EVERYMAN'S SCIENCE

Vol. XLVII No. 2 (June '12 – July '12)

COVER PHOTOGRAPHS

Past General Presidents of ISCA

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Printed and published by Prof. S. S. Katiyar on behalf of Indian Science Congress Association and printed at Seva Mudran, 43, Kailash Bose Street, Kolkata-700 006 and published at Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700 017, with Prof. S. S. Katiyar as Editor.

Annual Subscription : **(6 issues)**

Institutional ₹ 200/- ; Individual ₹ 50/-

Price : ₹ 10/- per issue

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EDITORIAL

SWINE FLU – A SCOURGE OF PAST AND A CONCERN FOR FUTURE

INTRODUCTION

Influenza viruses are viruses which cause mild to severe respiratory infections. They belong to the family *Orthomyxoviridae* and are classified into three types, A, B, and C, based on the variation in the structure of their surface proteins. Influenza A infects many mammals and aquatic birds and is the most common and the most severe pathogen among the three types. Influenza B is almost exclusively a human pathogen, whereas Influenza C causes milder disease and is less common than the other types. Influenza A viruses are further classified into subtypes based on the surface glycoproteins hemagglutinin (1-16 subtypes of HA) and neuraminidase (1-9 subtypes of NA). At a given time, the most common subtypes circulating in human populations are H1N1 and H3N2.

The last century witnessed three Influenza pandemics – the Spanish Flu caused by H1N1 (1918-1920), the Asian Flu caused by H2N2 (1957-1958), and the Hong Kong Flu caused by H3N2 (1968-1969). The first pandemic of the present century was caused by the 2009 H1N1 Influenza A virus, also known as H1N1pdm of the H1N1 subtype. This virus was formerly also known as swine flu as it contains a unique combination of gene segments from human, avian, and segments from the so-called triple reassortant swine viruses that emerged in North American pig populations in the late 1990s. No major Influenza virus activity was reported in pigs when the outbreak was recognized in humans, however, pigs can be experimentally and naturally infected with 2009 H1N1 viruses, resulting in mild respiratory infection.

SPREAD OF PANDEMIC

The 2009 H1N1 Influenza virus first appeared in Mexico in March, 2009, and in California in the United States in April, 2009, and swept the globe with unprecedented speed. The World Health Organization (WHO) declared a "public health emergency of international concern" in April, 2009, and within two months, announced the highest alert level (phase 6, pandemic) in June, 2009, which indicates widespread community transmission in at least two continents. Globally, 214 countries reported H1N1 cases, with more than 18 thousand deaths reported in the pandemic phase. In India, the first case of the H1N1 flu was confirmed in Hyderabad in May, 2009; thereafter cases were detected in other parts of the country. Overall, more than 2 lakh persons were tested for pandemic Influenza A H1N1, and there were more than 50 thousand positive cases and approximately 3 thousand deaths in India. In August, 2010, WHO declared the Post Pandemic Phase and that Influenza A H1N1 ceased to be a public health emergency of International concern. The cases have further decreased in 2011, and presently only sporadic cases of H1N1 are reported from various parts of the world.

CLINICAL FEATURES

The clinical manifestations vary from asymptomatic infection to serious fatal illness. Influenza-like illness (ILI) is defined as a fever of $> 37.8°C$ ($> 100°F$) plus cough and/or sore throat in the absence of any cause other than Influenza. Most cases of 2009 H1N1 infection presented as mild upper respiratory tract illness, however, in some instances, the disease progresses in severity resulting in multi-organ failure, respiratory failure, acute respiratory distress symptoms (ARDS), and sometimes death. Pathological findings include diffuse alveolar damage, hemorrhagic interstitial pneumonitis, and peribronchiolar and perivascular lymphocytic infiltrates. The risk of severe disease increases with underlying chronic conditions such as asthma, autoimmune diseases, cardiovascular diseases, diabetes, and obesity.

DIAGNOSIS

For diagnosis of Influenza, specimens like nasopharyngeal swab with synthetic tip (polyester or dacron), nasal wash, bronchoalveolar lavage (BAL) or endotracheal aspirate can be collected. All diagnostic laboratory work on samples from suspected patients should be done in a biosafety level 2 (BSL-2) laboratory. The gold standard for laboratory diagnosis of the 2009 H1N1 Influenza is the real-time reverse transcriptase polymerase chain reaction (rRT-PCR) test, which is tailored to the specific detection of this virus. A single step rRT-PCR approach targeting the matrix gene of the Influenza A/H1N1pdm was designed by CDC and is used worldwide. A number of other diagnostic tests are also available, but they differ in their sensitivity and specificity. Rapid diagnostic tests have high specificity but variable sensitivity. Isolation of the virus in cell culture or embryonated eggs is diagnostic, but it may not yield timely results.

Other nucleic acid amplification techniques have also been evaluated, amongst which, Loop-mediated isothermal amplification (LAMP) is a specific, efficient and rapid technique that is similar to PCR amplification but the DNA amplification is performed under isothermal conditions. A one-step, single-tube LAMP assay for clinical diagnosis of H1N1 Influenza virus was found to be tenfold more sensitive than the WHO approved rRT-PCR with the advantage of naked-eye visualization of gene amplification by means of SYBR Green I dye within 30 minutes compared to 2 to 3 hours for a rRT-PCR. Other newer techniques which have been used include Nucleic acid sequencing-based amplification (NASBA) which is a suitable and robust alternative technique for field Influenza A virus surveillance, and Pyrosequencing, which can be used for genotyping and sequencing disease genes. Pyrosequencing, combined with RT-PCR techniques, has provided rapid, high-throughput and cost-effective screening of NA inhibitor-resistant Influenza A viruses.

MANAGEMENT

A majority of patients infected with the H1N1pdm Influenza A virus can be treated with simple supportive care at home using antipyretics (e.g. acetaminophen or ibuprofen). Antiviral therapy should be started empirically as soon as possible for persons with suspected probable or confirmed Influenza and illness requiring hospitalization; progressive, severe or complicated illness regardless of previous health status; and/or high risk for severe disease. The virus can be treated with neuraminidase inhibitors like oseltamivir and zanamivir, but is resistant to ion channel inhibitors like amantadine and rimantadine. Oseltamivir resistance has now been reported, both in oseltamivir-treated and -untreated individuals. Also, in contrast to 2009 H1N1 viruses a majority of seasonal H1N1 viruses are now resistant to oseltamivir. A concern therefore exists that in future these pandemic viruses may acquire this resistance trait through mutation.

VACCINES

The CDC recommends annual flu vaccination for all but infants less than 6 months of age, with an even stronger recommendation for high-risk groups, i.e., children, pregnant women, patients with comorbidities, morbid obesity, and the elderly. Several candidate vaccines were developed in which the HA and NA genes of A/California/07/2009 virus were combined with the remaining genes of A/Puerto Rico/8/34 (H1N1) virus, the virus commonly used for human Influenza vaccine production, and the first vaccines against 2009 H1N1 viruses were approved in September of 2009. Vaccine safety has been monitored closely and the percentage of serious adverse reactions was similar to that observed with seasonal Influenza vaccines. A particular focus has been on cases of Guillian-Barré syndrome (GBS), a neurologic disease that occurred at a higher incidence with earlier H1N1 vaccines, and currently there is no indication that there were increased number of cases of GBS with 2009 H1N1 vaccine as compared to the seasonal Influenza vaccines.

CONCLUSION

The recent pandemic of the swine-origin H1N1 Influenza A virus and the continuing circulation of highly pathogenic avian H5N1 Influenza A virus stress the need for rapid and accurate identification of Influenza viruses for surveillance, outbreak management, diagnosis and treatment. Much has been learnt about the evolution of this virus; however, it is still not possible to predict when the next pandemic will occur and which virus will be responsible. Hence, an improved surveillance at both national and international levels in humans as well as swine and avian hosts appears to be crucial for early detection and prevention of future Influenza pandemics.

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> ***"No amount of experimentation can ever prove me right; a single experiment can prove me wrong."***
>
> ***— Albert Einstein***

PRESIDENTIAL ADDRESS

SCIENCE AND TECHNOLOGY IN INDIA : PRESENT AND FUTURE

PROF. (MRS.) A. CHATTERJEE, D.Sc., F.N.A.

Madam Prime Minister, distinguished delegates and Members of the Indian Science Congress, Ladies and Gentlemen :

I am much beholden to my colleagues, friends and well-wishers for the honour they have conferred on me by electing me President of this Congress. While it is a great privilege to serve the scientists of the country, knowing my limitations as I do as a humble co-worker of yours, I feel hesitant to present an address worthy of the Institution on the occasion of this august gathering. This feeling sharpens all the more when I recall the distinguished men of Science, including my most venerable teacher, Acharya Prafulla Chandra Ray who in the past had addressed the Annual Session of the Science Congress.

Since the last meeting of the Congress in January, 1974, we have lost two of our most distinguished past Presidents, Professor S. N. Bose and Dr. A. Lakshmarmvami Mudaliar. Professor Bose died in early February last year. He was the greatest of the theoretical physicists of our times and a pioneer in many ways in India and presided at the 1944 session of the Science Congress in this city. Dr. Mudaliar was a distinguished gynaecologist of the country and made unique contributions to advancement of Science and education. He passed away in April last. He also presided over the Science Congress held at this campus in 1959. We pay our homage to the memory of these two great men of Science and education.

We are most grateful to Shrimati Indira Gandhi as she has honoured us and Indian Science Congress by her presence here today and has given us her inspiring Inaugural Address despite an unusually heavy call on her time. We would also recall in this connection how that great patron of Science and lover of humanity, late Shri Jawaharlal Nehru, father of our beloved Prime Minister, laid the foundation of scientific development in the independent India and provided inspiration to the nation as its guide and counsellor, much above the position he held as Prime Minister. It would look like a coincidence that it was at the last Delhi Session of the Science Congress held in October, 1963, that Nehru delivered his last Inaugural Address before he passed away in May, following. I could not help quoting from what he said at the above Congress about the role of Indian Scientists, "Scientists in India have a double role to play. They should on the one hand contribute to general development and thinking in the world, and on the other help in solving problems of the country. Both are important and vital things. While India would welcome help and expert advice from outside in the important task of scientific advance people should learn to rely on themselves as far as possible. The first objective it seems to me, from my point of view and more specially from the point of view of Science is to help in building of a free and self-reliant India," As a matter of fact, we all are now

* General President, 62nd Indian Science Congress held during January, 1975 at Delhi.

engaged in the nation-wide endeavour to achieve self-reliance. Total self-reliance in Science and technology may not be achieved, because, scientific and technological advancement is so rapid that discoveries and innovations of today are becoming out-dated tomorrow. But for the developing country like ours, with the added problem of an enormously rising population the goal of achieving a self-reliant economy calls for utmost capability of developing, absorbing or adapting advanced technologies imported from abroad to Indian conditions.

Fortunately for the country, under the inspiring leadership of Jawaharlal Nehru, the Indian Parliament adopted a Scientific Policy Resolution in 1958 with a view to developing Science and technology as an integral part of national endeavour. Earlier, the Government of India had set up a chain of national laboratories, technological institutes, research and development organisations, established increased research facilities at universities and also helped to set up a larger number of universities including a number of IITs, founded a number of basic industries and adopted other measures to provide for a firm infrastructure for scientific and technological advancement.

Thanks to the foresight of Nehru again who initiated the earliest possible steps in India almost with the dawn of independence, to develop atomic energy for peaceful purposes. India is now among the world's handful of countries which have been successful in finding newer dimensions of this wonder of atom. The objective of establishing research facilities for atomic energy was explained by Nehru at the Session of the Science Congress held in Delhi on the eve of Independence in January, 1947. He observed during the Presidential address, "I know how difficult it is for a line to be drawn between scientific work for peace and for war. This great force—atomic energy that has suddenly come through scientific research may be used for war or may be used for peace. We cannot neglect it because it might be used for war; obviously in India we want to develop it, and we will develop it to the fullest. Fortunately, we have eminent scientists here who can do so. We shall develop it, I hope, in cooperation with the rest of the world, and for peaceful purposes", By acquiring the capability of exploding the nuclear device, our scientists have taken a big step forward in sophisticated technology. This advancement now opens up newer vistas for exploring possibilities of utilising atomic energy for the peaceful purposes of regenerating the economic structure of the nation, Though further progress may be a little time-consuming, the possibilities of getting the country out of woods now seem nearer than ever before.

SCIENCE AND TECHNOLOGY *VIS-A-VIS* OUR PROBLEMS

It would be appropriate in this connection to discuss the progress of Science and technology in India and their scope in furthering the cause of national economy of the country. This is a crucial year considering the commencement of the Fifth Plan period, Four plan periods are over. From the assessment of the progress of Science and technology it has now been revealed that much work on fundamental research has been done. But much emphasis has not been given on applied research. It has also been revealed that fruitful results obtained in various research centres including universities have not been utilised through proper organisations. For this purpose a committee (National Committee of Science and Technology) [N.C.S.T] has been founded by the Government of India to coordinate the activities of all the research organisations (the Council of Scientific and Industrial Research (C.S.I.R), Indian Council of Medical Research (I.C.M.R), Indian Council of Agricultural Research (I.C.A.R), Defence and development Organisation, University Grants Commission (U.G.C), Electronics Commission, Atomic Energy Commission and Department of Space, and other leading research organisations) with a view to implementing National Policy decisions and steering the research in proper direction to meet the immediate needs of our country with a population of 563 millions.

It is, therefore, necessary to programme the integrated development of our scientific and technological resources in achieving the national objective of providing the basic minimum needs of the common man such as food, clothing, housing, health including protection from environmental pollution, education, water-supply, communication and adequate employment opportunities, development of self-reliance, reduction of import of technology and the maximisation of returns from the existing investments in Science and technology. The N.C.S.T. has undertaken to work out properly these exercises and to cover a wide spectrum in the evaluation and development of our natural resources (such as minerals, water, land, soil and forests) through proper machinery and also to develop medical research and research on material Science.

SCIENTIFIC WAY OF THINKING

However, to develop Science end technology for ensuring the growth of a sound economy and prosperity of the country the students are to be made conscientious school levels about the theory and applications of Science and technology in a simple manner mostly through experimentations, scientific films, popular lectures on Science, Science museums audio-visual programmes and hobby centres. These efforts will catalyse in accentuating the development of the originalities and scientific potentialities and genius lying dormant in the youngsters. In future, these talented scientists will be the assets of India in her scientific and technological pursuits and developments. The Central and State organisations as well as the private sectors must come forward to help the future generation particularly when India is being beset with economic and social problems. This scientific way of thinking, if properly cultivated, would help secure for the people of the country all the benefits of progress in Science and technology. But dissemination of scientific knowledge must not be limited to urban areas. It should be extended also to people in villages in an effective manner. In this field the Indian Science Congresss could play an effective role as well. More wide-spread and systematic dissemination of scientific information is sure to educate public opinion.

UNIVERSITY THE BAROMETER OF SCIENCE AND TECHNOLOGY

The university constitutes the platform wherefrom our younger talents will have their final training. But it is the general impression that much care is hardly taken for the applied research in the universities. Being a University teacher may I say that it is not entirely correct. It is a fact that our universities are mainly interested in the development of fundamental Science, but no one can deny that applied research is the outcome of the fundamental Science. Let me cite an example of what could be the dimension of use which a piece of research in fundamental Science could lead to. When Michael Faraday demonstrated his famous experiment that when a magnet is brought suddenly near a coil of wire, a current of electricity is produced in the wire, its utility was questioned even by that scholar and statesman, Mr. Gladstone, who could not help asking him, "After all, of what use is it ?" Faraday did not take a moment to reply, "There is every chance that you would soon be able to impose a tax on it". Faraday proved prophetic, and today no Finance Minister could afford to neglect the revenue obtained directly or indirectly through taxing this great energy — electricity.

UNIVERSITY TRAINING (TEACHING AND RESEARCH)

Since the universities are the backbone of scientific and technological training and the university research still forms the "spear-head" of scientific progress and provides a reasonably good barometer to the standard of Science and technology in the country, the universities should receive the high national priority. In a developing country like India, the strengthening of the universities is of paramount importance, The experience of more than a century has already proved that teaching and research flourish in combination but in isolation they wither. The best of either is achieved in an environment where both are cultivated pari passu. In this combination of teaching and research, education and discoveries, lies the real strength of the universities. If research in these academic institutions is poor and neglected, research outside these centres cannot flourish for any length of time. It has been said that a research institution, no matter—under what auspices, will seldom last a generation as a creative enterprise, if it has no continuing (effective) contacts with young research students, This underscores the central role of university research in national development, and the extreme importance of close links between universities and research institutions including the National Laboratories and Industries,

In this context, the progress in Japan is noteworthy. During the past decade the Japanese Government spent on the State Universities half of its total budget for research and development. The total R and D budget for 1972 was 374 million yen. This greatly enlarged the capabilities of the universities to train high quality scientists and engineers and to deal with new scientific development relevant to the industrial growth of Japan. The R and D policy of Japan is now undergoing a major shift in emphasis from economic growth to social welfare in the light of the adverse effects of unchecked industrial growth.

The Fifth Five Year Plan (1974-1979) document in India recognizes that in the past, research in the universities, though crucial for national development and self-reliance, received only a "meagre support". The Fifth Plan provides for an outlay (Plan and Non-Plan) on Science and Technology of Rs. 1568 crores, as against Rs. 376 crores in the Fourth Plan. The total outlay envisaged for the Fifth Plain is Rs. 53,411 crores.

