EVERYMAN'S SCIENCE

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As per decision of Council meeting held on May 03, 2014, Presidential Address will not be printed henceforth in Everyman's Science as they are already printed in the above mentioned book.

EDITORIAL

A Brief Outline on Parkinson's Disease

Since ancient times the conditions of Parkinson's Disease are known. In Ayurveda this condition was described as Kampavata. In western medical literature it had been described as 'Shaking Palsy' in A.D. 175. In 1817 James Parkinson a London based doctor wrote an assay which had established Parkinson's disease as a recognized medical condition. Jean Martin Charcot recognized the importance of Parkinson's work and named the disease after him. Continuous research has advanced our knowledge in this field. But there is still a large lacunae in knowing the indepth mechanism of development of Parkinson's disease. The symptoms in this disease are progressive and degenerative and generally affect older people. It is understood that there is still no cure for this disease. However, severity of the disease can now be effectively controlled. An estimated 7-10 million people are living with Parkinson's disease and resulted in the death of about 103000 worldwide. Incidence of Parkinson's disease increased with age and 4% of people with the disease are diagnosed before the age of 50. It is a neurodegenerative brain disorder that progresses slowly in most people. In most cases it takes years to develop. This disease is not fatal but the complications from the disease are serious. It is known that there are neurons at the region of Substantia nigra of human brain which produce dopamine. Dopamine acts as a chemical messenger in communicating between the Substantia nigra and another area of the brain called Corpus striatum. This communication coordinates smooth and balanced muscle movement. A lack of dopamine results in abnormal nerve functioning which causes a loss in the ability to control body movement. Dopamine helps humans to have smooth, coordinated muscle movement. When 60-80% of the dopamine producing cells are damaged and do not produce enough dopamine the motor symptoms of Parkinson's disease develops and the process is known as neurodegeneration. There are four primary symptoms of Parkinson's disease such as tremor or trembling in hand, arms, legs, jaw and face, rigidity or steepness of limb and trunks, slowness of movement, impaired balance and coordination. Patients may have difficulty in walking, talking and doing other simple tasks when these symptoms are more pronounced. This disease is both chronic and progressive. Chronic type of disease persists over a long period of time whereas in progressive type the symptoms grow worse over time. Although some people become severely disabled others get only minor motor disruption. Presently it is not possible to predict which symptoms will affect an individual and intensity of the problem varies from person to person. A group of scientists believe that earliest sign of Parkinson's disease are found in enteric nervous system, the medulla and particularly olfactory bulbs which control the sense of smell. This hypothesis is increasingly supported by the evidences that non motor symptoms such as loss of sense of smell, sleep disorder and constipation may precede the motor features of the diseases by several years. Researchers are now focused on these non-motor symptoms for both detecting Parkinson's disease as early as possible and to find out the ways to stop progression. There is increasing evidence that Parkinson's disease may be passed genetically from family members. There is controversy about the possibility of a genetic cause of Parkinson's disease in a small number of families. Specific genetic abnormality leading to illness has been identified. However, the vast

majority of people with Parkinson's disease do not have one of these identified genetic abnormalities. It is probable that in people who develop Parkinson's disease early in life may be due to genetic component. In recent years several genes that are directly related to some cause of Parkinson's disease have been discovered. In terms of pathophysiology Parkinson's disease is considered as synucleiopathy due to an abnormal accumulation of α- synuclein protein in the brain in the form of lewy bodies. There are some evidences that certain toxin in the environment may cause Parkinson's disease. Scientist has suggested that external and internal toxin may selectively destroy dopaminergic neurons causing the disease. These factors may include manganese, carbon mono oxide, carbon di oxide and some other pesticides.It is also believed that oxidative stress can cause Parkinson's disease.Free radicals are normally formed in the brain and body but there are mechanisms to get rid of them .In people with Parkinson's disease this defensive mechanism fails,Oxidation is thought to cause damage to tissues including neurones. The exact cause of Parkinson's disease is unknown. More experts agree that Parkinson's disease is caused by combination of genetic and environmental factors. Extensive research programmes are going on throughout the world to study how the disease progress and to develop drug by using animal models. The search for possible environmental factors that may trigger the disorder and also to find out how defective genes play a role. To date there is no known prevention or cure for Parkinson's disease but there are several treatment options including drug therapy or surgery that can reduce the symptoms and make living with the disease easier. Further research in this field may come out with a better prospect for the ailing patients of Parkinsonism in future.

Dr.(Mrs.) Vijay Laxmi Saxena

To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science.

- Albert Einstein

DNA Damage and Mechanisms of Reactivation in Bacteria

Balkrishna Sandikar

DNA is the prime important biomolecules in living organisms. However, DNA can be damaged by many physical and chemical agents. Fortunately, the living beings have an ability to repair the damaged DNA which is important for the survival. The mechanisms involved in the repair process include- Photoreactivation, Base excision repair, Nucleotide excision repair and Mismatch repair.

