीबाजारमाहि,
विचिमैंववेगहरेरखांहि।
चौकनिमैंकुंडरचेगंभीर,
जगपीवततिनकोंमिषतनीर।

There is a market in chowkri.
In it there are 4 chowks.
In the middle it is deep.
There is a well in the chowkri,
People drink its sweet water.

Kapad-dwara documents also details about the phased evolution of the market centres. Ram Ganj, finds continuous entry in the documents, which indicate that though the designing of the market was done in Sawai Jai Singh's time but it was completed after his death. The market came to handle a well-organized trade in cotton wool, with the development of a *rui-ki-mandi* (shopping area for cotton wool), in its panorama.[34]

Virachit in *Kurmvillas* gives information on the establishment of numerous bazars or markets in Jaipur. Most of these markets were located near Chowkries and were flourishing and lots of money exchanged hands as Kuber (Hindu God of wealth) like figures were its owners. The shops had perforated panels, which acted as decorations as well as allowed light and air to pass through.[35]

Over years instead of being recognized for its architectural heritage, Jaipur came to be renowned for trade and commerce a fact corroborated by the *Kapad-Dwara* and the *parwanas* secured in the Bikaner state archives. In fact, it is well- established fact that Sawai Jai Singh had himself invited many traders from across India, to settle down in Jaipur along with their families and as a lucrative benefit they were even freed from their hasil tax a fact which is corroborated from the Buddhi Vilas.

बहुविधिकेकारीगरअनूप,
परिवारसहितबुलवायभूप।
तिनकोंपुरमैंदीन्हेवसाय,
हासिलसबकोमाफीकराय।

Many different categories of craftsmen,
Were called along with the families.
They were settled in the Pur/city,
Even they were exempted from their hasil (tax).

In order to support and promote these trading activities, Sawai Jai Singh had very early laid the foundations of all the major markets i.e. Sireh Deorhi, Kishanpole, Johri Pole, and Gangari.[37]According to the map LS/14 (dated 1725), in the city palace museum collection, which has come to be known as the progress report map. 162 shops were constructed by the state in each of these bazars.[38]All these shops

were uniform in shape; size and all these features were also ordered to be in harmony with each other. Almost immediately afterwards similar bazars were constructed along Chandra pole, Tripolia, Ramganj. They were ready before1734. The shops were constructed in typical architectural style on both side of the road. They were only single storied and any vertical expansion was disallowed as the first floor of the shops were reserved for the masses of the city, so that they could watch the royal processions from there.[39]

The concentrative evolution of Jaipur city as a prosperous hub bringing together heterogeneous social groupings was a defined political motive force of its ruler as is even evident through paragraphs of *Buddhi Villas* which elaborate that Sawai Jai Singh settled people of all the four Varnas in the city and even invited different faith followers to settle down in the city.

छत्रीब्रामणअरवैस्यसूद्र,
च्यारिहूवरणकेगुण-समुद्र ।

Kashtriya, Brahaman and Vaishya, Shudra,
Resource pool of all the four Varnas.

However, despite settling all the different categories of the citizens in the new capital city, Sawai Jai Singh did not do away with differential pattern of social equation and continued to abide by the notion of social hierarchy, by settling different categories and communities in different mohallas as even portrayed by Poet Bhakata Rama in his work Buddhi Villas.

पुर-छोरवशीवारांगनासु,
वहुकरतनाचमनुअपछरासु ।

At the extremity of the city walls were settled
Prostitutes,
They performed dances like apsaras (nymphs).

The city of Jaipur as understood from both scholarly interpretations and archival notings presents a picture of an evolving landscape, which cannot be merely understood as a political project of its ruler i.e. Sawai Jai Singh and rather be subjected to wider explorations. The Jaipur city appears as a relationship between ideas, ideologies and architectural forms that were forever evolving, across space and time. It is true that architectural patronage of capital cityscape was a genuine concern of the Sawai Jai Singh, so as to etch his name in the history books, but as discussed earlier, many additional concerns necessitated the massive city construction. Thus, city planning was an evidence of political manoeuvre, social projection, economic ventures and cultural negotiation along a continuum of relationships.