The fund for Science and technology outlay is nearly three per cent of the total Fifth Plan. The information available shows that Rs. 54 crores has been earmarked for R and D work in the universities and IITs (about Rs. 9 crores for IITs and an amount of Rs. 20 crores in the universities) for the projects identified by the N.C.S.T. It is apparent that the universities do not receive the emphasis that they ought to. I feel, more funds should be allocated here for R and D work to give incentives particularly to younger scientists. As already mentioned that the forum for the advanced training in Science and technology is mainly the universities, it is desirable to maintain there good standard of teaching and research. So we need at the university level teachers of high standard who know the body of facts that Science has discovered and organised and also recognise the important difference between merely transmitting the facts of Science and instilling in their pupils an awareness of their significance — a rare skill which requires deep insights into and a high degree of competence in the arts of communication. To attain it, University authorities have to attract high calibre educators to the teaching profession with better pay scale and should provide them with adequate scope and facilities for teaching and research. It is also necessary to appoint adequate staff to get a working formula of students: teachers ratio. It will help to produce the kind of young scientists and technologists who will boost up India's Industrial output and economy.

EMPLOYMENT OF SCIENCE GRADUATES

At present the universities are producing a large number of Science graduates. But the employment of Science graduates of our country is now facing a grave situation. Two decades ago, it was thought that unless the country was prepared to expand higher education continued economic growth was unlikely. With the expansion of higher education, there has been a surplus of Science graduates who are not being provided with suitable jobs. It points to the fact that we have combined a maximum opportunity in the past with a maximum of expectation in the present and depressing amounts of opportunity in the future. This can lead all too easily to disappointment, disenchantment, frustration and even resentment amongst some of our ablest young citizens. This is not only a problem of our students but will become a problem for society. Disappointment may well be unavoidable. Resentment impinges on society and can and ought to be minimised. The effect of increasing the number of graduates will simply lead to more and more sub-professional jobs. The leaders of the country should give serious thoughts about these matters. The course taught to them should be broad and contains elements of all the major thoughts and value systems. It should include some study of our cultural, literary and artistic heritage, of the treasures of Nature (natural resources) in the country, some of the methods and insights of the social science, some of the concepts of pure Science, and some study of the present and likely future impacts and achievements of technology. The ultimate aim of a course of this nature is flexibility. This will impart realistic attitudes to our graduates.

NEED FOR TECHNICIANS

To bring scientists, technologists and industrial accountants and other experts together in teams is necsssary for productive research and for evolving newer technologies. Also, for utilisation of these technologies, facilities for turning out efficient technicians would have to be arranged. Here I am reminded of Lord Todd who observed in his Presidential Address at the meeting of the British Association for the Advancement of Science held in September, 1971, "Whatever system of education is finally adopted, I hope we will bear in mind that we need more technicians than scientists and technologists. If we train too many of the latter, then many of them will have to follow the career of technicians, for which their training was not designed and which they will tend to regard as inferior. The result will be a frustrated white collar class with all the dangers to society that such a class implies". Though Lord Todd dwelt on this in the context of the situation prevailing in the United Kingdom, the same could be held applicable to India now. Our country has a big contingent of unemployed engineers and scientists; still for skilled labour we depend too much on what is available almost spontaneously through different industrial establishments. Though a good number of technical training institutes exist all over the country, very few have the facilities for practical training in factories and workshops of the industries as such. If facilities for the training of technicians could be expanded and reoriented we can employ the engineers and scientists for the purpose for which they are meant.

RETURN ON INVESTMENT

Some distinguished persons including our Prime Minister have often mentioned about the return on the fairly large investment made by India in Science and technology since Independence, while the scientists at large have continued to plead for larger and larger allocation for science and technology. If after two decades and a half during which period, investments in Science and technology have risen enormously as envisaged in the Fifth Plan, and the country has yet to depend (on foreign technical know-how in many vital sectors of economy, the appropriateness of people's doubt on the results of investment is self-evident. A good part of such doubt in respect of the utility of investing so large a chunk of revenue on Science and technology has of course disappeared with the progress made in researches relating to atomic energy; but as far as achievement of success in evolving new industrial processes is concerned, considerable unhappiness continues to prevail. But progress in Science could hardly be measured in concrete terms only in relation to what has been achieved in the growth of industries. There is no dearth of talents nor lack of endeavours on the part of researchers to contribute their mite. If results have not been up to expectation that could be traced to some deficiency in the organisations they serve. This would however call for deeper study with a view to setting things right.

The very relevance of scientific pursuit as well as education is now being questioned; there is a creeping fear as to where Science and technology are taking the people to. The critical attitude of the students also is manifest in their demand that their studies should be relevant. This unrest of students is an outward manifestation of their critical attitude and is not confined to India alone. But the discontent of the younger people is not due to any lack of their respect for Science : rather Science is receiving a sort of extreme respect which could better be described as fear. The spectre of unemployment is no doubt a drag on their ability to devote to study; but that is not the sole reason for the general display of anger. Because even in the more advanced countries where absence of employments is not so common, and the unemployed receive financial support from the respective governments, the percentage of agitating students for one reason or other is also on the increase. The conclusion becomes irresistible that the majority of students have developed a tendency to turn to easier and softer methods of study, and the chain consequential reaction has followed in the shape of increasing discontent.

For such state of affairs we teachers are no less responsible. If Science has to be taught to a disciplined mind, the teacher too, needs to be equally or more disciplined, and it is time that teachers ask themselves if something is not lacking in them to affect directly or indirectly the mental attitude of students. It is the students of today who will be the builders of the nation tomorrow. So frustration and disappointment with learning should not be allowed to have a grip on them otherwise no plan or policy for Science and economic development will succeed.

The possible remedy lies in explaining "more clearly the relevance of Science and reason to the problems which are of most concern today", as emphasised in a lecture delivered by Sir George Porter at the Diamond Jubilee Session of the Science Congress in Chandigarh in January, 1973.

The endeavour of scientists, teachers, and all those who in one way or other are engaged in the pursuit of science, should be to help not only the students but also the people at large, to understand the value of such pursuit. The facts of history and also the requirements of scientific progress will point to the supreme need for promoting the public understanding of Science. The success of this effort will depend on our sincerity and zeal as also the depth of team spirit with which we would address ourselves to this enlightening task.

RESEARCH AREAS TO BE FURTHER DEVELOPED AND UTILISATION OF NATURAL RESOURCES

As an organic chemist I would like to say a few words on Pharmaceutical and Drug research in India in which field we have been working for more than three decades. Research in this area can be divided into two main aspects :

1. Research on some basic problems involving the biochemistry and the mechanism of drug action, and
2. Research directly oriented towards the discovery and development of new drugs.

It is suggested that future financial assistance for pharmaceutical and drug research should be mainly confined to the following areas, since these are directly connected either with the current needs of a country or are topics of current international research.

Mechanism of drug action, physico-chemical aspects of formulation, transport, turnover and metabolism of drugs, development of drug delivery systems, quantitative studies of structure-action relationship using regression analysis, biologically active substances (from the plant world, and animal kingdom, including marine flora and fauna), insect hormones, steroids and polypeptides. Drug research has become an extremely sophisticated operation involving huge expenditure and the screening of enormous compounds in an exhaustive manner Consequently priorities should be determined in areas which are of great interest to India. Such areas include development of new anti-fertility agents and devices, anti helminthic, anti-protozoal, anti-leprotic and anti-viral agents, anti-cancer and anti-microbial agents, drugs for deficiency diseases, collagen and connective tissue disorders, arthritic conditions, senile dementia and mental ill-health. So disease-oriented research backed by judiciously chosen screening programme is necessary, Interdisciplinary research in these fields will lead to a remarkable progress in the development of synthetic and natural drugs with the maximum utilisation of natural resources.

In 1928 Professor Simonsen in course of his Presidential Address at the Indian Science Congress suggested that the chemists of India should study more intensively the wealth of natural materials that lay at their doors and devote less time to the study of problems of only theoretical interest. Within four and a half decades since Professor Simonsen made this fervent appeal, the chemists of India, particularly the phytochemists, have made many important contributions in this field. In very broad outlines, it may be stated that these investigations have embraced the isolation, the determination of the constitution, and in some cases, the synthesis of a large variety of terpciuids, various hetcrocycles, including Alkaloids, glucosides, cardenolides, plant colouring matters and antibiotics. Many of them are used commercially and others are utilised by their chemical transformation into useful products.

In the limited time at my disposal it is not possible to refer to all the investigations in this field; but Professor Simonsen's appeal from this chair is now paying much dividend.

Another area which needs effort for extensive development is the chemical engineering and industry. It covers a wide range of industries from the giant petro-chemical and fertilizer complexes to small sector industries. One of the vital areas in the development of chemical engineering and industry in India is in respect of petrochemicals, bulk organic chemicals, polymers and elastomers. This will cover the utilisation of downstream products of the petrochemical complexes to produce a variety of chemicals used in the polymers, agricultural, dyes, pharmaceutical and other industries.

POWER DEVELOPMENT

For successful implementation of the Science and technology plan, power development is essential, but we live in an age of energy crisis which is to be solved.

For the foreseeable future, electricity will continue to be the largest source of power and one of the largest consumers of fuel. The inadequacy of R and D activities in the field of this power development is to be compensated.

Sources of nuclear energy are also to be fully explored on which we have made substantial R and D investments already over the last twenty years.

It is now apprehended coal and oil may be exhausted in future. Thereby alternative sources of energy like solar, tidal, wind, chemical and geo-thermal etc, will have to be assessed. Much thoughts are being given in this direction by our scientists and technologists.

SCIENCE AND HUMANISM

However, all efforts to develop Science and technology will be futile if human implications of Science are not given due consideration.

Both science and technology are so much a part of the cultural, economic, social and political affairs of all modem nations that lack of understanding can have foolish, if not dangerous, consequences leading to unmitigated disaster. On the other hand the future holds great promise, if science is pursued with dedication and technology is wisely used in the true interests of the community, and not for narrow sectional ends dictated by selfishness and mistrust. This needs the amalgamation of science with humanism. The scientific community has a vital role to play in this matter, the first imperative being to promote its varied aspects at national and international levels of the human implications of Science, To be more explicit, the aim of Science and technology is not only to meet the materialistic needs of the country but also to create a better world with higher objectives and with a conception of global community. The time has come for nations to act in this vision. This is not a difficult task if the nations are really keen to realise the truth that the "World is one, in fact and in potentia" and if they could have the perception of the unity amidst diversity, a harmony amidst chaos and if they are prepared to listen to the note of concord throughout the discordant sounds in this universe. Such perception comes from the microcosmic mind provided it is in perfect harmony with the macrocosm (external). Knowledge on this cosmology will help science and technology to achieve the higher objectives when peace will be showered on earth and the whole universe as a single entity will begin to shine in its own glory. Madam Prime Minister, Ladies and Gentlemen, let me conclude with the song of Tagore:

"Where knowledge is free;
Where the world has not been broken up
into fragments by narrow domestic walls;
Where words come out from the depth of truth;
Where tireless striving stretches its
arms towards perfection;
Where the clear stream of reason has not lost its way
Into the dreary desert sand of dead habit
Unto that Heaven of Freedom,
my Father, let my country awake".

May we all join in this quest for such a Heaven of Truth and Freedom.

IRRADIATION IN POST HARVEST MANAGEMENT OF VEGETABLES

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Vegetables are highly perishable commodities, where the post harvest losses are greater ranging from 20-30% of the produce. Protection of vegetables against losses due to insect infection, harmful micro-organisms and other spoilage agents is a challenge to mankind. Prevention of food losses is being given high priority during present days, in India as well as world over. The aim is to provide the safe foods to the consumers and minimize food losses due to spoilage. Different techniques are being used for decreasing post harvest losses of vegetables. One of the latest techniques is Irradiation. Being an effective and environment friendly technology, it can supplement or replace some of our traditional food processing technologies for safeguarding our harvests and for hygienization of vegetables.

INTRODUCTION

Ever increasing need of food for growing population has posed challenge for civilization. Moreover, integration of global economies has led to a rapid increase in international food trade. But limited arable land has contributed a wide gap between world food requirements & food production. Vegetables have high nutritive value (also called as protective food) along with high productivity in terms of per unit time and space. So, one of the solutions to increase the availability of food may be to move towards more vegetable production. But here too the way is not so easy due to high post harvest losses. Vegetables are highly perishable commodities, where the post harvest losses are greater ranging from 20-30% of the produce.

Protection of vegetables against losses due to insect infection, harmful microorganisms and other spoilage agents is a challenge to mankind. Reduction in food losses is being given high priority during present days, in India as well as world over. The aim is to provide the safe foods to the consumers and minimize food losses due to spoilage. Different techniques are being used for decreasing post harvest losses of vegetables. One of the latest techniques is Irradiation.

Irradiation denotes the exposure of a material to short wave energy from ionizing radiations such as gamma rays, electrons and X-rays to achieve a specific purpose such as extension of shelf life, insect disinfestations and elimination of food borne pathogen and parasitism. In comparison with heat or chemical treatment irradiation is considered a more effective and appropriate technology to destroy food borne pathogens. Irradiation is a physical process, which can be used to disinfest, sterilize and preserve vegetables. Mostly vegetables can be irradiated wet, dry, thawed or frozen. So it is a necessary tool for increasing availability of vegetables in addition to increasing production and productivity of vegetable crops. Major functions achieved by irradiation are disinfestations of insect pests in stored vegetables and spices, destruction of

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microbes responsible for spoilage, inhibition of sprouting of tubers and bulbs, extension of shelf life in vegetable crops, sterilisation of vegetable crops, decontamination, delay ripening, inhibition of sprouting. Irradiation offers a number of advantages to producers, processors, retailers and consumers.

Advantages

(1) Irradiation doesn't leave any harmful /toxic residues.

(2) Irradiation is a physical process and can be used to pasteurise and sterilize fruits, vegetables and spices.

(3) Irradiation is a cold process and does not cause changes in freshness and texture unlike heat.

(4) It can be used to treat the products packed in heat sensitive packaging material.

(5) Gamma irradiation has a high penetration power therefore it is more useful to destroy the insect pests hidden inside the vegetables and spices.

(6) Irradiation is safe for quarantine restrictions in international trades.

(7) Irradiation is an effective substitute for chemical fumigants used against fruit flies.

Though this technology has many advantages at the same time it has many limitations also :

Disadvantages

(1) Irradiation doesn't leave any identification markers, which can be used for detection of radiation treated products.

(2) Irradiation process require strict adherence to safety procedures.

(3) Lack of proper information about the irradiation process has developed the misconception among people towards the irradiation products.

(4) Not easily availability of irradiation facility.

(5) Requires periodic replacement of decayed Gamma irradiation source.

PROCESS & SOURCES OF IRRADIATION

The irradiation process involves passing of vegetables through a radiation field allowing it to absorb desired radiation energy. The vegetable itself never comes in contact with the radioactive material.

Three types of ionising radiation can be used for the treatment of vegetables; Gamma rays from ^{60}Co or ^{137}Ce, X-rays generated from machine sources operated at a maximum energy of 5 Mev, Electrons generated from machine source at a maximum energy of 10 Mev. Gamma rays produce electromagnetic radiation of very short wavelength, which is mostly used for irradiation of vegetables.

APPLICATION OF GAMMA RADIATION

Gamma rays penetrate deep inside the solid particles and produce ions (electrically charged particles). The ions, produced by such radiation can affect the normal biological processes. Microorganisms and insects present in vegetables are killed by direct & indirect effect of radiation on DNA molecules and cell structure. The bonds of DNA molecules are either broken directly by radiation energy or by reactive radicals such as OH^-, H^+, H_2O_2 etc. which are produced by the interaction of radiation energy with water. Although electron beam is much safer than gamma rays but its penetration is very low (only 3 inches deep). Further more, low dose radiation process doesn't eliminate all the bacteria and fungi. But, it does slow the normal enzymatic action, which retard the nutritional degradation and results in extended shelf life of the produce. At higher dose of radiation, all microorganisms are killed thus sterilizing the vegetables.

MECHANISM OF IRRADIATION

The preservative characteristics of ionizing radiations are due to both the primary and secondary effects resulting from interaction of radiations with molecules and microorganisms, present in vegetables. The incident radiation interacts with the atoms and molecules present in the vegetable and cause ejection of electrons. This leads to ionizations and dissociation. The ejected electrons cause further excitation of molecules present in the vegetable[4,12].

EFFECT OF IRRADIATION ON NUTRITION & QUALITY OF VEGETABLES

In general, macronutrient (protein, lipid, and carbohydrate) quality does not suffer due to irradiation and minerals have also been shown to remain stable[1,13,14]. Studies have shown that the macronutrients such as proteins, carbohydrates and fat are quite stable to the doses up to 10 kGy[16]. There is much concern over the effect of irradiation on other micronutrients, especially vitamins.

Effect on carbohydrates

The changes in carbohydrate on irradiation depend on the dose and conditions under which vegetables are irradiated. Under dry conditions of irradiation, carbohydrates undergo changes in melting point, optical rotation, absorption spectra, etc. Chemical changes in aqueous solution increase linearly with the radiation dose. The concentration of carbonyls and H_2O_2 formed with irradiated glucose are found to increase with dose.