INTRODUCTION

The living beings are made up of mainly four types of biomolecules- Nucleic acids (DNA and RNA), Proteins (structural and catalytic proteins), Carbohydrates and Lipids. All these four basic biomolecules are important like the fingers of a palm. DNA plays important role as the principle of heredity and controlling unit of all characters in living organisms. The genes are segments of DNA that controls specific characters. The nucleic acids play vital role in protein synthesis process. The life of living organisms is mainly due to the presence of active DNA molecules in the cell. Hence, it can be called 'Pran' or Blue print of life.

As the genetic material is transferred from generations to generations, it must be stable and strong enough. However, minor changes in it play important role in evolution of the living organisms. Many physical and chemical agents damage the DNA molecules in cell. Fortunately, the living beings have ability to repair the damaged DNA which is very important for their survival. Tomas Lindahl, Paul Modrich and Aziz Sancar were honored with Nobel Prize 2015 in Biochemistry for their valuable research on DNA repair and its possible applications in development of therapeutic drugs for life-threatening diseases like cancer[1].

STRUCTURE AND COMPOSITION OF DNA

James Watson and Francis Crick in 1953 first proposed the double helical structure of DNA and

Department of Microbiology, Maharashtra Udayagiri College, Udgir, (Maharashtra), Pin- 413517. E-mail: bal krishna64@rediffmail.com

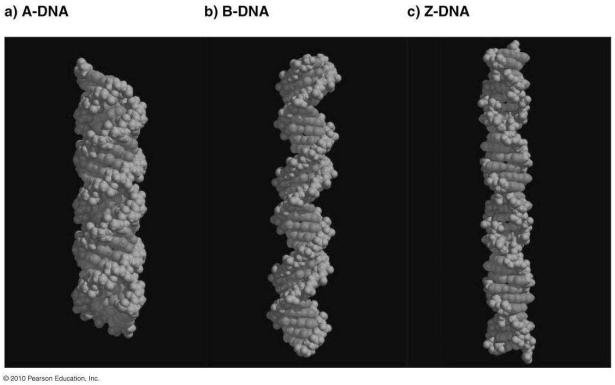

Fig.1 A, B and Z DNA

honored with Nobel Prize. The DNA is a polymer of nucleotides. DNA nucleotides are made up of nitrogen bases (adenine, guanine, thymine and cytosine), pentose sugar deoxyribose and phosphate group. Accordingly, the nucleotides are named as deoxyadenylate, deoxyguanylate, deoxythymidylate and deoxycytidylate. The nitrogen bases in two strands are linked to each other by hydrogen bonds. The base pairing is always precise, i.e. A=T and G≡C. A species of microorganism has specific G+C percentage in its DNA. This original form of DNA proposed by Watson and Crick is referred as B-DNA. Some times it may exist as A-DNA or Z-DNA. These forms of DNA differ in their helical sense (right handed or left handed), width, number of base pairs per helical turn (average 11 in A, 10.5 in B and 12 in Z DNA), base tilt, sugar pucker conformation, and glycosyl bond conformation (*anti* or *syn*)[2].

DAMAGE OF DNA MOLECULES

Different types of damages are caused that either

decreases the activity or totally loses the activity of DNA. The most common types of damages includes- single strand break, double strand break, dimer formation by covalent linking of two adjacent pyrimidines in the same strand, damage to bases, removal of bases creating apurinic or apyrimidinic (AP) sites, substitution of wrong bases, covalent cross linking of two DNA molecules, etc. Each of these abnormal changes in DNA is called 'lesion'[3].

Change in the sequence of nucleotides of genes results into mutations. When a bacterial culture is exposed to UV radiations, 99% or more cells in the population are killed and a high rate mutation occurs among the survivals. A physical or chemical agent that causes mutation is called 'mutagen'. Basic structure of DNA is also damaged by different physical and chemical antimicrobial agents. The physical agents involve heat, non-ionizing radiations (UV) and ionizing radiations like X-rays and gamma rays. The chemical agents include base analogues, alkylating agents and the chemical agents producing distortions in DNA. Many other chemical antimicrobial agents used to control microorganisms have DNA as the target biomolecules[4].

The 5-Bromouracil is an analogue of thymine which is wrongly incorporated at complimentary position of adenine. The 2-Aminopurine is an analogue of purines and wrongly incorporated at complimentary position of pyrimidines. As a result the activity of genes is decreased or totally lost. The alkylating agents like dimethyl sulfate (DMS), ethyl methane sulfonate (EMS) and ethyl ethane sulfonate (EES) causes alkylation of the bases resulting to mutations due to removal of bases or change in their pairing behavior. The chemicals like nitrous oxide cause deamination of Adenine and Cytosine resulting to change the pairing behavior and hence mutations. Certain fluorescent acridine dyes such as proflavine and acridine orange cause mutations by insertion or deletion of bases.