Endnotes:

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27. Vibhuti, Tillotson,*Building Jaipur*, PP. 65.
28. Poet Krishanadatta written *Pratap Prakash* was completed in 1802 and manuscript is in the form of dialogue between Krishnadatta and Maratha chief Peshwa Baji Rao II (1795-1818). In this poem the poet describes about the daily life, courtly engagements of Sawai Pratap Singh. Historically the work is very crucial for reconstructing the history of 18th century Jaipur, especially in the light of detailed descriptions given on Jaipur city and its various buildings, markets etc.
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Revisiting the Sustainable Development Goals in connect with COVID-19 and how can Green Chemistry make a difference

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Introduction

Ever since the seventeen goals for sustainable development were recognized and outlined by the various member countries of U.N., the world seemed to come on a common consensus of working towards a cleaner, waste-free and healthier planet.[1] Just a few years down the line and it has been striking to note the significant advancements made in this direction. Today, we have a ready access to a broad spectrum of products that are safe, sustainable and most importantly environmentally sound. We have managed to increase agricultural production that can almost suffice the requirements of the growing population, reduce escalating levels of CO_2 in the atmosphere and other greenhouse gases, provide safe drinking water and prevent critical diseases and ailments. Also, we have started making efficient use of our resources that have enabled us to combat many of the grave environmental challenges on the horizonand these achievements can be largely credited to chemistry. In fact, chemical industrieshave shown tremendous potential towards making the SDG's a reality and transforming the world for the better by powering the manufacture of almost 95% of essential goods *via* energy generation.[2] As per the American Chemistry Council, "the business of chemistry is worth 450 billion dollar enterprise which is about 26% of the global chemical product and the key of the nation's economy." However, it is important to mention here that when we talk about chemistry and chemical manufacturing, what we mean is green chemistry which is the only way how chemistry should be practiced and the only key that can help in achieving complete sustainability. Economic growth cannot be synonymous with sustainable development, if the chemistsdo not consider the environmental impact of the manufacturing routes and adopt a waste-free route. Thankfully, Green Chemistry has transformed the landscape of syntheses and given the much needed key to achieve the SDGs.[3]

In this minireview, we have attempted to summarize the ways in which GC has impacted sustainable development and the indispensable role it has been playing in meeting the 2030 agenda of SDGsby contributing towards good health, quality education, gender equality, safe drinking water, clean energy and decent work for all and tackling climate change. We intend to enlighten the readers about the latest innovative greener tools and techniques that can be utilized for swiftlyprogressing towards a sustainable tomorrow. Even though incredible progress has been witnessed in this regard till now, yet a number of obstructions lie in the road which need to be overcome especially related to their universal, integrated, interconnected and inclusive implementation. The SDGs are ambitious and hence far reaching will require a pragmatic shift in how we think chemistry, how we conduct education and research and how we produce chemicals in a more sustainable manner. It is important to trace the obstructions for complete success. It is envisioned that this review will serve as a guiding tool to inspire the scientific community to explore, design and employ green chemistry tools and transform all our strict commitments into action for reaching these goals.

2. Glancing through the SDGsand impact of COVID-19 pandemic

The year 2015 was crucial as this was the year when the entire world got unified by common goals of protecting the planet and ensuring that by 2030,

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there is peace and prosperity all over.[4]The aspirational goals were paving the framework for sustainability and these were called as the "sustainable development goals"-SDGs.[5]Thesewere developed after prolongeddiscussions and consultations from relevant stakeholdersincluding those from Non-Governmental Organisations (NGOs),policy-makers, the civil society and businessmen holding international experience. Adopted by all the United Nations Member States, the SDGs provide a blueprint for all countries, industries and organisations to adopt in line withtheir own priorities in especially improving health and education, reducing inequality and spurring economic growth.Underpinning the 17 goals is a set of 169 specifictargets which describe, in detail, the ways in which the goals may be measuredand achieved.

The 17 SDGs have been highlighted below:

2.1 No Poverty: SDG-1 aims at ending poverty in all its forms everywhere and for accomplishment of this goal, ensuring social protection for all children and other vulnerable groups would be important.[6]The world, especially developing nations have been critically afflicted with poverty issues since long which have been inevitable in face of ever growing population and rapidly exacerbated by natural disasters. By the end of 2020, it has been expected that +71 million people will be pushed towards extreme poverty. However, the current COVID-19 pandemic crisis hasmade the situation worse by leading to the first increase in global poverty in decades. The loss in terms of a social as well as economic crisis is devastating and discouraging. Coping up with the severe crisis will take indeed not just months but years.In response to the socio-economic COVID-19 crisis, the UN divulged a framework of action for extending maximum help to the poorest and most vulnerable, whichcalls for a massive scale-up of international efforts and commitment for assuring that people all across the globe have a basic access to all essential services and are given social protection.