Effect on proteins

Direct or primary action of radiation plays an important role in dry state of protein. In the aqueous state, indirect actions are more important. A large proportion of radiation energy goes into denaturation of proteins. It has been demonstrated that the changes produced due to irradiation are practically negligible up to the doses of 10 kGy. At doses permitted for vegetable irradiation, enzymes are not inactivated.

Effect on lipids

On irradiation, cleavage occurs mainly at –COO site or at double bonds. Products mainly produced are CO_2, CO, H_2, hydrocarbons, and carbonyls. In presence of oxygen, the free radicals may form hydroperoxides, which yield a number of products. Radiolytic products of water do not play a major role in the degradation of lipids as these are insoluble in water.

Effect on vitamins

Radiolytic degradation of vitamins generally occurs due to their reaction with free radicals. Generally, fat soluble vitamins such as A, D and E react with radicals produced by direct action of radiation on lipids. Water soluble vitamin such as B_1, ascorbic acid etc. are exposed to radiolytic products of water, where secondary effects of radiation play a dominant role. In most studies, vitamins have been shown to retain substantial levels of activity after irradiation. Vitamins A, C, and E are more sensitive and are thereby reduced at higher doses of irradiation, even though these losses are often similar to those occurring with thermal processing. Vitamin E is the most sensitive of the fat-soluble vitamins with significant losses (50%) occurring when irradiated in the presence of oxygen. When oxygen is excluded or vacuum packaging is used, the losses are less than 10 per cent[2]. Significant losses occur in vegetables (vitamin C) treated with high doses[15]. However, these findings are irrelevant because high-dose radiation is not used for such products. The changes in vitamin C content of five potato cultivars subjected to gamma irradiation (100 Gy) to control sprout inhibition were compared with nonirradiated control tubers during storage at 27-32°C (ambient temperature) and 15°C, and also with control tubers stored at 2– 4°C the commercial cold storage temperature. During the first two months vitamin C levels were lower in irradiated potatoes stored at 15°C than in the controls stored at 2–4°C, but were subsequently higher[17] . Potatoes irradiated with doses of 0.1 kGy and stored for six months, registered 50% losses in pro-vitamin A (β-carotene) contents[18]. Thiamine (vitamin B_1) has been shown to be the most vulnerable to radiation and is therefore used to demonstrate "worst-case" results[3]. United States Food and Drug Administration (FDA) concluded that the effects of irradiation processing on nutrient quality are similar to those of conventional food-processing methods.

DOSES OF IRRADIATION

Irradiation doses have been categorized as low, medium and high depending on the amount of energy to which a food product is exposed.

Low dose

An irradiation dose up to 1 kGy classified as low. It is used for sprout inhibition in bulbs and tubers, insect disinfestations and elimination of food borne parasites.

Medium dose

An irradiation dose of 1-10 kGy is classified as medium. It is used for reduction of microbes in vegetables & spices to improve hygiene, extension of shelf life, reduction of microbial load, and improvement in technological properties of vegetable crops.

High dose

An irradiation dose of 10-70 kGy is classified as high. It is used for commercial sterilization, elimination of viruses and sterilization of packaged vegetable products which are shelf-stable without refrigeration

Table 1. Vegetables, irradiation dose and the purpose as approved by Govt. of India[4]

S. No.	Name of vegetable	Irradiation dose (kGy)		Purpose
		Min.	Max	
1.	Onion	0.03	0.09	Sprout Inhibition, extend shelf-life and reduce post harvest losses
2.	Potatoes	0.05	0.15	Sprout Inhibition, extend shelf-life and reduce post harvest losses
3.	Spices	6.0	14.0	Microbial decontamination and insect disinfestations[5]
4.	Ginger	0.03	0.15	Sprout Inhibition, extend shelf-life and reduce post harvest losses
5.	Garlic	0.03	0.15	Sprout Inhibition[7]
6.	Shallots (small onion)	0.03	0.15	Sprout Inhibition, extend shelf-life and reduce post harvest losses
7.	Carrot	1.0	2.0	Delayed senescence
8.	Asparagus	1.0	2.0	Increase shelf life[6]
9.	Chayote	0.03	0.15	Increase shelf life[9]
10.	Pepper	1.0	1.46	Increase shelf life[8]

BENEFICIAL USES OF IRRADIATION

Decontamination of spices

India is the largest producer, consumer and exporter country of spices in the world. Spices are valued for their distinctive flavours, colours and aromas. Unfortunately, they are often contaminated with large number of bacteria, moulds and yeasts. Irradiation is an effective tool for control of microbes and other living organisms present in spices. At a minimum dose of 5 kGy, bacteria, yeasts and moulds are killed. A dose of 5-10 kGy results in an immediate reduction of minimum 2-3 log cycles of bacteria. Storage further enhances the effect because injured cells are unable to repair and die off during storage. At a dose between 7.5-15 kGy, the sensory properties of most of the spices are well maintained. At doses required to control microbial contamination, insects and other pests will also be killed in all the life stages.

Sprout inhibition in onion and garlic

Traditionally onion and garlic are stored under ambient conditions in sheds, *chawls* etc. During prolonged storage, losses occur due to sprouting, dessication and microbial rottage. Low ambient temperature and high humidity during rainy season promote sprouting. By improving the ventilation, losses through microbial spoilage can be reduced but sprouting continues. Sprouted bulbs shrivel faster due to increased water loss by transpiration. The reserve food substances present in the fleshy scales are used up for the sprout growth which ultimately render the bulbs unfit for consumption. Irradiation at very low dose levels i.e. 60-90 Gy inhibits sprouting when properly cured bulbs are irradiated within 2-3 weeks of harvesting. Any further delay between harvest and irradiation may not result in good sprout control or may lead to a transient stimulation for sprouting. Post irradiation storage environment, particularly cooler temperature (4-20° C) or high humidity (> 85%) may promote transient increase in sprouting. Although these sprouts wither-off during subsequent storage, the dead sprouts can be a source of fungal infection and may lead to rotting of adjoining fleshy scales. In general, irradiation at a dose required for sprout inhibition in the bulbs does not change their external appearance, texture and sensory qualities. But, some times irradiation may cause a brownish discoloration in the inner buds or growth centre.

Sprout inhibition in Potato

Potato can be stored for 4-6 weeks under ambient conditions. Storage (up to 6 months) of potatoes in cold storage (2-4° C, RH 85-90%) is the only chemical free technique available for extension of shelf life, which is very costly. Irradiation of potatoes combined with refrigeration at 15°C can increase the storage period up to 6 months with minimum losses. Irradiation has more benefits than prevailing refrigeration technique.

1. During cold storage, level of reducing sugars in potatoes increase with time which renders the tubers unsuitable for processing industry.
2. Due to exposure to light during cold storage, there is formation of an alkaloid, *solanine* that causes greening of potatoes. Irradiation has no such side effects. Irradiated potatoes are suitable for processing into chips and fresh fries.
3. Irradiation at very low levels (0.05-0.15 kGy) inhibits sprouting in tubers while cold stored potatoes on removal to ambient conditions sprout profusely and the trade, usually resorts to manual desprouting.

Generally, irradiation at the dose levels required for sprout inhibition in potato does not change its texture, external appearance and sensory qualities. However, in certain varieties of Indian potatoes, bluish-grey discoloration occurs when irradiated tubers are boiled or french-fried. Irradiation of potatoes may result in a temporary rise in soluble sugar levels and a reduction in vitamin C content during the early period of storage. But during extended storage, sugar content returns to normal levels. Vitamin C content of irradiated potatoes stored at 15°C is found to be higher than control tubers held at 2-4°C for similar durations.

Quarantine treatment for vegetables

In the international trade of vegetable and their products, certain insect pests spread from one country-to-another where they did not exist previously. Therefore, several countries have quarantine regulations by virtue of which entry of such items is restricted unless they have been adequately treated by approved procedures to eliminate insect pests present in them. Export of potato, sweet potato like vegetable commodity from India to other countries is not permitted due to presence of weevil and tuber moth. Conventional chemical and physical treatments are not so effective as irradiation. Low dose levels are effective against weevil and tuber moth. So this technique can also be helpful in promoting export of vegetable potential in countries like India.

Based on the research work that determined the efficacy of irradiation as a treatment for the pest in *Ipomoea batatas,* Technical Panel on Phytosanitary treatments recommended Irradiation treatment for *Euscepes postfasciatus* as Minimum absorbed dose of 150 Gy to prevent the development of Fl adults of *Euscepes postfasciatus*[10]. Thus, the exportable commodity easily passed to the quarantine treatment.

ripening. Post-harvest rots frequently occur as a result of rough handling during the transportation and marketing process and are caused by a wide array of micro-organisms. Virus infection frequently lowers the quality of perishable commodities, usually as a result of visual deterioration, although viruses may also affect flavour and composition.

Table 2. Recommended irradiation dose for quarantine treatments against pests of vegetables

Scientific name	Common name	Major host/ commodity	Most tolerant stage present in commodity	Minimum dose required (Gy)	
				To inhibit development of immature	To sterilize adults
Acanthoscelides obtectus (Coleoptera : Bruchidae)	Dry bean weevil	Beans	Pupa	300	60
Callosobruchus chinensis L . (Coleoptera : Bruchidae)	Cowpea Weevil	Pulses	—	100	100
Cylas formicarius elegantulus (Coleoptera : Curculionidae)	Sweet potato weevil	Sweet potato	Adult	—	165
Neoleucinodes elegantalis (Lepidoptera : Pyralidae)	Tomato fruit borer	Tomato	Pupa	400	300
Tula absoluta (Lepidoptera: Gelechiidae)	Tomato worm	Tomato	Pupa	300	200

Delay in ripening of vegetables

Irradiation at low dose levels can delay ripening and over-ripening in tomato when treated at mature but unripe stage. Low dose of radiation when combined with hot water dip treatment (50-55°C for 5-10 min.) is found to improve the shelf-life as well as reduce fungal decay in tomato.

Decay control in vegetables

A major cause of losses in perishable vegetable crops is the action of a number of micro-organisms on the commodity. Fungi and bacteria may infect the plant organ at any time. "Latent" infections, in which fungi invade vegetable tissues shortly after flowering, become apparent only at the onset of ripening.

Control of insect infestation

Fresh vegetables may harbour a large number of insects during post-harvest handling which causes decay in vegetable crops. Many of these insect species, in particular fruit flies of the family Tephritidae can seriously disrupt trade among countries. These flies become sterile when subjected to irradiation doses ranging between 50 and 750 Gy. The actual dosage required to produce sterility in insects varies in accordance with the species concerned and its stage of development. Irradiation doses of 250 Gy can be tolerated by most fresh vegetables with minimal detrimental effects on quality. Detrimental effects of irradiation on fresh produce may include loss of green color (yellowing), abscission of leaves and petals, tissue discoloration and uneven ripening. These detrimental effects may not become visible until the commodity reaches the market. The effects of irradiation must therefore be tested on individual commodities, prior to large-scale commercialization of the irradiation treatment.

Radappertization of Vegetables

Radappertization refers to the application of a dose of ionizing radiation sufficient to reduce the number and activity of viable microorganisms to such an extent that very few, if any, are detectable in the treated vegetables by any recognized method (viruses being excepted). No microbial spoilage or toxicity should become detectable in vegetables so treated, regardless of the conditions under which it is stored, provided the packaging remains undamaged. The required dose is usually in the range of 25-45 kGy.

Only a few vegetables have been studied. There has been no proper determination of the minimum radiation dose (MRD) for sterility. The MRD may vary with different vegetables at least to the degree as to whether they are classified as acid ($pH < 4.5$) or not. In view of thie lack of accurate knowledge concerning the MRDs for vegetables, the doses so far determined must be viewed as only indicative of what is required for sterility and cannot be regarded as authoritative.

Doses in the range of about 20 to 30 kGy provide a product of acceptable quality and stability at ambient temperatures. Blanching is a prerequisite. Irradiation in the frozen state reduces chlorophyll degradation. Based on a study with spores of *Clostridium sporogenes* PA 3679, and MRD of 45 kGy was indicated for string beans and 25 kGy for carrots. Blanched peas irradiated with a dose of approximately 20 kGy remained stable at ambient temperatures. Sensory characteristics were satisfactory. Peas irradiated with dose in the range 8-10 kGy and heated to 100°C for 5 min. were stable at ambient temperatures. Such peas have more acceptable sensory characteristics then those sterilized by heating at 115° for 40 min. Some softening may occur with irradiation. Irradiation in the frozen state improved flavour and colour. Blanched pumpkins irradiated with doses in the range of about 15 to 25 kGy were stable at 22°C. Aroma was excellent and colour too was found good.

LEGISLATION ABOUT IRRADIATION

International Scenario

The Codex Alimentarius Commission, United Nations Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO) have laid down standards for Good Irradiation Practices (GIP) for food including a number of vegetables. The Codex has published two documents on irradiation namely :

Codex General Standards for Irradiated Foods (Codex stan 106-1983).

Recommended International Code of Practice for the Operation of Irradiation Facilities used for the Treatment of Foods (Document CAC RCP-19-1979 Rev. 1)

Codex General Standards for Irradiated Foods (Codex stan 106-1983)

This standard was published in 1983 after the Joint Expert Committee on Food Irradiation (JECFI) evaluated significant data and concluded that irradiation of any food commodity up to an overall dose of 10 kGy causes no toxicological hazard.

Recommended International Code of Practice for the operation of Irradiation facillities used for the Treatment of Food (Document CAC RCP-19-1979 Rev. 1.

This document was adopted by the CAC in 1979 and subsequently, revised in 1983. This standard covers the aspects of the Irradiation plant (to include radioactive sources, machine sources, dosimeter and process control), Good radiation processing practices, Product and Inventory control requirement including record keeping procedures.

Indian Scenario

In India, use of radioactive materials and radiation generating equipments is strictly controlled by Atomic Energy Regulatory Board (AERB), Mumbai. Department of Atomic Energy is the licensing authority for food irradiation. In 1986, the Govt. of India constituted a National Monitoring Agency (NMA) to oversee all aspects of commercial food irradiation in the country. Applications for clearance for irradiation of specific food items are initially examined by an Expert Group on Food Irradiation, constituted by NMA. The recommendations of this Expert Group are further considered by the Central Committee for Food Standards (CCFS) and then finally by NMA and notified in the Gazette of India, as an amendment to prevention of Food Adulteration (PFA) Rules, 1954.

A major step for food irradiation in India was taken when Government of India approved clearances for domestic marketing and consumption of irradiated onions, potatoes and spices in August 1994. The necessary amendments to the Prevention of Food Adulteration (PFA) Rules, 1954 were published in a Gazette Notification No. 329, dated August 9, 1994. The Atomic Energy Rules, 1966 published in the Gazette of India, June 22, 1966 provides the General statutory Rules for the authorization and licensing of irradiation facilities for the treatment and procedures for obtaining certificate of approval and licence for a irradiation facility, qualifications and training of personnel such as operators of irradiation facility, radiological safety officer and quality control officer. Bhabha Atomic Research Centre (BARC) conducts the necessary training courses for operations of food irradiation facilities and food inspectors from Food and Drug Administration of different states in the country. Research and technology development work on food irradiation undertaken at the Food Technology Division, BARC have shown the commercial potential of the technology under Indian conditions. On 9th August 1994, the Ministry of Health and Family Welfare, permitted irradiation of onion, potato and spices for internal marketing and consumption.

IRRADIATION FACILITIES FOR IRRADIATION OF VEGETABLE IN INDIA & ABROAD

First, large scale facility for potato irradiation came up in Canada in late sixties. But it was closed down after 2 years due to some uncertain reasons. Second, commercial facility for potato irradiation came up in Japan in early seventies and is operating till date. In recent years, many more multipurpose Food Irradiators have come up. The most important is the first large scale plant in USA which is by M/S Vindicator Inc. in Florida. This plant has processed products like onion, tomato and potato. Today, the three important dedicated, operating food irradiators are situated in USA, the Netherlands and Japan[4]. Countries possessing irradiation facilities for commercial food processing are listed below :

Table 3. Countries possessing irradiation facilities for commercial processing[11]

S.No.	Country	Products
1.	Algeria	Potato
2.	Argentina	Spices
3.	Bangladesh	Potato, onion
4.	Belgium	Spices, dehydrated vegetables
5.	Brazil	Spices, dehydrated vegetables
6.	Canada	Spices
7.	Chile	Spices, dehydrated vegetables, onion, potato
8.	China	Spices and vegetables seasonings, garlic, onion, potato, dehydrated vegetables seasoning, tomato, spices

S.No.	Country	Products
9.	Croatia	Spices
10.	Czech Rep.	Spices
11.	Cuba	Potato, Onion, beans
12.	Denmark	Spices
13.	Finland	Spices
14.	France	Spices, vegetable seasoning
15.	Hungary	Spices, onion
16.	India	Onion, garlic, potato, spices
17.	Indonesia	Spices
18.	Iran	Spices, condiments
19.	Japan	Potato
20.	Korea Rep.	Spices, Garlic powder
21.	Mexico	Spices
22.	Netherlands	Spices, dehydrated vegetable
23.	Norway	Spices
24.	Peru	Spices
25.	Poland	Onion, garlic, spices,
26.	South Africa	Potato, onion, spices
27.	Thailand	Onion, spices
28.	U.K.	Spices
29.	United States	Vegetable and Spices
30.	Yugoslavia	Spices

In India two pilot plant irradiation facilities, namely the Food Package Irradiator in Food Technology Division, Bhabha Atomic Research Centre and another at Defence Laboratory, Jodhpur have been cleared for domestic trade and consumption.