The nucleic acids absorb the UV light causing their nitrogen bases to become highly reactive free radicals. The resulting unstability may cause the conversion of one base to another. This effect is so called substitution mutations (Transition or Transversion). The mutations may arise spontaneously. The extent of effect on the living organism depends on the type of radiations, time of exposure, number of bases or base pairs damaged, site of mutation on the gene molecule, i.e. whether, near the 5' end or 3' end, and last but not least, how much the damaged gene is important for the life of that organism.

Mismatching of bases in genes may arise by spontaneous mutations or by a physical or chemical mutagen. For example, spontaneous deamination of cytosine to uracil results to mismatching. This uracil is easy to detect in DNA by the repair system as it is normally absent in DNA.

MECHANISMS OF DNA REPAIR

Fortunately, living organisms have an ability to repair the damaged parts in DNA and reactivate it. Different mechanisms of DNA repair and reactivation have been proposed. Photoreactivation (repair by direct reversal), base excision repair (BER), nucleotide excision repair (NER), mismatch repair (MMR), SOS repair, nick repair, non-homologous end joining (NHEJ) and replication repair (RR) are the main mechanisms of DNA repair in bacteria and other living beings. Many enzymes play vital role in this process.

PHOTOREACTIVATION (REPAIR BY DIRECT REVERSAL)

Repair of damaged part in DNA molecule by the activity of enzyme photolyase, in presence of light is called photoreactivation. The enzyme photolyase is light dependent and requires flavin adenine dinucleotide as a cofactor. The pyrimidine dimers (T=T, T=C or C=C) created by effect of UV radiations are particularly repaired by this mechanism. Albert Kelner in 1949 first reported the photoreactivation phenomenon in *Streptomyces griseus*[3]. Later on, the process was studied in *Escherichia coli* and many other bacteria, in plants and some animals. However, the process has not been

till observed in humans. Photoreactivation is essentially an error-free mechanism because it does not involve excision of bases or nucleotides[3].

First, the enzyme photolyase (a product of gene phr) scan the DNA molecule; identify the dimmers and binds to it. The photolyase-dimer complex absorbs a quantum of light in the wavelength range 3500 to 5000Å, i.e. the low wave length visible light). Absorption of light energy results in the uncoupling of the dimer. The bound photolyase is then released from the DNA molecule[3].

BASE EXCISION REPAIR (BER)

Excision repair refers to the DNA repair that involves removal of damaged portion and incorporation of precise bases or nucleotides in place of it. When only the damaged nitrogen bases are removed from DNA and replaced by new precise bases complementary to those in other unaffected template strand, the repair mechanism is called base excision repair.

A base can be removed from a nucleotide within DNA by different ways as direct action of an agent such as radiation, spontaneous hydrolysis, an attack of oxygen free radicals, or DNA glycosylases the enzymes that detect the damaged bases and remove them. Currently, at least five DNA glycosylases are known in bacteria. These enzymes examine thousands of base pairs per second. For example, uracil-DNA glycosylase, the product of *ung* gene in *Escherichia coli*, recognize uracil (formed by deamination of cytosine) within the DNA and removes it by hydrolytic cleavage of glycosidic linkages between base and deoxyribose. The resulting site is called AP (apurinic/apyrimidinic) site, because of the lack of a purine or pyrimidine. Such AP sites are also created by high temperature[5].

The AP endonuclease recognizes AP site and nicks the DNA at the 5' side of it. Enzyme phosphodiesterase then removes the base-free nucleotide (Sugar-Phosphate). DNA polymerase (polymerase I in *Escherichia coli* while DNA polymerase β in mammals) then inserts a precise nucleotide at the AP site. DNA ligase then closes the