2.2 Zero Hunger: SDG-2preaches to end hunger, achieve food security and improvednutrition and promote sustainable agriculture.[7]It is highly disheartening to note that today, nearly 820 million people go to bed hungry. Out this huge number, almost 135 million are affected with problems arising due to acute hunger aggravated by man-made conflicts, climate change and economic downturns. Adding to the complexity of the situation, the COVID-19 has worked as a poison by almost doubling this figure and hence swift action needs to be taken in this regard. Increase in agricultural and food production food production can prevent this stressful situation by alleviating the perils of hunger.

2.3 Good Health and Well Being: SDG 3 aims at ensuring healthy lives and promoting well-being for all.[8]This is the most essential tool towards achieving sustainable development. We all are very well aware of the prevailing global health crisis the world is facing due to COVID-19 which has also destabilized the global economy. Just before the virus had taken the entire world under its clutch, remarkable progress was being witnessed in the health sector, measured by the increasing life expectancy, improved sanitation and hygiene, augmented access to physicians etc. However, now the current situation is demandingmore investment in this regard and calling urgent attention from government and society.

2.4 Quality Education: The fourth SDG signifies the need to ensure inclusive and quality education for all and promote lifelong learning. Education is the only strategic tool to uplift socioeconomic status of the society along with ending poverty.[9]The past decade has witnessed an overall hike in access to education at all levels. However, the pandemic has caused a major setback by leading to temporary closure of schools and colleges, jeopardizing 91% of children worldwide. In an attempt to ensure that the students have access to continued learning, UNESCO launched the COVID-19 Global Education Coalition. Thisprime aim of this coalition is to foster multisector collaboration between IT partners, UN family, civil organization and media so that they can collectively and intellectuallydesign as well as deploy novel solutions that can enable different countries to tackle the connectivity gaps, expedite comprehensive learning opportunities during this difficult period.

2.5 Gender Equality: This SDG discourses the concept of gender equality and empowering all girls and women.[10]This goal is self-explanatory. It is clear that if the world is to progress, then women need to be given priority as they represent half of the population and henceforth half of its potential.[11] Gender inequality has remained a problem of serious global concern which has retarded complete social evolution. Women continue to remain under represented and suffer from serious discrimination

issues. As per reports, during this COVID-19 pandemic, domestic violence has increased manifold in many of the countries. Thus, initiatives have been directed in this regard. For instance: The Spotlight Initative was a global intiatives by EN/UN partnership has focused on ending all forms of violence against women and girls.

2.6 Clean Water and Sanitation: This is one of the most important SDGs; as we know that no form of life could have ever existed had it not been "water" the key resource for quenching our thirst and sustaining all forms of life on earth. SDG-6 sheds light on ensuring rapid and facile access to water and sanitationfor all.[12]Although great strides have been achieved so far in fulfilling this goal, however, still billions of people especially those residing in the rural areas still do not have access to clean water. Water is extravagantly polluted by a myriad of contaminants including heavy metals, dyes, pesticides, drugs etc. Thus, the Water Action Decade was launched by the UN General Assembly launched on 22 March 2018 for mobilizing action towards transforming the current water management techniques in a sustainable manner.[13]

2.7 Affordable and Clean Energy-SDG 7 advocates the need to generate and use energy sources judiciously and ensure access to affordable, reliable and sustainable energy for all.[14]Efforts have been directed in this regard and the outcomes are appreciable. We have been able to utilize biomass for conversion into fuels for powering various chemical processes. Not just chemicals, but we have also been able to utilize bioenergy for the purpose of sufficing basic needs like cooking. Also, we have managed to derive renewable sources of energy from natural resources such as sun, wind etc. Photochemical and visible light driven reactions have gained increasing momentum for accelerating industrial transformations as well as combating environmental challenges. The energy progress report has provided a snapshot of how far we are still from triumphing the targets of SDGs.