A prototype commercial demonstration irradiator with an initial throughput of 20 tons/day for treatment of spices and dehydrated onions is constructed in Vashi, Navi Mumbai, under the management of Board of Radiation and Isotype Technology (BRIT) a constituent unit of the Department of Atomic Energy. The plant is operational since January 2000 and now has a capacity of processing 30 tones of material per day. An irradiator for the treatment of onions and potatoes at a throughput of 10 tons/hr is under development at BARC. The first prototype commercial demonstration irradiator KRUSHAK (Krushi Utpadan Sanrakshan Kendra) was made operational in July 2003 at Lasalgaon, Dist. Nashik in Maharashtra. The plant has a capacity of processing 10 tones of onion per day. The Centre for Advanced Technology (CAT), Indore has developed a Microtron Electron Beam Irradiator, which could be used for certain vegetable irradiation applications.

FUTURE PROSPECTS

Irradiation has been extensively studied for wholesomeness, toxicological and microbiological quality and approved to be safe by Joint Expert Committee on Food Irradiation (JECFI). Being an effective and environment friendly technology, it can supplement or replace some of our traditional food processing technologies for safeguarding our harvests and for hygienization of vegetables. Although, irradiation technology is not a panacea, yet is capable of solving specific problems of vegetable losses and food safety. Govt. of India has cleared this technology for a number of products. Consumer acceptability in Indian conditions has to be studied through market tests. Moreover, consumer should be satisfied through education on the subject bringing out its desirable aspects and impacts.

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TRANS FATS : ALL WE NEED TO KNOW

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Fats are required for energy and taste, when eaten in moderation fats are essential for good health. Recently there has been a growing global concern over the counter effects of Trans Fats. We the Indians need to worry even more for our genetic predisposition to heart disease and fetish for fried food. The situation is alarming especially with the younger generation being lured by junk foods, become vulnerable to heart diseases in the prime of their life. Here is what we need to know all about Trans fats in our food.

INTRODUCTION

Trans fats/fatty acids are a type of unsaturated fat that acts like saturated fats. Most trans fats are mono unsaturated (one double bond) fatty acids. The shape of trans fat molecules is more like cholesterol-raising saturated fat than a typical mono unsaturated fatty acid. A large no. of the trans fats in our food are created as byproducts of the process called Hydrogenation. Trans fats can also be produced by heating oil and occur naturally in the meat and milk of ruminant animals such as cows and sheep.

HYDROGENATION

To convert soybean, cottonseed, or other liquid oil into a solid shortening, the oil is heated in the presence of hydrogen and a catalyst. This Hydrogenation process converts some polyunsaturated fatty acids to monounsaturated and saturated fatty acids. It also converts some monounsaturated fatty acids to saturated fatty acids. Thus, healthful oil is converted into a harmful one. The problem arises when some of the fatty acids are converted to the "trans" form, term *"Trans"* comes from the fact that two parts of fatty acid molecules are on opposite sides of double bonds. In the usual *"Cis"* fatty acids, the two parts are on the same side of the double bonds. The degree of Hydrogenation determines how solid the final product will be and how much of the different fatty acids it will contain. In complete hydrogenation trans fats are not formed and the product is solid, the melting point is high.

PARTIAL HYDROGENATION

To increase shelf life and obtain the cooking properties of solid shortenings, oils are partially hydrogenated. That eliminates most of the unstable fatty acids—those with three or two double bonds. Partially hydrogenated oils have been used to replace butter, lard, palm oil, coconut oil, and other "hard" fats in such foods as many processed foods. In partial hydrogenation the product is semi solid and forms trans fat and has higher melting point.

FULLY Vs PARTIALLY, HYDROGENATED OILS

Interestingly fully hydrogenated oils appear to be harmless. In the case of fully hydrogenated soybean oil, the hydrogenation process increases the amount of saturated fat, but most of that fat is stearic acid. Stearic acid does not raise "bad"

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(LDL) cholesterol levels, because the body converts it swiftly to monounsaturated oleic acid.

NUTRITIONAL GUIDELINES

Trans fatty acids whether of plant or animal origin are not essential and provide no known benefit to human health.Trans fat increases the amount of "bad" (LDL) cholesterol in blood, and that increases the risk of heart disease. It also decreases the "good" (HDL) cholesterol, which may increase the risk of heart disease even more. Preliminary research suggests that trans fat might have additional harmful effects on the body as the hydrogenation process also destroys some of the vitamin K in vegetable oil, which might be a problem for consumers who have marginal intakes of that vitamin. Large population studies have shown that people with a high intake of trans fats have higher level of heart disease. They are also found to be worse because they inhibit metabolism of an essential fatty acids called Omega-6. Trans fats during maternity increases the risk of diet related chronic diseases; breast cancer and infertility in women along with diabetes, Alzheimer's disease, obesity and liver diseases. From a nutritional standpoint the consumption of trans fatty acids results in considerable potential harm but no apparent benefit.

Owing to such facts and concern no safe level of trans fat consumption is recommended. This is because any incremental increase in the consumption of trans fats is directly proportional to the increase in the risk of coronary heart diseases.

TRANS FATS ; A DIFFERENT ASPECT

Despite the above facts the complete elimination of trans fat is not recommended as they are naturally present in animal foods though in trace amount. Moreover, totally avoiding them in our diet would result in cutting out on other nutrients as well, especially from dairy and meat products. The complete removal of trans fats from our routine diet might lead to undesirable side effects and nutritional imbalance. The WHO in the year 2003, has suggested a practical level of Trans fat consumption to be limited to less than 1% of overall energy intake.

Trans fats are not toxin that will kill everyone who eats even in a small amount. It is the trans fats coming from manufacturing process that is of concern, from health and nutrition perspectives.

TRANS FAT FREE FOOD

According to the Prevention of Food Adulteration Act (1954), if the food uses hydrogenated vegetable fats, it must be declared on the label "Contains Trans Fat". If the manufacturer claims it to be "trans Fat Free" it would mean that product contains less than 0.2 gms of trans fat per serving.

THE INDIAN CONCERN

A large proportion of the population in Indian sub continent is identified as genetically predisposed to Cardio Vascular Diseases (CVD) and the risk is further compounded due to the consumption of vanaspati and trans fatty acids (TFA).Vanaspati/ PHVO, shortenings as in cookies, crackers, snack foods i. e. jalebi, samosa, pakora, panipuri, mathri, tikki, chaat, namkeen fried foods poori, parantha, bhature, vada, dosa, chips, papad, deep fried meat, dough nuts, pastries, baked goods and other processed foods, French fries, noodles (the list in fact, is endless as far as staples in different part of India are concerned) made with or fried in partially hydrogenated oils are all sources of trans fats.

THE NATIONAL INSTITUTE OF NUTRITION STUDY AND RECOMMENDATION

The National Institute of Nutrition (NIN) conducted a national consultation based on recommendations of the third meeting of Food Safety and Standards Authority of India (FSSAI) on January 9, 2010. The consultation concluded that Trans Fatty Acids (TFA) level in vanaspati/ PHVO should be below 10 per cent. It also recommended that the existing regulations for melting point which is at 31°C to 41°C should be removed all together, to be in line with the Codex Alimentarius guidelines.

The FSSAI prepared the proposal on the lines of the NIN recommendations. The proposal recommends setting the limit of trans fats to 10 per cent and reducing it to five per cent in three years. It also considers increasing the melting point from the current limit of 41°C to 51°C or removing the limit completely. Mandatory labeling of trans fatty acids and saturated fatty acids content on vanaspati packs, edible oils or any other product containing trans fatty acids from vanaspati sources has also been proposed.

According to a risk assessment report by the NIN on trans fatty acids in Indian diets, the fat consumption in rural and urban India is 20 grams and 30 grams per day, respectively. If a 10 per cent trans fatty acid level is permitted in vanaspati/ PHVO, a person consuming 2000 Kcal will derive 0.9 and 1.35 per cent energy from the trans fatty acids. This shows that even at 10 per cent trans fatty acids level, the vanaspati/PHVO will pose a risk to the urban consumer as it exceeds the 1 percent energy limits to be derived for trans fatty acids as is recommended by WHO.

THE REGULATION OF HYDROGENATED OIL AND TRANS FATS, IN INDIA

In 2004, the Union health ministry's Oils and Fats Sub-committee, under the Central Committee for Food Standards, begun discussions on a standard for trans fats. In January 2008, the sub-committee forwarded its recommendations to the Central committee for standards. But the Central committee is still awaiting more data and information. Instead of standards, in September 2008, the Union ministry issued a notification for labeling of trans fats on oil and food.

The NIN proposal calls for further studies to make an informed decision but no committee has been appointed by the FSSAI as of now to study this. In India even though our food regulatory authorities have accepted trans fats as serious health concern, but there have been delay in setting the standards, "As a result, India has no regulation to check the content of trans fats in oil".

THE DENMARK GOVERNMENT'S BREAK-THROUGH

In the year 2003 Denmark became the first ever country to legislate against trans fats in foods limiting, the trans-fat content of foods to two percent of the fat. (Naturally occurring trans fats are exempted from that limit.)

THE ALTERNATIVES WE HAVE

A variety of oils in the food preparation as Sunflower, Mustard, Soyabean, Olive, Peanut, Sesame, Grape seed can be used. Oils rich in Saturated/ Trans fat including Palm oil, Tallow, Lard, Butter, Ghee, Vanaspathi and Baking Margarine, must be avoided to the extent one can. Home makers / the nurtures of the Family are advised to stick to baking, grilling or steaming rather than deep frying the food using such fat, as far as they can.

CONCLUSION

Trans fats were first used commercially about 75 years ago, and became far more widespread in the 1950s, that means prior to this our diet has very much survived without using such fats. Now for commercial reasons to make profits (unhealthy profits) it is used in many thousands of processed foods to meet the demands of ever growing market. Bringing out some modification in our routine diet and lifestyles, by adhering to the basics will fulfill our health objectives.

It is very important to eat a diet that is based largely on whole grains, fruits, vegetables, and low-fat animal products. Try to minimize saturated fat, sodium, cholesterol, and refined sugars.

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CONTRIBUTION OF DIFFERENTIAL EQUATION AS A MATHEMATICAL MODEL

U. N. Singh and Amal Kumar*

Differential equations are not only applied by physicist and engineers but they are being used more and more in certain biological sciences, social sciences, engineering & applied sciences, fuzzy control system and queueing theory and probability distribution. The purpose of this paper is to correlate the differential equation with experimental observation in terms of mathematical models.

INTRODUCTION

Any equation which gives the relation between independent variable, dependent variable and the derivative of dependent variable is called differential equation. If a relation Y = f(x) involving two variables X and Y exist, then we call X is independent variable and Y is dependent variable.

The subject of differential equation constitutes a part of mathematics and it plays an important role in understanding the physical sciences and other phenomenon also. It is the source of ideas and theories which constitute higher analysis. In physics, engineering and many other disciplines, it has become necessary to build a mathematical model to represent the problem. These mathematical model often involve the search for unknown function that satisfies an equation in which derivative of the unknown functions play an important role. The primary purpose of differential equation is to serve as a tool for studying changes in physical world.

HOW DIFFERENTIAL EQUATION ARISE

Differential equations occur quite frequently in our daily life. The notion of an object can always be associated with a differential equation. The changes in prices of commodities, the flow of fluids, the deflection of beam etc. often lead to differential equation. Such equation may depend on one or more independent variables. They are studies in two types, such as ordinary and partial differential equation. Further they may include the derivative of the first or higher order. In order to determine their exact physical significance the unknown functions need to satisfy certain conditions.

MATHEMATICAL MODELING

Our general aim is to understand the background of any observed phenomenon i.e. to analyse its manifestation and then to predict its future, wherever possible e.g. in case of an epidemic it is necessary to study how rapidly the virus and infection spreads in order to arrest the epidemic, these problems are referred to as word Problems. In each case the prediction sought for is the solution of the corresponding word problem, and so is referred to as the word solution. Mathematics comes into play its role in the process of deriving the desired word solution to the proposed word problem, to achieve this the word problem are required to be converted into mathematical problem the process being known as mathematical modeling. Various mathematical

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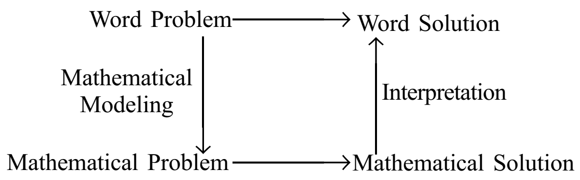
tools are then employed to obtain the solution of the mathematical problem under concern. This solution has to be interpreted properly in order to achieve the required word solution of the given word problem, the whole process is depicted below :



Now we shall correlate the differential equation with mathematical model in different fields as below :

THE BIOLOGICAL SCIENCES

The problems of biology are manifolds of these we discuss here only the spread of virus and epidemics.

(a) The spread of Virus : Suppose that in a college hostel accommodating 1000 students, one of them came in carrying a flu virus, then the hostel was isolated. If the rate at which the virus spreads is assumed to be proportional not only to the number Ni of infected students, but also the number of non-infected students and if the number of infected student is 50 after 4 days then more than 95% of the students will be infected after 10 days. According to the assumption of the problem, we have $\frac{dNi}{dt}$ = KNi (1000 – Ni), Ni(0) = 1 → (1) It is a differential equation with variable separable.

(b) Spread of epidemics : Several diseases spread by infection. Suppose that the susceptible is also infected by contact. This process continuous to cover the entire susceptible population, let us have some assumption to simplify the mathematical considerations. Assume that a person once infected remains so far all time dump the spread of epidemics and none of them die during the period.

Let X (t) = The popultaion susceptible of infection

Y (t) = The infected population at a time t.

At t = 0, the starting time of the epidemic.

Suppose that a person from out of the town, who is carrier of the epidemic visits the town. It implies that at t = 0, there is one individual who is infected i.e. Y (0) = 1, further X (0) = p.

These consideration lead to the following relation

$X(t) + Y(t) = p + 1 \longrightarrow (2)$

Clearly the rate of change of epidemic is given as,

$$\frac{dy}{dt} = \alpha y,$$

where α is a parameter of proportion here α depends on the size of susceptible population x.

If α (x) = kx, where k is a constant, then the differential equation may be the form

$$\frac{dy}{dt} = kxy - ky\,(p + 1 - y) \longrightarrow (3)$$

which represents the spread of epidemic in the town.

IN SOCIAL SCIENCES

The population growth is an important problem in social sciences. If the growth is independent of external influences, it is found that the rate of growth of a species is proportional to the number of species present at the time. If x = x(t) denotes the number of species present at time t,

$$\frac{dx}{dt} = kx \longrightarrow (4)$$

ENGINEERING AND APPLIED SCIENCES

Several problems in engineering modeled as initial boundary value problems consisting of partial differential equation with initial condition t = 0 and boundary conditions specified in the problem such as heat flow equation.

(a) Heat flow equation : Consider a heat conduction rod of length L placed along x axis. The amount of heat crossing the rod per second depends on uniform corss section A, conductivity k of the rod and temperature gradient $\frac{\delta u}{\delta x}$

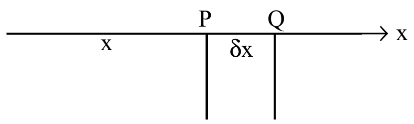
Let u(x, t) be the temp. at the point x at any time t, then the rate of increases of heat in the rod is given $\frac{\delta u}{\delta t} = \frac{K}{sp}\left\{\left(\frac{\delta u}{\delta x}\right)_{x+\frac{\delta x}{\delta x}} - \left(\frac{\delta u}{\delta x}\right)_x\right\}$ Here s is specific heat and p is density.

Taking limit $\delta x \to 0$ we get :

$$\frac{du}{dt} = C^2 \frac{\delta^2 u}{\delta x^2} \text{ where } C^2 = \frac{k}{sp} \longrightarrow (5)$$

Equation (5) is known as on dimensional heat flow equation.

(b) Transmission line equations : Consider the flow of electricity is a long insulated cable placed along x axis. Assuming the flow to be one dimensional the current I and potential V at any point in the cable is completely determined by one co-ordinate X and time variable t.



Consider the fall of potential in a linear element PQ = δx situated at point x, we obtain

$$-\delta V = IR\delta x + L\delta x \left(\frac{\delta I}{\delta t}\right)$$

Where R and L are resistance and inductance per unit length respectively. If there is a capacitance C and conductance G per unit length, then we have

$$-\delta L = GV\delta x + C\delta x \left(\frac{\delta v}{\delta t}\right)$$

Dividing by δx and taking limit as $\delta x \to 0$, the above equations becomes

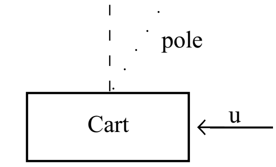
$$\frac{\delta v}{\delta x} + RI + L\frac{\delta I}{\delta t} = 0 \longrightarrow (6)$$

$$\text{and } \frac{\delta I}{\delta x} + GV + C\frac{\delta v}{\delta t} = 0 \longrightarrow (7)$$

Equations (6) and (7) are known as transmission line equations.

IN FUZZY CONTROL SYSTEM

We will consider here a cart-pole problem. This system consists of a wooden rectangular base with mounted on it. Based on the control strategy, the block will be moved to and fro manually.