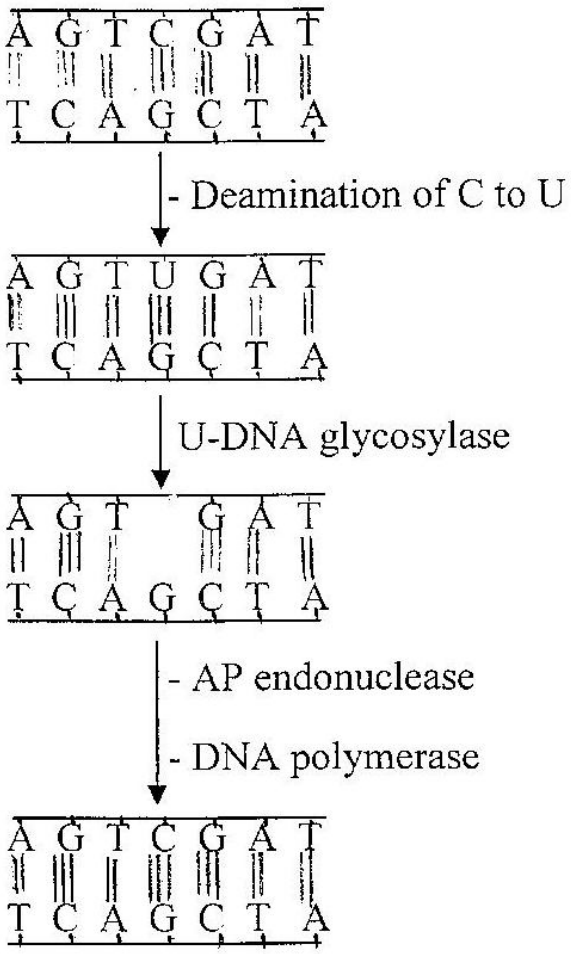

Fig.2 Mechanism of Base excision repair

nick. Generally, only one base is replaced (80-90% cases) whereas some times (10-20% cases) many adjacent bases are removed and replaced. DNA ligase then seals the gap[4]. Fig.2 Mechanism of base excision repair.

NUCLEOTIDE EXCISION REPAIR (NER)

The nucleotide excision repair is a more common form of DNA repair and probably the main process in most living beings. This multistep enzymatic process is best understood in *Escherichia coli*, in which the process was originally discovered. NER is an important mechanism by which DNA damages particularly the pyrimidine dimers are repaired by a mechanism quiet different than

photoreactivation. The NER process involves following steps-

Incision- The enzyme repair endonuclease recognizes the distortions (swelling) produced by pyrimidine dimers and makes two cuts on each side of the damaged portion. One cut is located about eight nucleotides apart from the dimer towards 5' end and another nick at about 4-5 nucleotides apart from the dimer towards 3' end.

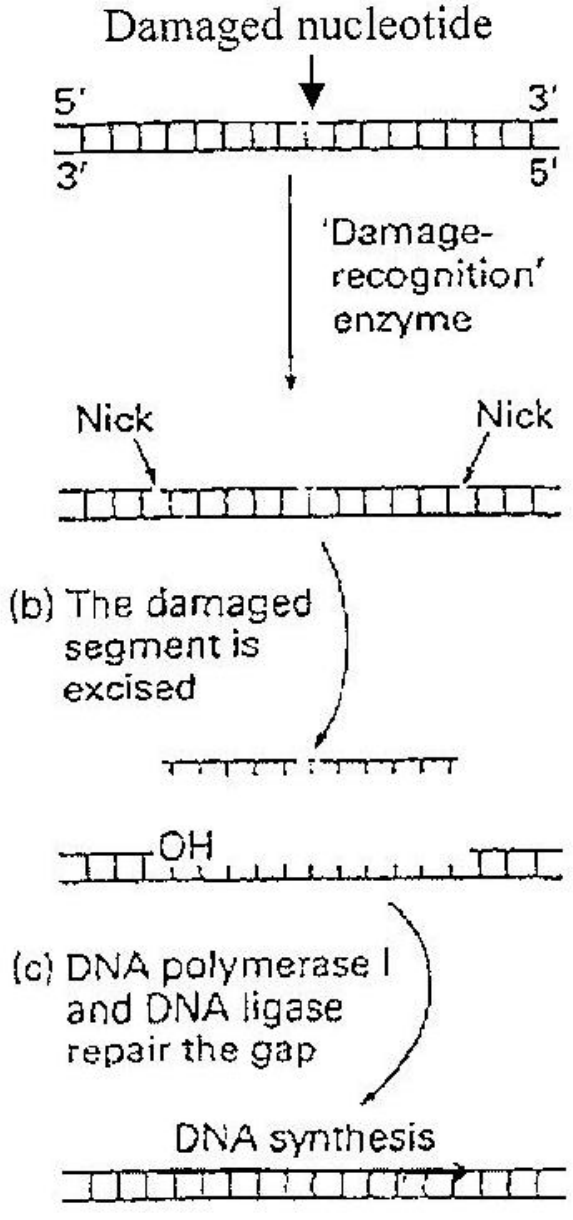

Fig.3 Nucleotide excision repair

Removal of strand and Synthesis of new polynucleotide chain - At the incision site, there is 5' phosphate group on one side of the cut and 3' –OH group on the other side. The 3' hydroxyl group is recognized by **DNA polymerase-I**. It has exonuclease activity as well as polymerase activity. Polymerase-I removes the DNA segment of about 15 bases including the dimer and introduce a complementary polynucleotide sequence in 5' to 3' direction.