2.8 Decent Work and Economic Growth: SDG-8 aims to promote inclusive and sustainable economic growth, employment and decent work for all.This goal propagates the concept of sustained economic growth which can drive progress in true sense and drastically improve the current living standards. COVID-19 has disrupted billions and trillions of life by hampering the economic growth. Unfortunately, there has been a historic recession, marking unemployment, hunger, deprivation and this crisis is unfortunately hitting the economically weaker section. Therefore, an agenda for the prompt socio-economic response to this pandemic was outlined which will serve as a roadmap to extend social and economic support to all the countries.

2.9 Industry, Innovation and Infrastructure: This goal primarily expounds building of resilient infrastructure that aim atpromoting sustainable industrialization and fostering innovation.[15] Development ofinnovative technologies, expediting international trade and empowering the effective utilization of resources can play an essential role in meeting this goal.The pandemic situation created due to the rapid spread of corona virus has called the need for extensive investment in infrastructure. Thus, it is not surprising that digitalization of many businesses and services have been accelerated to cope up with the crisis. The teleworking and video conferencing systems have particularly assisted largely in connecting people all over the globe.

2.10 Reduced Inequalities: SDG-10 sheds light on reducing inequality within and among countries which is integral to attaining sustainability.[16] Unfortunately, COVID-19 has worsened the existing inequalities, and hit the economically weaker section the most. It has also risked the progress made in gender equality.

2.11 Sustainable cities and communities: This SDG propagates the need to make cities and human settlements more inclusive, safe, resilient, and sustainable.[17] The prime target for this goal is to ensure safe and affordable housing for all. Although cities have been the contributors towards economic growth and prosperity, yet, unfortunately they have been responsible for also causing 70% of global carbon emissions. The accelerated urbanization rates have also overburdened existing infrastructure and worsened the problems related to atmospheric pollution. The impulsive, life threatening corona virus has further threatened the cities and communities, endangering the public health tremendously. The overcrowding issues have also made it difficult to follow the measures of social distancing in this pandemic COVID-19 situation.

2.12 Responsible Consumption and Production: This goal highlights the need toensure

sustainable consumption and production patterns.[18] Unfortunately, over the last century we have threatened our environment through increased industrialization and other activities, that is endangering our very own survival on this planet. The environmental degradation scenario has made us realize that we did not follow sustainable consumption and production practices in near past. We all need to understand that if we wish to alleviate poverty and transition towards a sustainable economy, then we need to incorporate sustainable practices in our production as well as consumption processes. The advent of COVID-19 has delineated the significance of relationship between nature and human beings. It has made us understand and appreciate the limits to which the humans can actually push nature, before the impact turns out to be hazardous. This means that although we have unlimited desires and needs, but nature has limited capacity to suffice these needs. Hence, we must not try to overburden our resources.

2.13 Climate Action: According to the SDG-13-"UrgentAction is mandatory to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy." The sudden climatic changes as a consequence of global warming have been devastating for our economy as well as lives.[19] Our own activities have caused the levels of $CO_2$and other greenhouse gases to rise in the atmosphereand the year 2019 was recorded to be the warmest year. However, since the COVID-19 pandemic made its way into this universe, nature has been able to rejuvenate and the greenhouse gas emissions have been projected to drop by 6 % due to all the imposed travel bans.

2.14 Life below Water: This goal aims at conserving and sustainably using the oceans, seas and marine resources for sustainable development. In view of deterioration in the quality of coastal waters due to pollution and ocean acidification, life below water has been impacted negatively. As we know, marine biodiversity is important to the health and functioning of this planet, therefore we need to save these resources.[20]Thankfully, the pandemic has again had a positive impact on this goal as it has provided an opportunity to revive the oceans advance the goal of building a stable and sustainable ocean economy.

2.15 Life on Land: SDG-15 intends to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.COVID-19 has emphasized the necessityof addressingvarious threats to ecosystem as well as wildlife.

2.16 Peace, Justice and Strong Institutions: As per this goal, we need to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. In response to the COVID-19 pandemic crisis, we must respect human rights and build holistic solutions for today's emergency and tomorrow's recovery.

2.17 Partnerships for the Goals: According to this goal, we need to strengthen the means of implementation and revitalize the global partnership for sustainable development. If we wish to have a win-win situation over the SDGs, then we need to have strong partnerships/collaborations.[21] The current pandemic has also made us realize the same. We are experiencing the worst recession and to recover from this crisis we need to ensure a strong international co-operation.