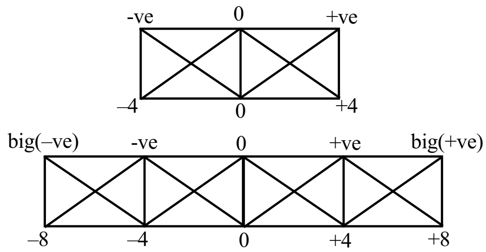
Cart-pole arrangement

For this arrangement the governing equation is,

$$-mL^2 \left(\frac{d^2Q}{dt^2}\right) + mLg \sin Q = u \longrightarrow (8)$$

Where m is mass of the pole which is assumed to be located at the top of pole, L is length of pole, Q is angle made by pole with vertical line and u is applied force to the cart.

After solving equation (8) we get equations for simulating system Q (k + 1) = Q(k) + X (k) and X(k + 1) = Q(k + 1) – u(k). If domain of Q and X are the same and given by [– 4, 4] and domain of u is [– 8, 8], we choose three fuzzy sets – N, Z and P on the domain of Q and X and five fuzzy sets NB, N, Z, P and PB-on the domain of u.



Fuzzy partition for Q, X and u

The rule base for cart-pole control is shown below :

		X: N	X: Z	X: P
Q	N	NB	N	Z
	Z	N	Z	P
	P	Z	P	PB

IN QUEUEING THEORY AND PROBABILITY DISTRIBUTION

Queueing process is a random process since the customer's arrival and their service time are not known in advance. The probability distribution is very effective in mathematical modeling of queueing problems.

Mathematical modeling : we consider the queueing situation in which the number of arrivals and departure during an interval of time is controlled by the following conditions :

1. the probability of an arrival or depatrture occuring in time interval T and T + h dependents only on length of h of the interval and not on T. The corresponding inter arrival density function is given as f(t).
2. In any interval of time $h > 0$ there is positive probability of an arrival.
3. At most only one arrival can occur during a small time interval h.

Let Pn (T) = Probability of n arrivals in the interval (O, T). Using exponential distribution $f(t) = \lambda e^{-\lambda T}$ we get an equation :

$$\frac{d}{dt} Pn = -\lambda \, Pn\,(T) + \lambda \, P_{n-1}\,(T),$$

for n = 1, 2, ⟶ (9)

Which is a linear first order differential equation with constant coefficient.

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GENETICALLY MODIFIED FOODS : CURRENT SCENARIO

Abhishek Bansal and Seema R. Pathak*

G. M. food are latest major breakthrough in the field of biotechnology. Genetically Modified Foods provides us with a possible solution for the problem of food shortage, removal of possibilities of diseases, good crop yield, which is only going to intensify in the coming years. Along with being the best solution, it is also most controversial one. This article covers the idealistic & realistic problems faced by the governments of various countries & impact of GMF on environments as well as on human health.

INTRODUCTION

The world population has topped 6 billion people and is predicted to double in the next 50 years. Ensuring an adequate food supply for this booming population is going to be a major challenge in the years to come. Genetically modified foods or GM foods promise to meet this need. The term genetically modified foods is most commonly used to refer to crop plants created for human or animal consumption using the latest molecular biology techniques. Their genetic material (DNA) has been altered in a way that does not occur naturally. The technology is often called "modern biotechnology" or "gene technology", sometimes also "recombinant DNA technology" or "genetic engineering". It allows selected individual genes to be transferred from one organism into another, also between non-related species, to enhance desired traits such as increased resistance to herbicides or improved nutritional content. The enhancement of desired traits has traditionally been undertaken through breeding. GM foods are developed – and marketed – because there is some perceived advantage either to the producer or consumer of these foods. This is meant to translate into a product with a lower price, greater benefit (in terms of durability or nutritional value) or both. Initially GM seed developers wanted their products to be accepted by producers so have concentrated on innovations that farmers (and the food industry more generally) would appreciate. The initial objective for developing plants based on GM organisms was to improve crop protection. The GM crops currently on the market are mainly aimed at an increased level of crop protection through the introduction of resistance against plant diseases caused by insects or viruses or through increased tolerance towards herbicides. Insect resistance is achieved by incorporating into the food plant the gene for toxin production from the bacterium Bacillus thuringiensis (BT)[1].

This toxin is currently used as a conventional insecticide in agriculture and is safe for human consumption. GM crops that permanently produce this toxin have been shown to require lower quantities of insecticides in specific situations, e.g. where pest pressure is high. GM foods promise to be better in various factors such as pest resistance as pest destroys crops at a staggering level leading to devastating loss to farmers. Typically this problem is overcome by using millions of pesticides and consumers are left with no choice other than contaminated food having potential hazards that is direct way of harm that a pesticide can create apart

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from that agricultural waste from excessive use of pesticides affects purity of underground water as well as disturbs pH of land leading to great harm to environment.

For centuries, archaic forms of genetic engineering have been practiced by farmers by gathering and planting the seeds of fatter grains or cross-fertilizing different plant species to result in one that gives the cleanest characteristics of the parent plants. However, this approach is limited by the fact that breeders can only breed a plant with its stop relative, and results can sometimes be random or imprecise, therefore it could take decades to produce a crop that can be commercialized. Insist applications started in the 1960's, when genetically modified foods first appeared on the market. In 1967, a new breed of potatoes called Lenape potato was genetically engineered to contain high solid content which made it useful for making potato chips. Two years later, the Lenape potato developed a toxin called solanine, which lead to the withdrawal of this variety from the market by the U.S. Department of Agriculture. The development of this toxin showed that genetic modification of organisms can lead to unprecedented effects. In the 1980s, researchers found a method of creating transgenic plants by using a certain pathogenic bacterium, this bacterium allowed researchers to insert a number of desired genetic traits into plants. In the late '80s, scientists came up with more advanced techniques for genetic transformation of plants and animals. In the '90s, a huge step was taken and the first genetically engineered foods were made available to the public. The first commercially grown genetically modified food crop was a tomato created by a California-based company in the early 1990s. It was genetically modified so that it took longer to decompose after being picked. A number of other GMO's were popular, such as the rBST in dairy cows (a growth hormone injected in cows to increase their milk producing capacity). Today, genetically modified foods are becoming very common, from pest resistant corn to long lasting apples, and scientists continue researching GMO's and their effects.

SOCIAL ISSUES

Many scientists argue that there is more than enough food in the world and that the hunger crisis is caused by problems in food distribution and politics, not production, so people should not be offered food that may carry some degree of risk.

Genetic modifications often have significant unforeseen consequences, both in the modified organisms and their environments. For example, determined strains of corn have been developed that are toxic to plant-eating insects. It has been suspected those strains cross-pollinated with other varieties of wild and domestic corn and passed on these genes with a putative impact on corn biodiversity. Following to the publication of these results, several scientists pointed out that the conclusions were based on experiments with developmental flaws. After this criticism *Nature*, the scientific journal where this data was originally published concluded that "the evidence available is not sufficient to justify the publication of the original paper". More novel attempts to replicate the original studies have concluded that genetically modified corn is absent from southern Mexico in 2003 and 2004.

Activists and many scientists opposed to genetic engineering say that with current recombinant (a form of artificial) technology there is no way to ensure that genetically modified organisms will remain under control, and the use of this technology outside secure laboratory environments represents multiple unacceptable risks to both farmed and wild ecosystems.

Potential impact on biodiversity may occur if herbicide-tolerant crops are sprayed with herbicide to the extent that no wild plants (weeds) are able to survive. Plants toxic to insects may mean insect-free crops. This could result in declines in other wildlife like birds which feed on weed seeds and insects for food resources.

Although some scientists have claimed that selective breeding is a form of genetic engineering, (e.g. dogs have evolved with human intervention over the course of tens of thousands of years from wolves), others assert that modern transgenesis-based genetic engineering is gracious of delivering changes faster than, and sometimes of different types from, traditional breeding methods.

INSTITUTIONAL REACTION

The spend of GMOs has sparked significant controversy in many areas. Some groups or individuals behold the generation and use of GMO as intolerable meddling with biological states or processes that have naturally evolved over long periods of time, while others are concerned about the limitations of recent science to fully understand all of the potential negative costs of genetic exploitation.

While some groups advocate the complete prohibition of GMOs, others call for mandatory labeling of genetically modified food or other products. Other controversies include the definition of patent and property pertaining to products of genetic engineering and the possibility of unforeseen local and global effects as a result of transgenic organisms reproduced.

United States

In 2004, Mendocino County, California became the first county in the United States to ban the production of GMOs. The measure passed with a 57% majority. In California, Trinity and Marin counties have also imposed bans on GM crops, while regulation to do so were unsuccessful in Butte, San Luis Obispo, Humboldt, and Sonoma counties. Supervisors in the agriculturally-rich counties of Fresno, Kern, Kings, Solano, Sutter, and Tulare have passed resolutions supporting the practice.

Canada

In 2005, a standing committee of the government of Prince Edward Island in Canada began work to assess a proposal to ban the production of GMOs in the province. Prince Edward Island has already banned GM potatoes, which anecdote for most of its crop. Mainland Canada is one of the world's largest producers of GM canola however.

Australia

Several states of Australia have had suspension on the planting of GM food crops dating from around 2003. However, in late 2007 the states of New South Wales and Victoria lifted these bans. A new government in Western Australia is to recall the states' suspension while South Australia continues its ban. Tasmania has extended their suspension to June 2008. The state of Queensland has allowed the growing of GM crops since 1995 and has never had a GM ban.

Italy

Italy banned four kinds of genetically modified corn and then refused to eliminate the ban a month later when the European Union said the corn was safe. That case is on hold pending a decision whether an EU member state has the right to impose standards stricter than those from the EU even when there is no published evidence that the products may be contemptible.

Currently, there is little international consensus regarding the acceptability and effective role of modified "complete" organisms such as plants or animals.

Crop plants genetically-engineered to be resistant to one very powerful herbicide could help prevent environmental damage by reducing the amount of herbicides needed.

Genetic engineering can also help us with evolution of disease resistant plants which are caused by many viruses, bacterieses and fungi. Cold tolerance drought tolerance and salinity tolerance can also be attained by genetic modification.

Nutritional values of certain crops for e.g. rice can also be increased by GM technology[2]. Edible medicines and vaccines are also being developed in tomatoes and potatoes. These vaccines will be much easier to ship, store and administer than traditional inject able vaccines[3]. Plants such as poplar trees have been genetically engineered to clean up heavy metal pollution from contaminated soil leading to phytoremediation[4].

ADAPTATION OF G.M. FOOD BY COUNTRIES

Thirteen countries grew genetically-engineered crops commercially in 2000, and of these, the U.S. produced the majority. In 2000, 68% of all GM crops were grown by U.S. farmers. In comparison, Argentina, Canada and China produced only 23%, 7% and 1%, respectively. Other countries that grew commercial GM crops in 2000 are Australia, Bulgaria, France, Germany, Mexico, Romania, South Africa, Spain, and Uruguay. Soybeans and corn are the top two most widely grown crops (82% of all GM crops harvested in 2000), with cotton, rapeseed (or canola) and potatoes trailing behind. 74% of these GM crops were modified for herbicide tolerance, 19% were modified for insect pest resistance , and 7% were modified for both herbicide tolerance and pest tolerance. Globally, acreage of GM crops has increased 25-fold in just 5 years, from approximately 4.3 million acres in 1996 to 109 million acres in 2000 - almost twice the area of the United Kingdom. Approximately 99 million acres were devoted to GM crops in the U.S. and Argentina alone. In the U.S., approximately 54% of all soybeans cultivated in 2000 were genetically-modified, up from 42% in 1998 and only 7% in 1996. In 2000, genetically-modified cotton varieties accounted for 61% of the total cotton crop, up from 42% in 1998, and 15% in 1996. GM corn and also experienced a similar but less dramatic increase. Corn production increased to 25% of all corn grown in 2000, about the same as 1998 (26%), but up from 1.5% in 1996. As anticipated, pesticide and herbicide use on these GM varieties was slashed and, for the most part, yields were increased.

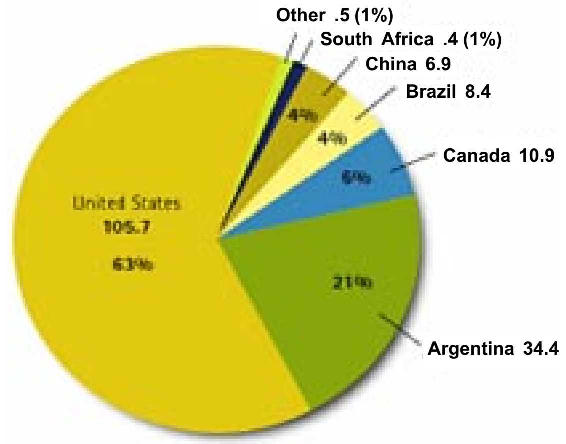

Fig.1 : Percentage of global land area planted in biotechnology varieties By countries (2003 total land area : 167.2 million acres)

CONTROVERSIES AND CONCERNS

"Genetic modification is analogous to nuclear power: nobody loves it, but climate change has made its adoption imperative. On the other hand, many believe that GM food has not been a success and that we should devote our efforts and money into another solution. "We need biodiversity intensification that works with nature's nutrient and water cycles, not against them," Environmental activists, religious organizations, public interest groups, professional associations and other scientists and government officials have all raised concerns about GM foods, and criticized agribusiness for pursuing profit without concern for potential hazards, and the government for failing to exercise adequate regulatory oversight. It seems that everyone has a strong opinion about GM foods. Most concerns about GM foods fall into three categories :

- Environmental hazards
- Human health risks
- Economic concerns

IMPACT ON ENVIRONMENT AND HUMAN HEALTH

Unintended harm to other organisms

Study shows that pollen from B.T. corn caused high mortality rates in monarch butterfly caterpillars[5]. Monarch caterpillars consume milkweed plants, not corn, but the fear is that if pollen from B.T. corn is blown by the wind onto milkweed plants in neighboring fields, the caterpillars could eat the pollen and perish. Unfortunately, B.T. toxins kill many species of insect larvae indiscriminately; it is not possible to design a B.T. toxin that would only kill crop-damaging pests and remain harmless to all other insects.

Reduced effectiveness of pesticides

Just as some populations of mosquitoes developed resistance to the now-banned pesticide DDT, many people are concerned that insects will become resistant to B.T. or other crops that have been genetically-modified to produce their own pesticides.

Gene transfer to non-target species

Another concern is that crop plants engineered for herbicide tolerance and weeds will cross-breed, resulting in the transfer of the herbicide resistance genes from the crops into the weeds. These "super weeds" would then be herbicide tolerant as well. Other introduced genes may cross over into non-modified crops planted next to GM crops. There are several possible solutions to the three problems mentioned above. Genes are exchanged between plants via pollen. Two ways to ensure that non-target species will not receive introduced genes from GM plants are to create GM plants that are male sterile (do not produce pollen) or to modify the GM plant so that the pollen does not contain the introduced gene.[6] Cross-pollination would not occur, and if harmless insects such as monarch caterpillars were to eat pollen from GM plants, the caterpillars would survive. Another possible solution is to create buffer zones around fields of GM crops. Estimates of the necessary width of buffer zones ranges from 6 meters to 30 meters or more.

The Impact on Human Health Due to regular consumption

Allergenicity Many children in the US and Europe have developed life-threatening allergies to peanuts and other foods. There is a possibility that introducing a gene into a plant may create a new allergen or cause an allergic reaction in susceptible individuals. A proposal to incorporate a gene from Brazil nuts into soybeans was abandoned because of the fear of causing unexpected allergic reactions.[7] Extensive testing of GM foods may be required to avoid the possibility of harm to consumers with food allergies. Labeling of GM foods and food products will acquire new importance, which has been discussed later.

Undetermined effects on human health

There is a growing concern that introducing foreign genes into food plants may have an unexpected and negative impact on human health. A recent article published in Lancet examined the effects of GM potatoes on the digestive tract in rats. This study claimed that there were appreciable differences in the intestines of rats fed GM potatoes and rats fed unmodified potatoes. Yet critics say that this paper, like the monarch butterfly data, is flawed and does not hold up to scientific scrutiny. Moreover, the gene introduced into the potatoes was a snowdrop flower lectin, a substance known to be toxic to mammals. The scientists who created this variety of potato chose to use the lectin gene simply to test the methodology, and these potatoes were never intended for human or animal consumption. On the whole, with the exception of possible allergenicity, scientists believe that GM foods do not present a risk to human health.