Sealing the new and original strand- The enzyme **DNA ligase** seals the gap between new and original strand. Thus, the defective portion along with some adjacent nucleotides is removed and replaced by new and precise polynucleotide sequence[5].

MISMATCH REPAIR (MMR)

In normal DNA structure there is precise pairing of bases between two strands, i.e. A=T and G≡ C. However, some times wrong pairing occurs between the bases. For example, template G may pair with T rather than C, or A in template may bind with C instead of T. Such wrong base pairs dose not fit correctly in the DNA duplex. This is so called mismatching of bases which results to decrease the activity or total loss of activity of respective genes. Mismatching may occurs spontaneously due to some inborn errors during the DNA replication process. The mismatching results to change the sequence of nucleotides and hence the sequence of codons within the gene, the effect called mutation. The proofreading polymerase generally corrects such type of errors but some times fails to do so. This type of error must be immediately corrected because it may carry wrong information from one generation to the subsequent generations. The abnormal pairs are corrected by an enzyme catalyzed process called mismatch repair.

The repair enzymes recognize the wrong base pairs and either mark it or repair it directly. In order to do this, the repair system must be able to distinguish the parental polynucleotide (template strand)

from the newly synthesized (daughter) strand. It is because the wrong bases are added in newly prepared complementary strand while the original correct bases exist in template strand. In *Escherichia coli* this distinction is possible because the parent strand is tagged with methyl group, attached to adenine nucleotides that occurs in specific sequence i.e. 5'-

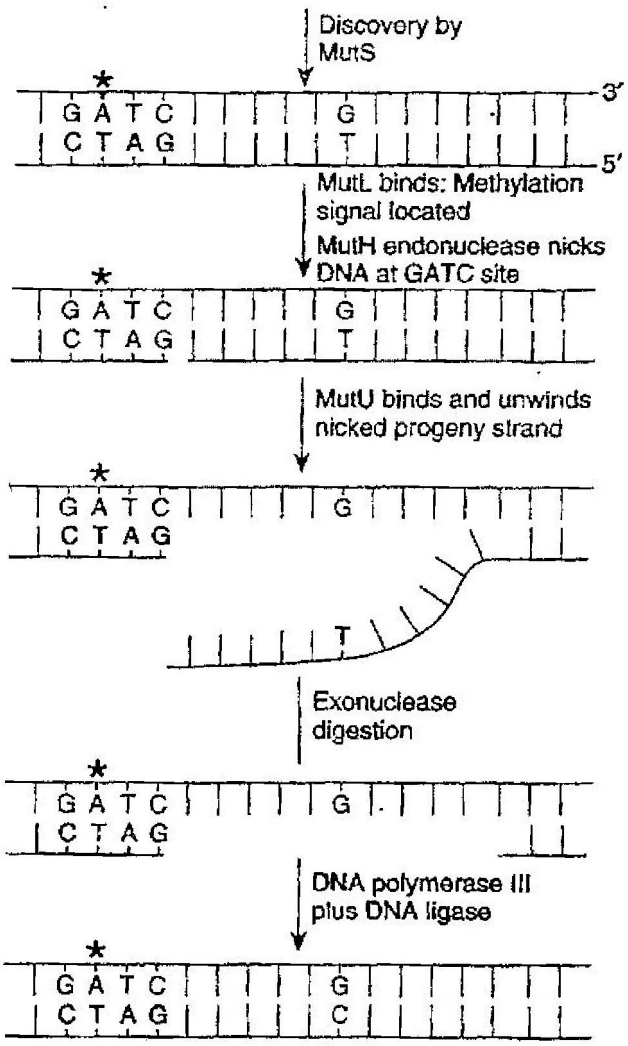

Fig.4 Mechanism of mismatch repair

GATC-3'. These modified adenines act as indicators of the parent strand and enable the repair enzymes to recognize which polynucleotide strand should to scanned and repaired. The process is called methyl-directed mismatch repair[6].

In *Escherichia coli*, the repair system involves products of genes *mutH*, *mutL*, *mutS*, and *mutU* ('mut' for mutator). The MutS protein in the form of homodimer (two copies of same protein) recognizes the mismatch. The MutL protein (also in form of homodimer) then binds and they together find the methylation signal. They also activate the endonuclease MutH, which then nicks the un-methylated strand at the 3'-CTAG-5' recognition site. At the recognition site, the MutS-MutL tetramer loads the helicase MutU which then unwinds the nicked strand. Any one of at least four different exonucleases then attacks the unwound oligonucleotides. The DNA polymerase adds correct bases complementary to the bases in template strand and DNA ligase then seals the gap[4].