3. Green Chemistry: A catalyst for accomplishing SDGs

Although it has taken almost a decade, but nevertheless, chemical entrepreneurs, researchers and other relevant stakeholders have started realizing their responsibility to provide society withsafer products and goods that are manufactured using environmentally benign pathways. The growing consciousness was fueled by a number of severe incidences and grave circumstances caused by lack of knowledge pertaining to usage and disposal of chemicals.[22]For instance, the Minimatadisaster-a dangerous case of mercury poisoning had led to the death of more than 100 people. This incident had occurred due tothe continuous disposal of waste residues containing Hg catalystby a polyvinyl manufacturing company located at Chissco, Japan near Minamata Bay. Likewise, the Bhopal Gas Tradegy, Love Canal Disaster, Times Beach, DDT poisoning case had raised an alarming situation forcing the chemists to rethink of their existing processes and practices. It was evident that the chemical industries were continuing to make technological advancements at the verge of harming the environment, without considering the repercussions of the use of chemical-products and pathways. Green Chemistry was the much neededkey to combat the environmental

challenges and move towards a sustainable tomorrow.[23]The twelve principles of green chemistry which also serve as the twelve basic tenets were incredibly designed by the fathers of this field-Prof. Paul Anastas and Dr. John C. Warner (**Figure 1**).[24]

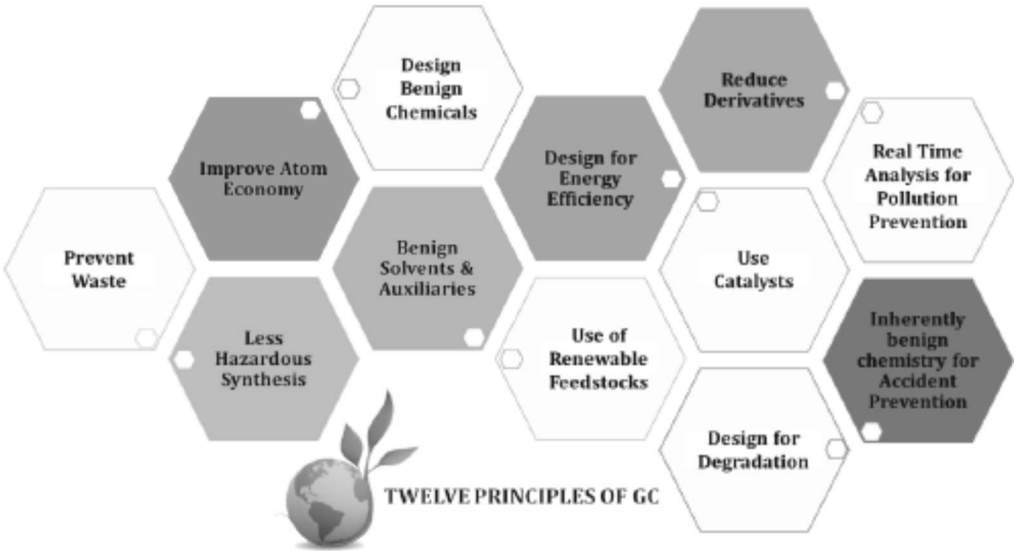


Figure 1 Glance into the 12 principles of Green Chemistry.

These serve as potential guiding tool for practitioners to revisit the age old methodologies, identify the loopholes, improvise and redesign them in a way that they are beneficial for the environment as well as human health. The word "green" embraces the color of environment and goodness of health and prosperity. Green Chemistry, since inception, has been playing a superlative role inreducing the environmental footprint. Today, we have greener catalysts for boosting industrially significant chemical reactions, greener solvents that provide eco-friendly medium for dissolution of reactants and greener energy sources for driving a host of processes without the need to worry about the availability in future.With the aid of green chemistry, we are also being able to recycle back the resourceswhich our mother earth had once gifted us, by utilizing the circular economic models. Different waste materials are being converted into valuables. We have slowly but steadily started our journey towards achieving the key goals of sustainability. American Chemical Society has identifiesseven SDGs that have utmost relevance to the chemistry community (**Figure 2**).[25]

Figure 2. Contribution of Green Chemistry to SDGs.