Economic Impact Due to the onset of GM Foods

Bringing a GM food to market is a lengthy and costly process, and of course agro-biotech companies wish to ensure a profitable return on their investment. Many new plant genetic engineering technologies and GM plants have been patented, and patent infringement is a big concern of agribusiness. Yet consumer advocates are worried that patenting these new plant varieties will raise the price of seeds so

Food species in which a Genetically Modified version exists are :

Food	Properties of the Genetically Modified variety	Modification	Percent Modified in US	Percent Modified in world
Soybeans	Resistant to glyphosate or glufosinate herbicides	Herbicide resistant gene taken from bacteria inserted into soybean	93%	77%
Corn, field	Resistant to glyphosate or glufosinate herbicides. Insect resistance via producing Bt proteins, some previously used as pesticides in organic crop production. Vitamin-enriched corn derived from South African white corn variety M37W has bright orange kernels, with 169x increase in beta carotene, 6x the vitamin C and 2x folate.	New genes, some from the bacterium *Bacillus thuringiensis*, added/transferred into plant genome.	86%	26%
Cotton (cottonseed oil)	Pest-resistant cotton	Bt crystal protein gene added transferred into plant genome	93%	49%
Alfalfa	Resistant to glyphosate or glufosinate herbicides	New genes added/ transferred into plant genome.	Planted in the US from 2005–2007 ; no longer planted currently due to court decisions	
Hawaiian papaya	Variety is resistant to the papaya ringspot virus.	New gene added/ transferred into plant genome	80%	
Tomatoes	Variety in which the production of the enzyme polygalacturonase (PG) is suppressed, retarding fruit softening after harvesting.	A reverse copy (an antisensegene) of the gene responsible for the production of PG enzyme added into plant genome	Taken off the market due to commercial failure.	Small quantities grown in China
Rapeseed (Canola)	Resistance to herbicides (glyphosate or glufosinate), high laurate canola	New genes added/ transferred into plant genome	93%	21%

Food	Properties of the genetically modified variety	Modification	Percent Modified in US	Percent Modified in world
Sugar cane	Resistance to certain pesticides, high sucrose content.	New genes added/ transferred into plant genome		
Sugar beet	Resistance to glyphosate, glufosinate herbicides	New genes added/ transferred into plant genome	95% (2010) ; planting in the US is halted as of 13 Aug. 2010 by court order	9%
Rice	Genetically modified to contain high amounts of Vitamin A (beta-carotene) [27]	"Golden rice" Three new genes implanted: two from daffodils and the third from a bacterium	Forecast to be on the market in 2012	
Squash (Zucchini)	Resistance to watermelon, cucumber and zucchini yellow mosaic viruses	Contains coat protein genes of viruses.	13%	
Sweet Peppers	Resistance to virus	Contains coat protein genes of the virus.		Small quantities grown in China

high that small farmers and third world countries will not be able to afford seeds for GM crops, thus widening the gap between the wealthy and the poor. It is hoped that in a humanitarian gesture, more companies and non-profits will follow the lead of the Rockefeller Foundation and offer their products at reduced cost to impoverished nations.

REGULATIONS ON GM FOODS AND GOVERNMENT'S ROLE IN DIFFERENT COUNTRIES

Governments around the world are hard at work to establish a regulatory process to monitor the effects of and approve new varieties of GM plants. Yet depending on the political, social and economic climate within a region or country, different governments are responding in different ways.

Japan

In Japan, the Ministry of Health and Welfare has announced that health testing of GM foods will be mandatory as of April 2001[8]. Currently, testing of GM foods is voluntary. Japanese supermarkets are offering both GM foods and unmodified foods, and customers are beginning to show a strong preference for unmodified fruits and vegetables.

7.2 India

India's government has not yet announced a policy on GM foods because no GM crops are grown in India and no products are commercially available in supermarkets yet. India is, however, very supportive of transgenic plant research. It is highly likely that India will decide that the benefits of GM foods outweigh the risks because Indian agriculture will need to adopt drastic new measures to counteract the country's endemic poverty and feed its exploding population.

Brazil

Some states in Brazil have banned GM crops entirely, and the Brazilian Institute for the Defense of Consumers, in collaboration with Greenpeace, has filed suit to prevent the importation of GM crops. Brazilian farmers, however, have resorted to smuggling GM soybean seeds into the country because they fear economic harm if they are unable to compete in the global marketplace with other grain-exporting countries

Europe

In Europe, anti-GM food protestors have been especially active. In the last few years Europe has experienced two major foods scares: bovine spongiform encephalopathy (mad cow disease) in Great Britain and dioxin-tainted foods originating from Belgium. These food scares have undermined consumer confidence about the European food supply, and citizens are disinclined to trust government information about GM foods. In response to the public outcry, Europe now requires mandatory food labeling of GM foods in stores, and the European Commission (EC) has established a 1% threshold for contamination of unmodified foods with GM food products[9].

United States

In the United States, the regulatory process is confused because there are three different government agencies that have jurisdiction over GM foods. To put it very simply, the EPA evaluates GM plants for environmental safety, the USDA evaluates whether the plant is safe to grow, and the FDA evaluates whether the plant is safe to eat. The EPA is responsible for regulating substances such as pesticides or toxins that may cause harm to the environment. GM crops such as B.t. pesticide-laced corn or herbicide-tolerant crops but not foods modified for their nutritional value fall under the purview of the EPA. The USDA is responsible for GM crops that do not fall under the umbrella of the EPA such as drought-tolerant or disease-tolerant crops, crops grown for animal feeds, or whole fruits, vegetables and grains for human consumption. The FDA historically has been concerned with pharmaceuticals, cosmetics and food products and additives, not whole foods.

LABELING GENETICALLY MODIFIED FOOD IN INDIA

In 2006, India proposed a draft rule requiring the labeling of all genetically modified (GM) foods and products derived thereof. This paper assesses the economic implications of introducing such a mandatory labeling policy for GM food. Focuses on four products that would likely be the first affected by such a regulation in India are: cottonseed oil, soybean oil, brinjal (egg plant), and rice. It has been found that GM food labeling would generate a specific market outcome for each of these products. With GM labeling, virtually all cottonseed oil would be labeled as GM, with limited costs for all factors involved, but also limited benefit for consumers. Labeling soybean oil derived from GM crops could affect market shares for edible oils at the benefit of domestic oils, and non-GM soybean oil could appear on the market at a very limited scale. Labeling GM brinjal would be extremely challenging. Assuming it was implemented, some non-GM brinjal would be sold at a premium in high-income retail outlets, while virtually all others would be labeled GM. A similar outcome would occur for rice, with high-quality rice used for both domestic consumption and exports markets certified non-GM and most of the remaining rice labeled as GM.

CONCLUSION

Genetically-modified foods have the potential to solve many of the world's hunger and malnutrition problems, and to help protect and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicides. Yet there are many challenges ahead for governments, especially in the areas of safety testing, regulation, international policy and food labeling. Many people feel that genetic engineering is the inevitable wave of the future and that we cannot afford to ignore a technology that has such enormous potential benefits. However, we must proceed with caution to avoid causing unintended harm to human health and the environment as a result of our enthusiasm for this powerful technology.

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WASTE WATER, A POTENTIAL RESOURCE FOR IRRIGATION

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Waste water is gaining popularity as a source of irrigation water in different countries around the world. This is especially true in India, where it has been in use for a long time. Its economic benefits and its importance as a coping strategy for the poor have had little recognition. The lack of alternative source of water has generated viable markets for wastewater. Increased disposable incomes have resulted from the catalytic use of waste water that was formerly not socially acceptable, i.e. the farmers considered it unhealthy and unclean. The use of waste water to grow food crops poses uncertain risks to the health of both, the consumers and to those who actually handle the waste water. It is useful in the discussion to differentiate between unplanned use of waste water resulting from poor sanitation and planned use which tries to address matters such as economic benefits but also institutional challenges and risks which require different management approaches and ideally different guidelines. This diversity makes the current WHO guidelines, which try to be global in nature, complex to understand and apply.

INTRODUCTION

Describing the present use of waste water in the agricultural practices of developing countries is not an easy task. On one hand, there is a lack of reliable and sufficient information and on the other hand, the available information does not use uniform terms and units to describe these practices, making it difficult to compare the data or to establish global inventories. In many countries, as a result of rapid urbanization and due to the lack of wastewater treatment facilities, urban farmers after use wastewater either directly from sewage drains or indirectly through wastewater-polluted irrigation water. Waste water use in agriculture is a common practice and is increasing as a result of the rising water scarcity worldwide[1]. But the use of wastewater for agricultural purpose can pose a significant occupational and public health risk[7].

The role of wastewater in agriculture has become increasingly important Worldwide, its agriculture use is not limited to arid areas. As both industry and populations continue to increase and fresh water availability decrease, wastewater becomes an important regional planning variable.

Land application of wastewater is a wide spread practice with a long tradition in many countries around the world. For centuries, farmers in china used human and animal excrements as fertilizers. In many European and North American cities, wastewater was disposed of in agricultural fields before the introduction of wastewater treatment technologies to prevent pollution of water bodies. In developing countries like China, Mexico, Peru,

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Egypt, Lebanon, Morroco, India and Vietnam, wastewater has been used as a source of crop nutrients over many decades[4, 8].

In India, wastewater irrigation is increasingly used for such crops as vegetables, fruits, cereals, flowers and fodders. Kolkata has a long history of using wastewater stabilization tanks for aquaculture. The rural of areas downstream of Vadodara in Gujrat, present an interesting case where waste water supports annual agricultural production worth Rs 266 million (U.S $ 5.5 million). Both food crops and cash are irrigated by domestic waste water and industrial effluent.

Therefore, agricultural use of untreated wastewater has been associated with land application and crop production for centuries.[11] However over the years, it has become less popular in developed countries with the improvement of treatment technologies and increased awareness of the environmental and health issue associated with the practice by contrast in developing countries, due to variety of factors described later farmers use it improve their livelihoods.

USE OF WASTEWATER IN IRRIGATION SYSTEM

In the literature, there is no comprehensive global inventory of the extent of non treated wastewater. Based on information from the countries providing data on irrigated areas, it is estimated that more than 4-6 million hectares (ha) are irrigated with wastewater or polluted water[8,9,11]. A separate estimate indicates 20 million ha globally an area that is nearly equivalent to 7 per cent of the total irrigated land in the world[10].

The resulting agricultural activities are indeed most common in and around cities[6]. But, can also be seen in rural communities located downstream of where cities discharge unless treatment or self purification processes take place. Much of this use is not international and is the consequence of water sources being polluted due to poor sanitation and waste disposal practices in cities. It was suggested from a survey across the developing world that wastewater without any significationt treatment is used for irrigation purposes in four out of five cities[2].

Few studies have quantified the aggregate contribution of wastewater to food supply. In Pakistan about 26 per cent of national vegetable production is irrigated with wastewater[5]. while in Hanoi, Vietnam which is much better than Pakistan about 80 percent of vegetable production is from urban and peri-urban areas irrigated with diluted wastewater.[3] Major cities in West Africa between 50% and 90% of vegetables consumed by urban dwellers are produced with in or close to the city[6]. Where much of the water used for irrigation is polluted. Faislabad is the third largest city of Pakistan, a detailed description of the city and its wastewater use practices is given by Ensink[2].

Sewage wastewater has source of different and many solid waste so ionic concentrations and hardness in wastewater is higher than in ground water. Sewage wastewater proved superior to ground water for the growth parameters giving higher shoot length, shoot fresh weight and dry weight, leaf number and leaf area. This may be because of the presence of essential mineral nutrients in wastewater like N_2, P, S, Ca and some of the micronutrients (Table 1) resulting in increased growth. Similar views have also been expressed[13,14]. The role of these nutrients is well known. For example, nitrogen is essential for cell division and expansion; Sulphur for certain amino acids and vitamins and the role of Phosphorus for energy transfer compounds[15].

Table-1 Comparison of physico-chemical characteristics of sewage wastewater and ground water

Determination	Sewage wastewater	groundwater
1. PH	8.2	7.5
2. EC	1210 dSm^{-1}	573 dSm'[1]
3. TDS	1421 mg/1	542 mg/1
4. BOD	155.18 „	16.75 „
5. COD	366.0 „	38.5 „
6. Calcium	157.05m.mol/1	23.98 m.mol/1
7. Magnesium	132.0 „	26.0 „
8. Carbonate	94.85 „	19.32 „
9. Bicarbonate	219.20 mg/1	68.0 mg/1
10. Chloride	130.70 mg/1	74.66 mg/1

The physiological parameters i.e. total chlorophyll content and photosynthetic rate were significantly enhanced by the application of wastewater as compared to ground water. It may also be due to the presence of many important nutrients in the wastewater in surplus amount. For eg. Mg, which is an important constituent of chlorophyll and K has a role in photosynthesis as a co- factor for many photosynthetic enzymes[16, 17]. Earlier reports have also indicated the beneficial effect of waste water on chlorophyll contents[17].

Thus the application of sewage wastewater may lower pressure on fertilizer industries as well as on major fresh water resources.

Table 2. The characteristics and composition of liquid distillery effluent parameters

1. Colour	Dark Brown
2. Odour	Unpleasent
3. PH	7.8
4. Electrical Conductivity	20.8 dsm-1
5. Organic Carbon	0.8 %
6. TDS	14635 mg/1
7. BOD	4620 mg/1
8. Total suspended particle	3800 mg/1
9. COD	20000 mg/1
10. Nitrogen	0.19%
11. Total Phosphorus	6 ppm
12. Potassium	5356 ppm
13. Total Calcium	100m.mol/l)
14. Total Magnesium	120 „
15. Sulphite	4.20 „
16. Chloride	14.40 „
17. Sodium	20.0 ppm
18. Zinc	6.0 „
19. Copper	3.0 „
20. Iron	38.0 „
21. Maganese	2.0 „
22. Boron	0.4 „
23. Carbonates	Nil
24. Bi Carbonates	150 mg/1

EFFECT OF WASTEWATER ON PLANT GROWTH

As a consequence of the high global food demand it is not surprising that, worldwide, the biggest user of wastewater is agriculture[23]. As important factor which makes wastewater valuable is that it is a reliable source of water as it is available all year round unlike pluvial precipitation or seasonal streams.

Where vegetables are the main commodity produced with wastewater there can be a more balanced diet. In the case of Accra, for example more than 200000 people eat vegetables produced with wastewater everyday[19]. On the other hand this is also the group potentially at risk as the possible adverse health effects to farmers and consumers are well established[10].

Wastewater recycles organic matter and a larger diversity of nutrients than any commercial fertilizer can provide. It is estimated that 1000 cubic meters of municipal wastewater used to irrigate one hectare can contribute 16-62 kg total N_2, 4-24 kg P, 2-69 kg K, 18-208 kg Ca, 4-110 kg Mg and 27-182 kg Na[20]. It therefore can reduce the demand for chemical fertilizers especially where the wastewater is not diluted i.e. make crop nutrients more accessible to poor farmers. On the other hand, excessive concentration of nitrogen in wastewater can lead to over fertilization and cause excessive vegetative growth, delayed or uneven crop maturity and reduced quality[20, 21].

Most crops give higher potential yields with wastewater irrigation reduce the need for chemical fertilizers resulting in net cost savings to farmers. Thus it is important to understand the specificity of crop effluent liasions for their appropriate application in irrigation practices[22].

CONCLUSION

With an increasing world population and improved living standards domestic water use will increase and so will the production of wastewater, excreta and biosolids. Simultaneously there are many regions facing severe fresh water shortages which are responding increasingly with unplanned or planned wastewater use. Water scarcity will thus continue to be a key driver for the recycling wastewater next to poor sanitation and wide spread water pollution. Reuse will be supported by economic and environmental perspectives to substitute for some uses that do not need potable water quality and will contribute to nutrient recovery[24].

The global fertilizer and energy crises call for the development of alternative solutions for producing affordable nutrients which can sustain agricultural food production. A new paradigm in waste processing is needed. Pollution growth, urbanization and improved quality of life are accompanied by an increase in demand for food and water, leading to the generation of large concentrations of waste products originating from urban centers.

Under these conditions, resource recovery of biosolids, water and nutrients become essential. The most appropriate options for water and excreta reuse are offered by the agricultural sector which uses on average around 80 per cent of total water consumption in developing countries, moreover, agricultural accepts a lower water quality compared to other uses[23]. In fact, water and nutrient recovery is happening extensively already but the practice at present is not free from risks to move forward, a strategy that accommodates the needs of the users. While full filling the public health and environment requirements is essential. This strategy should be developed locally based on local options and needs and can contribute to financing treatment facilities.

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INDOLE-3-CARBINOL : A BOON TO CANCER PATIENT

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The present article shows the importance of indole-3-carbinol, a product of cruciferous vegetables (cabbage, cauli flower, brussel sprouts) which contains numerous vitamins, minerals and photochemical. Indole-3-Carbinol, a major indole metabolite is a good chemo preventive to inhibit the development of tumours of fore stomach, glandular stomach, mammary gland, uterus and liver. Experiments of Indole-3-Carbinol on Swiss albino mice's skin was carried out and it was found that 44% of male and 29% of female mice remained tumour free in the experiment. A significant delay in the tumour induction time was also observed in Indole-3-Carbinol treated animals.

Cancer is becoming a leading cause of death in old age population groups. Most cancers arise in adults and at an advanced stage and the risk increases exponentially with age. Probably more than any other single disease, cancer provokes fearful images of pain disfigurement and inevitable death. According to Willis(1960)- "A tumour is an abnormal mass of tissue the growth of which exceeds and it is uncoordinated with that of normal tissues and persists in the same excessive manner after the cessation of stimuli which evoked the change"[10]. Yet cancer is not a single disease, it exists in more than 100 forms and has many causes from genetic factors to infections. Cancer may best be regarded as a group of diseases characterised by

- abnormal growth of cells
- ability to invade adjacent tissues and even distant organs
- death of the eventual abnormal growth of cells
- affected patient, if the tumour has progressed beyond the stage when it can be successfully removed or cured.

On the basis of their invasiveness tumour can be broadly divided into two categories that is benign and malignant tumours.

BENIGN TUMOURS

It does not invade the neighbouring normal tissues from which it originates but pushes it aside and grows by expansion. It still shows the characteristic histological pattern of its tissue of origin to a great extent.