SOS REPAIR

SOS repair is a bypass system that allows DNA chain growth across the severely damaged points of DNA segment. This post-replicative repair process is also called 'translesion DNA synthesis'. It involves a special class of polymerases that are synthesized only in response to DNA damages. These polymerases incorporate one or more nucleotides at the damaged portion that are not specified by the template strand. Therefore SOS response is itself mutagenic. However, such mutations are relatively less severe than lethal effects caused by incompletely replicated DNA.

In *Escherichia coli*, two genes play key role to control the SOS system: *lexA* and *recA* which respectively encode protein Lex A and Rec A. The protein LexA normally represses about 18 genes including itself. The other genes include *recA*, *uvrA*, *uvrB* and *uvrD*; two genes that inhibit cell division i.e. *sulA* and *sulB*; and several others. Each of these genes has a consensus sequence in its promoter called SOS box: 5'-CTGX_{10}CAG-3' (where X10 refers to any ten bases). The LexA protein normally binds at the SOS box, limiting the transcription of these genes. When single stranded DNA activates RecA, RecA interacts with the LexA protein to trigger the autocatalytic properties of LexA. Transcription then follows from all the genes having an SOS box[3,4]. The SOS repair.

NON-HOMOLOGOUS END JOINING (NHEJ) REPAIR

NHEJ is a repair mechanism for double-strand breaks in DNA. In this case, the break ends are directly ligated without the use of homologous template. The term "non-homologous end joining" was coined in 1996, by Moore and Haber.

Many proteins and enzymes have been involved in NHEJ in human cells**.** The steps involved in this repair mechanism include- End binding and tethering, End processing **(**removal of damaged or mismatched nucleotides by nucleases and insertion of new nucleotides by DNA polymerases**)** and ligation by DNA ligase IV complex with cofactor XRCC4. NHEJ repair mechanism is common in higher living beings including humans, but many bacteria lack this mechanism and have to rely completely on homologous recombination. However, NHEJ proteins have been detected in some species of *Bacillus* and *Mycobacterium*[8].

RECOMBINATION REPAIR

Recombination repair is an additional mechanism that handle situation in which damage remains in a daughter molecule and replication has been forced to bypass the site, which typically creates a gap in the daughter strand. A retrieval system uses recombination to obtain another copy of the sequence from an undamaged source; the copy is then used to repair the gap[7].

NICK REPAIR

Single strand break and double strand breaks are created by different physical and chemical mutagenic agents. Such nicks are sealed by DNA ligase. Ligases are versatile and ubiquitous enzymes that join 3' hydroxyl and 5' phosphate ends to form phosphodiester linkages.

Thus, the DNA repair mechanisms play vital role in living organisms. Microorganisms are the cause of many diseases of humans, other animals and plants. Study of DNA damage and repair is hopeful for development of therapeutic drugs for at least some of the life-threatening diseases.

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ARTIFICIAL RIPENING OF FRUITS—MISLEADING RIPE AND HEALTH RISK

R. U. Abhishek, H. N. Venkatesh, K. Manjunath and D. C. Mohana*

Fruits are highly nutritious and form as key food commodity in the human consumption. Ripening is a physiological process, which makes the fruit more edible, palatable and nutritious. Nowadays fruits are deliberately being contaminated by chemicals causing serious health hazards. Synthetic chemicals are being used to ripen them artificially which hasten the ripening process and make fruits appear fresher or even longer, particularly during early and off-season. One or more banned chemicals are still being used in Indian subcontinent and other countries. The food safety problems posed by artificial ripening agents pertaining to India's fruit trade have been discussed here.

INTRODUCTION

Fruits are widely distributed in nature, commercially important and nutritionally indispensable food commodity. Ripening is a process in fruits that causes them to become more edible. In general, a fruit becomes sweeter, less green, and softer as it ripens. However, the acidity as well as sweetness rises during ripening, but the fruit still tastes sweeter regardless. An organic compound involved with ripening is ethylene, a gas produced by plants from the amino acid methionine[1]. Ethylene increases the intracellular levels of certain enzymes in fruit and fresh-cut products, which include (i) amylase, which hydrolyzes starch to produce simple sugars, and (ii) pectinase, which hydrolyzes pectin, a substance that keeps fruit hard. Other enzymes break down the green pigment chlorophyll, which is replaced by blue, yellow, or red pigment[2]. Ripening is associated with change in composition *i.e.*, conversion of starch to sugar, by which fruits attain their desirable flavour, quality, colour, palatable nature and other textural properties. Synthetic chemicals are being used to ripen them artificially which hasten the ripening process and make fruits appear fresher or even longer, particularly during early and off-season. Fresh fruits are nutritious, but toxic artificial ripening agents pose health hazards. For many years, ethylene had been used as a ripening agent, but nowadays ethane, calcium carbide and ethephon are commonly used for faster ripening, inappropriate use of these chemicals to ripen fruits is associated with many health hazards.