We shall take up each of these SDGs and show how GC can prove to be useful in this regard:

3.1 GC and SDG-2

Accomplishing the zero hunger goal can indeed be highly challenging.GC has played a significant role

in contributing towards this goal by protecting plants/ crops from pest infestations, bringing major reformation in the food production and distribution practices and prolonging the shelf life of food viaremarkable advancements in packaging and enhancing food quality and safety.The following examples clearly illustrate the role of GC in meeting SDG-2:

3.1.1 Drought protection for plants

To help plants retain water and impart protection to them during struggling drought periods, Sean R. Cutlerfrom University of California, Riverside managed to identify a compound named "quinabactin" that could mimic the natural plant hormone abscisic acid (ABA).[26]Although successful for a number of key crops, yet it did not work well for tomatoes and wheat which led the researchers to gain an insight into the cause. After careful introspection, they managed to unlock the cause and developed a new compound it calls opabactin which was more successful.

3.1.2 Development of Greener Pesticides

Cortiva Agriscience™, the Agriculture Division of DowDuPontwon the Greener Chemicals Award in 2018 for designing and developing a herbicide named "Rinskor™" that provided a sustainable solution for farmers to control grass, broadleaf and sedge weeds, thereby improving rice production.[27]The advantages of low toxicity to various organisms including, birds and insects, low persistence in soil renders, low use ratesit a true example of "sustainable innovation for agriculture."

3.2 GC and SDG-3

Chemistry has played an instrumental role in improving health and is critical for well-being as it enables the production of numerous life-saving drugs and medicines.Due to efforts directed by the research community, today we have high quality vaccines, tables and syrups for almost any critical disease, which hashelped in increasing life expectancy. Albeit the remarkable achievements, the dwindling COVID-19 pandemic situation has made us realize that intensive investment is required in the healthcare sector, as there willalways be a need to keep developing drugs that will be effective against a broad range of viruses. All countries have deeply realized that the nation and its economy cannot progress, if the health of the citizens is endangered/riskedthe significance of developing effective treatment for this disease. Millions of people across the globe have already lost their lives and millions still fighting this difficult situation. Attempts are being directed towards exploring promising vaccine for the corona virus and hopefully people will be able to take a sigh of relief soon.

Nevertheless, why GC is critical in reaching this goal (SDG-3)can be readily understood as it is offers diverse tools for meeting the challenges of green manufacturing. The drug manufacturing processes should ensure environmental benignity. The following tools may be useful in this regard:

3.2.1 Green Solvents

GC Principle 5 states "The use of auxiliary substances (eg: solvents, separating agents etc) should be made unnecessary wherever possible and innocuous when used." The pharmaceutical industries employ enormous amounts of solvents in formulating life-saving drugs for dissolution of a broad range of substrates and separation of desired product from unreacted starting materials as well as by-products. Unfortunately, many of the solvents are toxic, volatile, flammable, carcinogenic expensive and synthesized from depleting fossil fuels. Organic solvents are associated with hazardous health effects including eye irritation, headache, allergy etc. The problems associated with the traditional solvents have made it necessary for us to carefully select solvents and preferably substitute it with a safer one. Thus, greener solvents, characterized by low toxicity, ready availability, enhanced efficiency and reusability have attracted significant interest of the academic and industrial researchers.[28]Examples of green solvent include water, ionic liquids, bio-based solvents, supercritical fluids (SCFs) etc.Industries view solvent selection as a crucial component in the complete sustainability profile of any manufacturing process. Thus solvent selection guides have been developed to help the user select a solvent based on health, safety and environmental criteria.[29]

3.2.2 Green Catalysts

According to GC Principle 9 "*Catalytic reagents (as selective as possible) are superior to stoichiometric reagents."*Catalysts are substances employed for accelerating rates of reaction and also enhancing yield as well as selectivity. They are accredited for shaping the modern world and have played a significant role in the generation of blockbuster drugs as well as other pharmaceuticals.