MALIGNANT TUMOURS

It may have a slow or fast growth rate but its tendency to grow is irreversible. It infiltrates, invades, displaces and destroys the neighbouring tissues.

CANCER REDUCTION

The aim of cancer education is to motivate people to seek early diagnosis and early treatment. Organisations working for prevention of cancer in many countries educate the public to the early

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warning sign (danger signal) of cancer. Some of these are :

(i) a lump or hard area in the breast,

(ii) any change in a wart or mole,

(iii) a persistent change in digestive or bowel habits,

(iv) a persistant cough or hoarseness,

(v) a swelling or sore that does not get better,

(vi) unexpended loss of weight.

CANCER CHEMOPREVENTION

Cancer chemoprevention is a promising strategy of prevention of cancer by the administration of one or more chemical entities either as individual drugs or as naturally occurring constituent of the diet[5].

CLASSES OF CHEMO PREVENTIVE AGENTS

The three types of chemo preventive agents are as below-

1. Preventing Agents : Compounds that prevent formation of carcinogens from their precursors.

2. Blocking Agents : Compounds that inhibit carcinogenesis by preventing carcinogenic agents from reaching or reacting with critical targets in the tissues i.e. they perform a barrier function.

3. Suppressing Agents : Inhibitors that act subsequent of exposure to carcinogenic agents.

QUALITIES OF CHEMO PREVENTIVE AGENTS

The chemo preventive agent should have the following qualities-

(a) little or no toxic effects,

(b) high efficacy,

(c) capability of oral administration,

(d) known mechanism of action,

(e) low cost.

DIETARY INHIBITORS OF CHEMICAL CARCINOGENESIS

In recent years a considerable number of dietary compounds have been found to protect against the occurrence of neoplasia. The diversity and widespread occurrence of food compounds make it virtually impossible to consume a diet that does not contain inhibitors of carcinogenesis[9].

Table–1 : Categorises of food with the most prominent chemopreventors

Type of food	Chemopreventors
Fruits (pomegranate, blue-berries, plums, oranges, grapes, cherries)	Vitamins, flavonoids, polyphenolic acids, fiber, monoterpenoids (d-limonene)
Vegetables (spinach, brussels sprouts, beets, onion, corn)	Vitamins, flavonoids, plant phenolics, chlorophyll, fiber , carotenes, aromatic Isothiocya-nates, Dithiolthiones, phytic acid calcium
Cereals	Fiber, alpha-tocopherol, phytic acid, selenium
Meat, fish, egg, poultry	Conjugated isomers of linoleic acid, vitamin A vitamin E, selenites
Fat, oil	Fatty acids,Vitamin E
Milk	Fermentation products, calcium, free fatty acids
Spices	Coumarins, curcumin, sesaminol
Tea	Polyphenols
Coffee	Polyphenolic acids, diterpene alcohol esters, melanoid
Wine	Flavonoids
Water	Selenium

Diet is a complex mixture and co operation or interaction of individual components in the diet is a confounding but interesting possibility. The potential role of diet in the causation of disease is well organized . Dietary indiscretion either through ignorance, poverty or socio cultural practices may be etiological important in the epidemiology of disease, including certain types of cancer. For the prevention of human cancer, dietary inhibitors of mutagenesis and carcinogenesis are of particular interest.

Chemoprevention of cancer may be defined as an attempt to use natural and synthetic compounds to intervene in the early stages of cancer against the development, before invasive disease actually spreads. Dietary constituents of cruciferous and organosulphur compounds are the source of some of the most promising cancer chemo preventive[4]. Many vegetables, fruits and grains are known to offer protection against cancers. Pomegranate an ancient fruit has powerful antioxidant and reduces hepatocellular carcinoma by regulating several house keeping genes under the control of NrF 2 without toxicity[2]. Dietary canola oil significantly ($p<0.05$) decreased colonic tumour incidence and tumour multiplicity as compared to dietary corn oil in rats[1]. In order to have a novel drug such compounds must be relatively non toxic and cost effective.

The cruciferous vegetables (cabbage, cauliflower and brussel sprouts) are a rich source of compounds including Indole derivatives i.e. Indole-3-Carbinol, Indole-3-Acetonitrile, Dithiolthiones and Isothiocyanates. Indole-3-carbinol (^{13}C), is a member of sulphur containing chemicals called glucosinolates. It is formed from parent compounds whenever cruciferous vegetables are crushed or cooked. Indole -3-Carbinol and other glucosinolates are antioxidants and potent stimulators of phase 1 and phase2 detoxification enzymes in the liver and intestinal epithelial cells. Glucosinolates are a group of secondary products commonly found in plants of the family Cruciferae. They upon enzyme hydrolysis give rise to a range of volatile pungent and physiologically active compounds eg. the Indole glucosinolates (glucobrassicins). This compound on chemically or enzymatically hydrolysed ,give rise to a range of involatile Indole compounds which shows the anticarcinogenic and mixed function oxidase (MFO) stimulatory activities of brassica vegetables[3]. Indole-3-Carbinol was most effective as a radical scavenger in the microsomal CC14 initiated system by inhibiting lipid peroxidation in a dose dependent manner[7]. Indole-3-Carbinol also inhibits the genotoxicity of alkylating agent like cyclophosphamide (CP) which forms crosslink to DNA molecule.

HOW TO USE CRUCIFEROUS VEGETABLES

Cruciferous vegetables must be chopped or chewed or crushed in a proper way for maximum advantages. The myrosinase enzyme is separated from the glucosinolates in the intact vegetables; indolythiocynates are formed from the broken plant cell. The more you chop before cooking or chew if eating raw the better it may be. Some Indole thiolcynates benefit may be lost with boiling or steaming, so we get maximum benefits from eating the cruciferous vegetables raw.

Another way cruciferous vegetables may help to protect against cancer is by reducing oxidative stress. Oxidative stress is the overload of harmful molecules called oxygen free radicals, which are generated by the body. Reducing these free radicals may reduce the risk of colon, lung, prostate, breast and other cancers.

From the above, as we know that interest in Indole-3-carbinol has remained high because it has several characteristics that are desirable in a candidate chemo preventive agent. We have done several experiments of Inole-3-Carbinol on mouse skin and also in mouse bone marrow cells. To study the potential of Indole-3-Carbinol in mouse bone marrow cells. We have given Indole-3-Carbinol (5mg/kg) orally to mice five days prior to Cyclophosphamide(25 or 100mg/kg b wt) administration. Mice exposed to Indole-3-Carbinol (5mg/kg body wt) for five consecutive days induced mild frequency of chromosomal aberration (chromosome breaks and fragments). The frequency of chromosomal aberrations in cells was much lower than that of cyclophosphamide (25 mg/kg or 100mg/kg) induced 5.88% and 8.47% aberration while with (Indole-3-Carbinol) the frequency declined to 1.72% and 3.86% respectively. In second experiment we checked the antitumor promoting activity of Indole-3-Carbinol in mouse skin . Here we use 7,12- Dimethyl benzanthracene (DMBA) as tumour initiator and 12-o-tetradecanoylphorbol-13-acetate (TPA) as tumour promoter. About 44% male and 29% female mice remained tumour free at the end of the experiment[8]. Above experiments indicate that Indole-3-Carbinol has the potential to inhibit the development of neoplasia in sacrificed animals. Diet has become a key factor in the fight against cancer. It is observed that people who were regular consumer of green leafy vegetables food had approximately 60% less cancer. All vegetables are not equally protective. Epidemiological studies suggest that cruciferous vegetables, onions and mushrooms are far more protective against cancer than vegetables over all. We should take anti cancerous diet by including at least 4 fresh fruits daily, at least one large raw green salad as well as two other cooked (steamed) vegetables, such as broccoli, carrots and peas, squash or other colourful vegetables[6]. Nowadays individuals are very-aware and very choosing to modify their lifestyle to improve their health or reverse diseases.

Acknowledgement —We are extremely grateful to Dr. Yogeshwer Shukla, Scientist, Environmental Carcinogenesis Division, IITR, Lucknow for his expert guidance.

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DETECTION OF COAL FIRES USING REMOTE SENSING IMAGES

Laxmi Shiveshwari[1], H. N. Sinha[2] and Rishikesh Bharti[3]

The surface and sub-surface coal fires are very severe problem for the most coal producing countries. With the advancement in remote sensing sensors and image processing techniques, ample spatial, spectral and temporal information can be acquired for the objects within the field of view (FOV). Since 1960, remote sensing images have been used to identify the surface and sub-surface coal fires with the synoptic view of a wide area in a single frame. Since then various high resoloution (spectral, radiometric and temporal) images came into use. The potential use of various satellite/sensor images like Landsat, ASTER and MODIS have been evaluated for detection and mapping of coal fires. Combustion of coal is a chemical process which releases energy : Coal + O_2 → CO_2 + Energy. This released energy is responsible to make coal fire detectable by short wavelength infrared images. Nowadays, a number of satellites are available which collects images in thermal infrared region and have been successfully used in various studies. For monitoring the coal fire over a period, temporal resolution plays a vital role.

INTRODUCTION

The surface and subsurface coal fires are the serious problem in many developing countries such as India, Indonesia and China[1]. In fact, coal fires are the result of spontaneous combustion of coal with oxygen and ambient temperature. The temperature starts to rise and when in reaches between 80°-120°C, the gaseous products mainly carbon dioxide liberates. The temperatue still to continue rise and when it reaches between 230°-280°C, the exothermic reaction takes place and burning of coal starts. The high ranking coals such as anthracite and sub bituminous varieties are susceptible to spontaneous combustion. Pyrite (FeS_2) is found associated with some coals as in impurity and it was believed once that the presence to pyrite in coal is the main cause of spontaneous combustion, but now it is thought that the oxidation of pyrite leads to breaking down of the coal into smaller fragments and exposing a larger surface area to the air[2]. An adequate flow of air through fissures, crakes and joints to sub surface coal deposit encourages fire through oxidation. However, the thermal conductivity of coal is poor and the heat produced by the oxidation is generally removed by rapid air flow and thus coal does not reach to its combustion of coal starts. The presence of moisture also plays an important role in coal firing. A specific amount of water is required during oxidation which produced intermediate compounds. When water vapour from the atmosphere reacts with coal then heat is liberated in the form of wetting and condensation heat. The reaction with liquid water produced wetting heat. Hence, it is always advisable not to use water to extinguish a coal fire. The low-rank coals have high heat of wetting and burning is often associated with such coals[2].

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Until 1960, underground coal fires were monitored by borehole temperatue, but it was difficult to get data for a large-scale synoptic view of the coal fire propagation. At the same time, this method was too expensive to monitor the coal fire. The airborne thermal infrared scanners became available in the 1960s and it was theoretically possible to demarcate the land surface temperatures over a large area. The thermal scanners on satellites have been used since mid-1980[2]. In 1962, 223 underground coal fires were detected in United States[3] and because of the fact, the necessary technology was more easily available to this country, the first remote sensing for coal fire detection studies were carried out there only. The use of airborne infrared scanners for the identification of underground coal fires were first described in Pennsylvania[4]. Reconofax-IV thermal infrared scanning systems were used to get surface thermal anomalies[4] in detecting coal fire in Pennsylvania. For understanding the coal fire dynamics, the following multispectral and hyperspectral satellite/ sensores can be used :

1. ESA-European Remote Sensing (ERS) satellites images.
2. NOAA-Advanced Very High Resolution Radiometer (AVHRR).
3. System for Earth Obervation (SPOT).
4. MODIS (Moderate Resolution Imaging Spectroradiometer).
5. Landsat Images.
6. ASTER (Advanced Spaceborne Thermal Emission and Reflection Rediometer).
7. Hyperion Images.
8. Airborne Visible/Infra-Red Imaging Spectrometer (AVIRIS).
9. Hyperspectral Digital Imagery Collection Experiment (HYDICE).

All these satellite and airbone sensors have their limitations and each of them partially detect fires depending on size of the fire, depth of the fire, topography of the area, month and time of data acquisition, existing weather conditions, etc. For example, in optical imagery, the brunt cap rock above the coal fire displays a unique spectral signature compared to the natural overburden. But, the optical imagery does not indicate the brunt cap rock due to present coal fire or due to palaco coal fire. The palaeo coal fires have been reported due to spontaneous combustion since Pleistocene (less than 1 million year) time in Sinjiang, northwest China[5]. Smoke and thermal anomalies are the best indicators of fires and recognized on air photos and thermal infrared imagery respectively.

The satellite imagery derived from the Landsat and SPOT statellites have been used to demarcate and delineate the coal fire areas. The six optical bands of Landsat TM with 30 m resolution provide data on brunt cap rock. SPOT-XS (three bands) at 20m spatial resolution is less useful than TM, in terms of area covered and choice of spectral bands. SPOT-Panchromatic Images (10 m spatial resolution) in stereo mode is also a useful tool. Russian SOYUS satellite images provide colour infrared aerial photographs with spatial resolution between 5m and 10 m. The data thus collected from the satellite has to be corrected geometrically. The method of geometric correction used for optical satellite systems (SPOT XS and Landsat TM) is done by selecting suitable ground control points (GCP's) at 1 : 50000 scales and then locating these on the images. Generally, on an average 30 GCP's are used to rectify the satellite image. The geometric corrections are vital for accurate temporal and multi-sensor image registration. For detection of coal fires, the images are radiometrically enhanced to maximize detection abilities. Hence, destripping of the Landsat TM images are done first followed by application of image enhancement techniques such as colour generation composite, contrast stretching, haze correction, principal component transformation etc. In the coal fire areas the best result for geological interpretation are achieved by using TM bands 4, 5, 6 of blue, green and red respectively. However the active coal fires cannot be detected directly on optical satellite imagery but the smoke or steam emitting through cracks on the surface can be noticed[2]. Landsat TM band 6 and Landsat TM/ETM+ band 7, data acquired in the 10-12.4 μm spectral region respectively are potentially used for the identifications of surface and sub surface coal fires[2, 6-9]. Some workers have only used day time data take between 9 : 30 AM and 10 : 30 AM by Landsat-7 ETM/TIR for delineating coal fires in Jharia coalfield, India. In the Lnadsat-7 ETM (Enhanced Thematic Mapper) the spatial resolution is 60m of thermal sensor and this is able to detect much smaller coal fires.

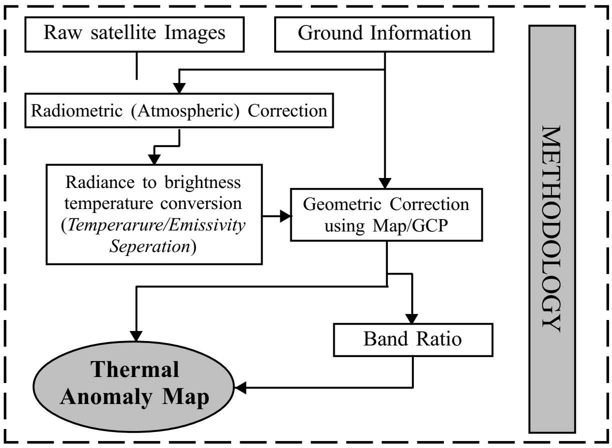
Apart from Landsat TM there are other satellite sensors which acquire data in the thermal wavelength bands. They are NOAA-AVHRR (Advanced Very High Resolution Radiometer) has several spectral bands in the thermal infrared region; channel-3 (3. 55-1.05 μm). Channel-4 (10.3-11.3μm) and channel-5 (11.5-12.5 μm) with 1km spatial resolution. Some workers reported the AVHRR band 3 data to detect the sub surface coal fires in the Jharia coalfield. The other satellite data used for thermal anomaly in form ATSR (Along Track Scanning Radiometer). This operates in the thermal infrared wavelength at 11μm, 12μm and 3.7μm in night time with 1km spatial resolution. The Russian RESURS-1 satellite have thermal sensor has a spatial resolution half-why between Landsat and NOAA-AVHRR as well as ATSR satellite sensor.

METHODOLOOGY

The heat released from combustion of coal does not necessarily escape from the surface, but the soils or rocks above the fire get heated due to conduction of heat. The thermal infrared images recorded by various satellites have been used to identify these thermal anomalies. The hot spot (local areas of elevated temperatures) identified by satellite images and the ground information together can be used to study the area. The temporal resolution can be used to monitor such area. In this study, we present the methodology which has been successfully used in monitoring and identification of coal fires.

The images recorded by sensors in thermal infrafed wavelength (3-14μm) region of the electromagnetic spectrum exploits the fact that above absolute zero (0°K/-273° C) everything emits energy. This emitted energy is recorded by the thermal infrafed sensors in terms of digital numbers. The relationship between the radiated energy recorded by the sensor and the temperature of the surface can be resolved by using Planck's law. Based on the differences in temperature, an infrared image will show a good contrast image.

The detection of surface and sub surface coal fires using thermal infrared remote sensing is based on the fact that the fire sources must produced detectable thermal anomalies[2, 7]. However, not all the underground fire produce any detectable temperature rise on the surface if it is located to deep, too low temperature, fire is young and the thermal conductivity of over lying rocks are too low[4].