On the basis of ripening behavior, fruits are classified as climacteric and non-climacteric fruits (Table 1)[3]. Climacteric fruits, defined as fruits that enter 'climacteric phase' after harvest *i.e.*, they continue to ripen. During the ripening process, the fruits emit ethylene along with increased rate of respiration. Ripe fruits are soft and delicate and generally cannot withstand rigours of transport and repeated handling. These fruits are harvested hard

Table-1: Few examples of fruits according to their respiratory behaviour at ripening[3]

Climacteric fruits	Non -climacteric fruits
Mango, banana, papaya, guava, sapota, kiwi, fig, apple, passion fruit, apricot, plum, pear, etc.	Orange, mousambi, kinnow, grapefruit, grapes, pomegranate, litchi, watermelon, cherry, raspberry, blackberry, strawberry, carambola, rambutan, cashew, etc.

Department of Microbiology & Biotechnology, Bangalore University, Jnana Bharathi, Bengaluru 560 056, E-mail: mohanadc@gmail.com

and green, but fully mature and are ripened near consumption areas. Small dose of ethylene is used to induce ripening process under controlled conditions of temperature and humidity. e.g., mango, banana, papaya, guava, sapota, kiwi, fig, apple, passion fruit, apricot, plum, pear, custard apple, *etc*. Non-climacteric fruits, once harvested do not ripen further, they produce very small amount of ethylene. There is no characteristic increased rate of respiration or production of carbon dioxide. e.g., orange, mousambi, kinnow, grapes, pomegranate, litchi, watermelon, cherry, raspberry, blackberry, strawberry, carambola, rambutan, cashew, *etc*.

Fruit ripening is an irreversible phenomenon involving a series of physiological, biochemical and organoleptic changes, that finally leads to the development of a soft edible ripe fruit with desirable quality. The fruits may require few days to ripen and this short period seriously limits their transport to distant markets. With the rapid development of fruit trade, artificial ripening has become essential. In order to hasten the ripening process and make fruits appear fresher or even longer, different chemicals are utilized for the commercial purposes.

ARTIFICIAL RIPENING OF FRUITS

Climacteric fruits like mango, banana, papaya, sapota and custard apple are often harvested in a mature but unripe condition and then subsequently allowed to ripen by natural release of ripening hormone (ethylene) from the fruit. However, natural ripening in some fruits is a slow process, which leads to high weight loss, desiccation of fruits and uneven ripening. With the rapid development of fruit trade, artificial ripening has become essential and the methods practiced earlier by small traders are smoking and calcium carbide treatment.

Ethylene is a naturally occurring gaseous plant hormone that is produced by many fruits and vegetables. It affects the physiological processes in plants and initiates the ripening process when internal concentrations increase from 0.1 to 1.0 ppm (parts per million)[3]. Externally applied ethylene can also initiate the ripening process. The commonly used ripening agents are calcium carbide, acetylene, ethylene, propylene, ethephon (ethrel), glycol, ethanol and some other agents[4]. For many years, ethylene had been used as a ripening agent, but nowadays ethane, calcium carbide and ethephon are commonly used for faster ripening, inappropriate use of these chemicals to ripen fruits is associated with many health hazards.

Globally, the ripening is done through gas emission systems or ethylene generator systems, depending on quality and shelf life desired. Use of ethylene for ripening of the fruit is a common practice in different countries; but due to high cost and scarcity in terms of its availability, many developing countries use low-cost ripening agents like calcium carbide. Chemicals like calcium carbide, ethephon and oxytocin are reportedly being used in fruit and vegetable farms for artificial ripening of fruits and for increasing the size of fruits and vegetables, respectively[4]. Calcium carbide is one of the most commonly used ripening agent for fruits, while other calcium salts like calcium ammonium nitrate, calcium chloride and calcium sulfate are used by local fruit industries to delay the fruit ripening process. The use of calcium carbide is being discouraged worldwide, due to associated health hazards. Calcium carbide treatment of food is extremely hazardous because it contains traces of arsenic and phosphorous, and once dissolved in water, it produces acetylene gas. Acetylene acts like ethylene and accelerates the ripening process. Arsenic, phosphorous and acetylene gas may affect the different organs and cause various health problems.

MECHANISM OF ACTION OF RIPENING AGENTS[1,5]

The concentration of ethylene required for the ripening of various fruits vary, but in most cases they are in the range 0.1-1 ppm. The time of exposure to initiate full ripening also vary depending upon the type of fruit. Several chemicals agents are used as artificial ripeners. The following are the some

important sources of ethylene or acetylene production.

Ethylene: Ethylene regulates the fruit ripening by coordinating the expression of genes responsible for enhacing the rate of respiration, autolytic ethylene production, chlorophyll degradation, carotene synthesis, conversion of starch to sugars and increased activity of cell wall degrading enzymes. It can be produced artificially by gas emission systems or ethylene generators.