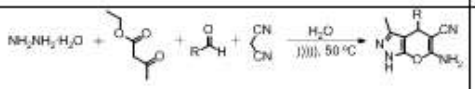
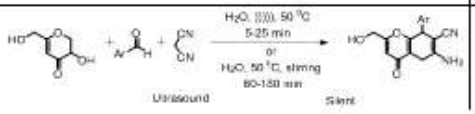
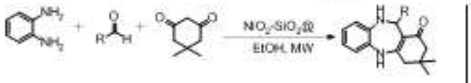
[30]The success stories of drugs such as Letermovir is a perfect example of State-of-the-Art Approaches to Sustainable Commercial Manufacturing Processes in the Pharmaceutical Industry that underwent rapid boost up in terms of yield by more than 60%, reduction in raw material cost by almost 93% by employing a better catalyst.[31]It is well known that the utilization of Pd based catalysts for C-C and C-heteroatom bond formation had completely changed the landscape of organic synthesis and the discoverers of these important coupling reactions had been conferred noble prizes. However, the separation as well as problems associated with metal contamination was a limiting factor for the large scale industrial applicability of these catalysts. Apparently, to overcome the drawbacks, heterogeneous catalysts were developed but these were not active and selective like the homogeneous ones. Thus, it was realized that there is a need to develop a catalyst that can integrate activity, selectivity and recyclability in one platform and such a catalyst would be called a "green catalyst."Now, the biggest question was "*how to design a green catalyst*?" Delightfully a solution was developed that could integrate the key benefits of homo and hetero catalysts, accomplished using heterogenization approach.[32] As per this approach, homogeneous metal complexes are immobilized onto the surface of an appropriate support matrix. Carbon, silica, graphene oxide, titania, zirconia etc have been commonly employed as support materials for the fabrication of heterogenized catalytic systems. With the advent of nanotechnology and nanoscience, nowadays attempts are being directed towards utilizing nanosized support, as they can tremendously boost the catalytic activity owing to larger surface area to volume ratio and also offer prospects of tuning their morphology for controlling catalysis. Consequently, iron oxide nanoparticles[33] and nanosilica[34]have emerged as support matrices of choice.The former one also facilitates ease of catalytic recovery by magnetic attraction.Biocatalysis also presents an interesting example of green catalysis.[35]

3.3.3 Green Energy

As per principle 6, Energy requirements should be recognized for their environmental and economic impacts and should be minimized." This principle simply states that for all processes, we must make efficient use of energy which means the focus should be on designing for energy efficiency. Green Chemistry has contributed towards promoting ways and technologies that can help in minimizing energy consumption required for powering various reactions.[36]**Figure 3** highlights all the green energy sources and their advantages.

Figure 3 Advantages of various green energy sources.

Table 1 projects examples of bioactive molecules possessing potent drug like activity that have been synthesized using safer eco-friendly energy.

Sl.No	Drug containing moeity	Bioactivity exhibited	Energy Source	Schematic Illustration	Ref
1.	Dihydropyrano [2,3c]pyrazoles	Autotaxin inhibition	Ultrasound		37
2.	4-Aryl-4H-chromenes	Potent apoptosis-inducing agents possessing vascular-disrupting activity	Ultrasound		38
3.	Tricyclic benzodiazepine derivatives	The benzodiazepine structure is present in some vital medicines such as diazepam, alprazolam, lorazepam, oxazepametc which have been utilized for treatment of anxiety disorders, alcohol withdrawal symptoms or muscle spasms.	Microwave		39

3.3 GC and SDG-6

The significance of water in sustenance all forms of life on earth is known to everyone.Unfortunately, but by virtue of our own activities we have ended up threatening the quality as well as quantity of water. By 2030, we aim to achieve universal and equitable access to safe and affordable drinking water for all. The contribution of GC in achieving this goal has remained unparalleled.Principles of minimizing waste, using safer solvents and catalysts, increasing energy efficiency, designing for degradation and real time analysis have been applied towards solving water pollution problems.By effective implementation of these principles, we have been able to develop new methods of water purification and lower cost desalination processes. Also, efforts shed in this regard have led to the development of efficient nanomaterials (nanosorbents and nanocatalysts) that have shown promising capability to eradicate/degrade diverse water contaminants such as heavy metals, dyes, drugs, pesticides from wastewater streams.[1]Photocatalytic technologies that rely on the rays of sunlight to drive the degradation of various toxic contaminants have proven to be highly useful in cleaning up of water. Nanosensors have particularly proven their utility in water quality monitoring.

Although considerable work has been carried out in improving water quality via exploration and deployment of greener technologies,[2] yet more research would be required in finding outinnovative methodologies for removal of micropollutants such as microplastics which is a challenging task.