The detection of thermal anomaly depends on the resolution of the data, the size of anomaly, and the difference between the temperature of the thermal anomaly and overburden background temperature[10]. The Landsat-5 TM thermal sensor acquires data within 10.4-12.5 μm wavelength band with 120m ground resolution. The radiant temperature can be calculated from digital numbers (DN) of Landsat-5 TM digital data[11] with following equation :

$$L_\lambda = L\min + \frac{L\max - L\min}{255} \times DN \quad (1)$$

Where,

L is the spectral radiance (in $W/m^2/Sr/mm$),

L min = 0.1238 $mWcm^{-2}sr^{-1}\mu m^{-1}$ and

L max = 1.56 $mWcm^{-2}sr^{-1}\mu m^{-1}$

Lmin and Lmax values are the minimum and maximum of the radiance recorded by the Landsat TM channel-6. The Landsat-5 TM data from the ground station are radiometrically post calibrated. Hence a linear relation lies between spectra radiance and the corresponding digital numbers (DNs). Planck's blackbody radiation equation expresses relation between the spectral radiance and wevelength with the radiant temperature of an object as follows :

$$L_\lambda = \frac{\varepsilon C_1 \lambda^{-5}}{\pi\left(\exp\left(\frac{C_2}{\lambda T}\right) - 1\right)} \quad (2)$$

Where,

$C_1 = 3.742 \times 10^{-16}$ Wm^2

C_2 = 0.0144 mk, is wavelength in meters,

ε = emissivity of the object

Equation (2) can be rearranged as follows for ratiant temperature,

$$T = \frac{C_2}{\lambda \ln\left(\left(\frac{\varepsilon C_1 \lambda^{-5}}{\pi L_\lambda}\right) + 1\right)} \quad (3)$$

In equation (3), wavelength may be taken as the mean of the spectral region under investigation. Using equation (3), the radiant temperature of a pixel can be calculated if the spectral radiance is known when spectral emissivity of a pixel is available then the kinetic temperature of the investigated pixel may be calculated with following mathematical relation :

$$T_{kin} = \frac{K_2}{\ln\left(\left(\frac{K_1}{L_\lambda}\right) + 1\right)} \quad (4)$$

Where,

K_2 = 1260.56 deg. K

K_1 = 60.776 $mWCm^{-2}sr^{-2}mm^{-1}$

Temperature of the fier pixels obtained by post-calibration method was found low. This appears unrealistic in those areas where surface fires occupy a larger areas extent of the pixels[9]. Recently scene-specific calibration parameters have been used from the kinetic temperature image of Jharia coalfield and surface and subsurface coal-fires pixels are delineated[9].

The ASTER includes five bands in thermal infrared region and can be used to estimate surface kinetic temperatures and emissivity image. The surface temperatues (T) measured by satellities are important in change detection studies. The ASTER temperature/emissivity seperation (TSE) algorithm is used to calculate surface temperature and emissivity images from raw data[12].

Each object has its own spectral emissivity pattern in thermal infrared wavelength region. The man made or natural materials may have high reflectance value in some spectral portion, however, it may absorb in another spectral region. The property is used to enhance the hidden information of the data. Band rationing is a very powerful technique used to highlight spectral properties, compensate the background effects and normalized the effect of sun angle, viewing angle, the atmosphere, topography, instrument noise, etc, to allow consistent spatial and temporal comparisons[13]. To monitor the coal fire over a period, it is very necessary to remove the effect of sun angle, viewing angle, the atmosphere, topography, instrument noise from all the images.

The development of thermal model allows determining the position, temperature, heat output and movement of underground coal fires. Various models have been suggested such as linear heat flow model, spherical models, geological models (deepening model, along-strike model lowering model, upwards models), coal fire depth model etc[2].

COMBATING COAL FIRES PREVENTION PLANS

Each fire represents its unique condition and two different fires situations are not similar. Hence all the fires cannot be controled alike. Several controlling methods have been suggested[2] : (a) loading out the fire (b) underground sealing (c) sufrace sealing (d) flushing with incombustible (e) fire barriers (f) inundation (g) remote sensing.

In Jharia coalfield about 3 million cubic meter of nitrogen gas has been flushed underground coal fires to control it[9]. The technology or remote sensing provides the adequate information for the work plan and planning of the fire fighting team such as area extent, precise size and location of the fire, depth of fire, topographical conditions of the area, infrastructure of the area, access to fire site, estimation of coal reserves, estimation of burnt coal, direction of fire, geomorphic features etc.[9].

CONCLUSIONS

Coal fires severe environmental and economic problems and has been reported in many countries such as USA, Australia, Germany, Spain, Czech Republic, Poland, Pakistan, Indonesia, China, India Venezuela etc. In China, the coal fires have been found in those areas where there is no human mining activity exit. Many palaeo coal fires have been reported there due to spontaneous combustion of coal seams. The remote sensing techniques have been proved reliable to detect location and intensity of thermal anomalies caused by surface and sub surface coal fires. The use of temporal satellite images can give the information about new fires at an early stage and it would be easier and cheaper to control it. Now a day the earth observation satellites are increasing which would provide data for detecting coal fires by using thermal infrared region of electromagnetic spectrum at different spatial, temporal and spectral resolutions combination.

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KNOW THY INSTITUTIONS

NATIONAL JALMA INSTITUTE FOR LEPROSY AND OTHER MYCOBACTERIAL DISEASES

Situated at Agra in Uttar Pradesh, the National JALMA Institute for Leprosy and Other Mycobacterial Diseases (NJILOMD) conducts research on leprosy, tuberculosis, HIV. Established by the Japanese as India Centre of JALMA (Japanese Leprosy Mission for Asia) in 1963, the Institute has a 60 bedded hospital for the treatment and care of leprosy patients. In the outpatient, on an average daily 300 patients are given consultative medical, surgical & preventive care.

THRUST AREAS

The following are the thrust areas of NJILOMD

To develop and standardize techniques of investigation for diagnosis, treatment and assessment for better management of leprosy in close co-ordination with the National Leprosy Eradication Programme (NLEP) in further reducing the disease and preventing deformities.

Early diagnosis and development of tests for early and rapid diagnosis of TB, drug sensitivity testing and designing and evaluating tests for rapid screening of sensitivity profile of *Mycobacterium tuberculosis.*

Operational research in TB including disease prevalence and drug resistance surveys in several districts of the state, molecular epidemiology in the field area, treatment using RNTCP protocols as well as participation in multi-centric studies for treatment and operational research and undertaking vaccine studies in animals with other partners.

In HIV as the NACO centre for ICTC to engage in the diagnosis and counseling as well as monitoring of anti retroviral therapy to patients of the medical college.

To pursue the following activities :

Developing newer modified methods of early diagnosis, assessment of treatment and also investigating the disease at patient and community level in both TB and leprosy.

Improving the methods of treatment in both the diseases and participating in multi-centric trials and studies in both TB and leprosy.

Conducting epidemiological studies such as intervention studies, investigations related to transmission and factors leading to reactions and preventing nerve damage in leprosy.

Participating in operational surveys for disease prevalence & drug resistance surveillance in TB.

Training to medical professionals in private sector and those engaged in National Leprosy Eradication Programme (NLEP).

Transferring the technologies developed/ established at the Institute to other scientists and medical professionals working in different institutions in the country.

Education and training to students, professionals, health workers for human resource development.

Upscaling and accreditation of Intermediate Reference Laboratories of RNTCP programme for drug resistance testing in TB in four states – Assam, Himachal Pradesh, Uttarakhand and Western UP.

INTERNATIONAL RECOGNITION

Participating centre in WHO multi-centric studies on Uniform MDT for all types of leprosy patients.

It is also the surveillance centre undertaking molecular detection of drug resistance in leprosy in coordination with SEARO, WHO.

Its studies on the use of immuno-modulator *Mw* as an adjunct to chemotherapy in CAT I and CAT II pulmonary tuberculosis approved by the FDA, USA.

HUMAN RESOURCE DEVELOPMENT

NJILOMD undertakes various training programmes as mentioned below :

Two day training programme on leprosy for district leprosy officers, medical officers; training ïïon methodology of drug resistance surveys in TB and EQA for smear microscopy.

Training of medical graduates of local SN Medical College as per the curriculum.

DBT multi-centric collaborative projects & trainings to various categories of personnel on molecular techniques (average 12-20 per year) to all categories of technical and scientific staff for over two decades.

Teaching research & training support for M.Sc. in Life Sciences (Microbiology, Biochemistry and Biotechnology) to Bhim Rao Ambedkar University, Agra since 1998.

Short term trainings, specialized trainings and capacity building trainings were imparted to more than 1000 aspirants of various other colleges/ universities/institutions, etc.

Drug resistance surveillance (DRS) training in TB to medical and paramedical staff of 35 districts of Bundelkhand and Western UP since 2007.

Having been recognized as a National Reference Laboratory (NRL) for RNTCP activities of Central TB Division of Government of India NJILOMD is providing training in laboratory diagnosis especially molecular techniques for diagnosis and drug resistance studies on tuberculosis since 2008.

RECOGNITION FOR DOCTORATE/ MASTERS BY A UNIVERSITY

NJILOMD has entered into MOUs with a number of universities for registering PhD students and for M.Sc dissertation projects –

PhD students from

(i) Bhim Rao Ambedkar University, Agra
(ii) Jiwaji University, Gwalior
(iii) Panjab University, Chandigarh
(iv) Rani Durgavati Vishwavidyalaya, Jabalpur

M.Sc dissertation from

(i) Jiwaji University, Gwalior,
(ii) Rani Durgavati Vishwavidyalaya, Jabalpur

Students from Bhim Rao University, Agra, and other regional and national universities are also considered for M.Sc project dissertation.

MAJOR ACHIEVEMENTS

Significant achievements of NJILOMD are the following

Established state of art laboratories e.g. micro-array lab, proteionomics including MALDI-TOF, two BSL-3 laboratories for microbiology and animal experiments with aerosol facility for MTB infection in guinea pigs.

Established a field centre i.e. Model Rural Health Research Unit at Ghatampur (MRHRU) and a satellite centre at Banda, the main focus of which is to bring technology to the people.

Examination of over 30,000 patients of leprosy annually in the OPD of its hospital and providing care and free diagnosis & treatment in the hospital and field for leprosy, TB, filariasis, etc.

Serves as a National Reference Laboratory (NRL) for tuberculosis for 4 states (Assam, Himachal Pradesh, Uttarakhand and Eastern UP) and repository centre for mycobacterial strains.

Established animal house facility as part of the initiative for detecting multi-drug resistancein leprosy using conventional mouse foot pad methods as well as molecular methods for surveillance of multi drug resistance in leprosy.

Serves as a surveillance centre for AIDS control and has a ICTC clinic. Besides testing of foreign nationals it also undertakes free HIV testing and counseling of referred and voluntary patients of the society.

Evaluated and demonstrated the immuno-prophylactic effect of immuno-modulator *Mw* on immuno-prophylaxsis of both TB and leprosy.

Designed several new treatment regimens for leprosy.

WHO has adopted modified PB regimen as uniform treatment regimen for all types of leprosy cases.

Established the safety and usefulness of addition of immunotherapy (*Mw* and BCG to MDT) and is now available in the market for use as Immunovac.

Identified antigenic targets and developed serological tests for leprosy.

Developed new surgical procedures for correction of deformities i.e. JALMA flap for restoration of volume of first web space in muscular atrophy associated with ulnar paralysis in leprosy.

Designed the partial micro array chip for leprosy (metabolic pathways and virulence) and TB (efflux pumps and gene associated quinolones resistance).

Developed new methods for early diagnosis of leprosy using amplification of RLEP, 16s gene region and established it in slit skin smears, biopsy specimens and also in tissue sections using in situ PCR.

Developed in house PCR RFLP based method to differentiate mycobacterial isolates (*M tuberculosis, M avium, M fortuitum* and other pathogens).

Developed molecular typing methods for studying the strain variations in *M leprae* for identification of sources and mode of transmission.

Established the presence of live bacilli in the environment (soil and water samples) by molecular methods.

Established a network of institutes / centres working in leprosy for detection of multi-drug resistance in leprosy using mice model as well as molecular methods.

Established a national repository for myco-bacteria, networking 38 Institutes and Medical Colleges, and supplying various strains to scientists.

Coordinated multi-centric studies on molecular methods (PCR based) for diagnosis of tuberculosis Developed methods for molecular diagnosis of Kala Azar.

Undertaking Government of India sponsored and UP Government funded drug resistance surveys (DRS) in 35 districts of Bundelkhand and Western UP region (in collaboration with STDC Agra and UP Government).

Part of DBT sponsored multi-centric studies of use of immuno-modulator *Mw* as an adjunct to chemotherapy in Cat I Na Cat II tuberculosis.

1175 project dissertation theses, 213 MD theses, and more than 35 PhD theses have been completed, with entire or part of the work performed at NJILOMD, and submitted at various educational institutes/universities.

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Conferences / Meetings / Symposia / Seminars

NATIONAL CONFERENCE ON "ADVANCES IN CHEMICAL SCIENCES" MARCH 1-2, 2013

Jointly Organized by Department of Chemistry, Maharshi Dayanand University, Rohtak - 124001 and Indian Society of Analytical Scientists - Delhi Chapter (ISAS-DC)

Objective and areas :

The areas covered during the Conference are : Analytical chemistry, green chemistry, solutions, organometallic compounds, nanomaterials, toxicology, phase transitions, adsorption processes, ligand binding processes and eco-friendly systems etc.

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7th INTERNATIONAL SYMPOSIUM ON "FEEDSTOCK RECYCLING OF POLYMERIC MATERIALS" (7th ISFR 2013)

Venue : India Habitat Centre (IHC), New Delhi, 23-26 October, 2013

Theme :

The symposium encompasses all topics related to the recycling and recovery of polymeric wastes like waste plastics (municipal, industrial, production, process, e-waste) and biomass.

- Polymer waste management around the world-holistic view
- Polymeric waste availability and conversion methods-statistics and strategies
- Mechanical recycling of waste plastics
- Metal recovery from polymeric wastes
- E-waste treatment techniques
- Thermo-chemical routes (pyrolysis, gasification, combustion, etc) for industrial, municipal plastic wastes and biomass.
- Novel materials / catalysts for conversion process
- Energy from waste polymeric materials
- Biological routes for industrial, municipal plastic wastes and biomass
- Novel analytical techniques (separation and analysis)
- Sustainability - LCA studies
- Going global - Opportunities and challenges

Contact : *Dr. Thallada Bhaskar*, Senior Scientist & Head, Biomass Thermocatalytic Processes Area (TPA) Bio-Fuels Division (BFD) CSIR - Indian Institute of Petroleum (IIP) Council of Scientific and Industrial Research (CSIR) Dehradun - 248 005, Uttarakhand, India Website : www.isfr2013.org

S & T ACROSS THE WORLD

HOW TO BOIL WATER WITHOUT BUBBLES

One trick to test whether a frying pan is hot enough is to sprinkle water on it. If the surface is sufficiently above the boiling point of water, droplets will skip across the pan. Those jittery beads of water are held up from the hot pan by a cushion of steam. The vapour cushion collapses as the surface falls below the 'Leidenfrost temperature', causing furious bubbling and spitting when the water droplet hits the surface and boils explosively

The Leidenfrost effect lies behind the discovery, published in *Nature,* that water can be made to boil without any bubbling if a surface is specially treated so that the vapour cushion does not break down. The key is to make the surface very water-repellent, according to Ivan Vakarelski, an engineer at the Clean Combustion Research Center at the King Abdullah University of Science and Technology in Thuwal, Saudi Arabia, and his colleagues. The effect might be used to carefully control how metals are cooled and heated, or to reduce drag on ships.

Vakarelski's team covered metal spheres with a commercially available coating that made the surface rough and strongly water-repellent, and heated these superhydrophobic spheres to 400°C (any higher and the coating would deteriorate). For comparison, they heated a set of smooth, water-attracting spheres to 700°C.

Each hot sphere was dropped into room-temperature water, where a layer of water vapour formed around it. The vapour layers around the water-loving spheres quickly collapsed, leading to explosive bubbling. The coated spheres, by contrast, kept their vapour layers as they cooled down, with no bubbling or explosive boiling.

"We thought we could improve the transition" from the Leidenfrost regime to bubbling, says Vakarelski, "but we are not only lowering the transition, we are completely avoiding it".

"It was really dramatic," says Neelesh Patankar, a theoretical mechanical engineer at Northwestern University in Evanston, Illinois, and a co-author of the paper. "As the temperature goes down, this vapour phase nicely settles down."

The implications of the work could be far-reaching, says Vincent Craig, an applied mathematician at the Australian National University in Canberra, who studies the physics of surface forces and bubbles. "They've shown that by keeping the surface rough you can keep that vapour layer at low temperature." The effect could be used to reduce drag on surfaces such as the tiny channels in microfluidic devices, he suggests.

In a related experiment, the team dipped metal rods with the same water-loving and water-hating surfaces into water. Heaters inside the rods warmed them, while probes monitored their temperature. The water-loving rods could only ever reach 106° C, because the water was always coming into contact with the metal and cooling it. But the coated spheres got up to 250° C, because they were constantly protected from the cool water by the vapour layer.

The next step, says Patankar, is to try to get the vapour layer to form at temperatures much lower than the boiling point of water. Water can exist as either liquid or vapour at room temperature, but it requires energy to stay in the vapour state. Patankar thinks that a surface could be designed that would make the vapour state more stable. A coating could then be used to form a vapour layer round a ship's hull to reduce drag or discourage organisms such as algae or barnacles from attaching themselves to the ship, he suggests. "It will be mind-blowing," says Patankar. "Who thinks of getting a vapour without heating?" (Nature, Sept. 12, 2012)