3.4 GC and SDG-7

Green Chemistry has helped enormously in meeting SDG-7 byenabling the development of new renewable energy sources and also made energy efficient in chemical industries. We have discussed briefly in the previous section about the green energy sources. Amongst the various significant contributions of GC, advancement in the design of cleaner fuel technologies has been remarkable. Biomass comprising of plant and animal waste material is being utilized largely for the production of biofuels like biodiesels that provide the much energy fuel source to vehicles for running.[3] As compared to conventional diesels that are derived from fossil fuels which have a limited stock left and are also highly polluting, biodiesels are cleaner fuels and also derived from renewable sources such as vegetable oil producing crops. The transportation sector of many the countries across the world have benefitted from the use of biodiesels, though there are challenges related to cost factor and implementation regulations in countries that undergo drastic climatic changes. Apart from this, energy from sun and wind are also being used for powering a host of processes. These are called as the photochemical and wind energy.

3.5 GC and SDG-9

The chemistry community as a whole can play a powerful role in these three aspects:Industries, Innovation and Infrastructure.[4] The industries can

innovate and tune the existing infrastructure to become more sustainable. In fact, GC has been helpful in accomplishing this goal as theprinciples of green and sustainable chemistry provide the researchers new tools for creation of products and processes that are cleaner, greener, safer and sustainable.

3.6 GC and SDG-12

This goal of responsible production and consumption again has a strong link with GC. There are a few examples of ways which illustrate this fact. GC has fundamentally given birth to the concept of circular economy that enables the practice of reconverting back the waste into precious resource, which has given the industries the much needed outlook and pathway in reducing life cycle impacts of consumption.[5]Materials that can be recycled, biobasedfeedstocks and second generation biofuels are examples of key technologies that have contributed towards SDG-12. However, the task of achieving a stable economy that promotes life cycle is challenging and will require novel business models, products as well as solutions that will that are based on the notion of multiple usage.

3.7GC and SDG-13

GC has also been instrumental towards meeting the goal of climate action. Global warming arising due to increase in level of CO_2 in the atmosphere has raised an alarming situation.To tackle this problem, catalytic CO_2 fixation/capture has emerged as a viable solution.[6] GC has enabled the design of novel catalysts that have shown the phenomenal capability to fix CO_2 and convert it into valuable chemical feedstocks.Apart from this, the development of advanced materials for renewable energy, improvement indisease treatment and production of high-yield seeds and fertilizers for increased food production have proven to be successful in combatting thecritical climate changes.The chemical industrieshavealso started making a paradigm shift towards low-carbon economy by designing products that are helping other sectors in reducing their carbon footprints.

Conclusionand Future Outlook

The framework for the 2030 Agenda of UN Sustainable Development goals was providedto direct the world collectively towards a prosperous, inclusive and environmentally sustainable future. However, with only a very few years left to accomplish the SDGs, the ever increasing perplexities of climatic changes as well as other challenges posed by the current COVID-19 crisis, we have been compelled to revisit the goals with a renewed focus. During these trying times, it is green chemistry that possesses the magic of transformingthese goals into reality. Green Chemistry is the chemistry that is sustainable, the chemistry that respects the boundaries of the planet, a chemistry that is beneficial for all. The modern world which is under the dearth of potent tools to meet the current grievous challenges needs this form of chemistry. In fact, the effective implementation of the fundamental principles of GC have already contributed immensely towards many of the SDGs. Right from water clean-up to improved health care to mitigating the impacts of climate changes to providing solutions for zero hunger to ending poverty to contributing towards better infrastructure, industries, innovation, GC has wondrously made all these possible. The Presidential Green Chemistry Challenge Awards have been conferred to many of the GC innovations also highlight the significance of GC in SDGs.

Although the accomplishments have been promising and worth applauding, yeta lot of efforts need to be directed not just towards innovating through GC,but also changing things at the ends of the supply chain. In particularly, we need to raise awareness amongst the general publicabout the usage of developed goods judiciously. Every consumer must considerit as their responsibility to make best use of the product and subject it to proper disposal methods once the use is over.This way the waste management hierarchy will be followed and we can slowly step towards a sustainable tomorrow that comprises of a healthier and safer planet. Nevertheless, this is just one aspect. There are so many other linked "to do's and not to do's" which must be identified and followed.It is the right time to accept our share of responsibility for reaching the 2030 vision.For this, we need to accept that GC is synonymous to sustainability and hence instead of questioning its capabilities and wasting time, we need towisely adopt it in our practices. Biomimetics, miniaturization, continuous flow techniques and photochemistry are some of the hot areas of GC which can play a significant role in near future in attainment of the SDGs. Fruitful collaborations may also foster the realization of the activities in this direction and have a relevant international impact.

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