(i) Ethylene generator: Ethanol is heated in the presence of catalyst to produce ethylene. $C_2H_5OH \rightarrow C_2H_4 + H_2O$

(ii) Ethylene mixture: Ethylene (6%) in carbon dioxide by weight, to avoid explosion, is used for fruit ripening.

Calcium carbide: When calcium carbide (CaC_2) is hydrolysed, it produces acetylene, which acts as an artificial ripening agent. It also contains trace amounts of ethylene that is sufficient to be used in fruit ripening.

$$CaC_2 + 2\ H_2O \rightarrow Ca\ (OH)_2 + C_2H_2$$

Ethephon or Ethrel: Ethephon (2-chloroethane phosphonic acid) is acidic in water and liberates ethylene in neutral to basic medium (above pH 5.0). Ethephon penetrates the fruit and decomposes to ethylene, thereby hastens the ripening process.

Ethylene glycol: Ethylene reacts with hydrogen peroxide to produce the ethylene glycol. Ethylene glycol is colorless, odorless and sweet tasting liquid. Ethylene glycol, when diluted with water, can ripen various fruits faster than the regular ripening rate of the fruits, in particular colder climatic conditions. It can also acts like ethylene in fruit ripening process.

HEALTH HAZARDS OF BANNED CHEMICALS

Fruits are still being commercially ripened with banned chemical like calcium carbide which after reaction with water vapour present in the surrounding atmosphere releases acetylene gas. Calcium carbide is a carcinogenic agent and is banned in India under Prevention of Food Adulteration Act-1955[6]. Although the Act prohibits the use of calcium carbide, this chemical is commonly used by collectors and traders for the production of acetylene to induce fruit ripening. According to the survey of Directorate of Marketing and Inspection (Ministry of Agriculture, Government of India)[7], 99% of the mangoes in India are ripened by using calcium carbide, as it is the most economical way for ripening process of mango. In 2013, Jindal *et al.* from India[8], reported a case of accidental poisoning of a 2 year old boy with calcium carbide, in which the child put paper piece contaminated with calcium carbide in mouth. Similarly, calcium carbide related ocular burn injuries are reported during mango ripening season of West Bengal in India[9]. Many incidences of this kind have been reported worldwide. Recently in 2014, the National Human Rights Commission of India has sought an action taken report from Indian Health Ministry over use of calcium carbide to ripen fruits despite a nationwide ban[10]. Some traders ripen fruits like banana in enclosed chambers where large quantities of calcium carbide is put and sprinkled with water before sealing the chambers. Though the released acetylene triggers ripening process in fruits, it is an inflammable gas involving risk of fire hazards. Calcium carbide is also put in small packets in the fruit boxes and in some cases sprinkled onto the fruit surface. However, calcium carbide contains chemical impurities such as arsenic hydride and phosphorus hydride that are highly carcinogenic compounds. The method used in the application of carbide is also hazardous to health, in that carbide pieces can find themselves among the heaps of fruit. Further, fruits ripened with calcium carbide though develop attractive surface colour, but are inferior in taste, flavour and spoil faster. In 2010, Pandarinathan and Sivakumar from India reported the biochemical changes in mangoes artificially ripened by calcium carbide, which recorded lesser amount of sugars (reducing sugar, non-reducing sugar and total sugar) and total soluble solids in the calcium carbide treated fruits than the untreated[11].

The chemicals or agents are used to ripe fruits as early as artificially. Nowadays, several other

chemicals are used as artificial ripeners *e.g.*, carbon monoxide, potassium sulfate, ethephon, putrescine, oxytocin, protoporphyrinogen, *etc*. Ethephon is an organophosphate pesticide, so it is not recommended as a ripening enhancer. Oxytocin is a mammalian hormone, used as a drug in veterinary medicine which is not advised for use in fresh fruits and vegetables[12]. In India, about 60% of the mangoes harvested early in the season are treated with calcium carbide, adding that the use of the chemical declines as the season progresses[13]. In a study, Hakim et al.[14] from Bangladesh reported the higher amount of heavy metals like lead and arsenic in ethephon-treated fruit and vegetable samples. Many instances have been reported that some unscrupulous elements are following the practise of dipping green vegetables in artificial colours to give them a fresh, attractive and pleasant appearance[7]. The other major contaminants found in fruits are pesticide residues, crop contaminants, mycotoxins (aflatoxin, patulin, ochratoxin, *etc*.), naturally occurring toxic substances and heavy metals. Heavy metals are harmful and become toxic for health if they are taken above the limit of daily dietary allowance recommended.

Indian Ministry of Agriculture has clarified that the fruits exposed to ethylene gas (fruit ripening plant hormone), in low concentration of 10-100 ppm exogenously to trigger their ripening, are safer for consumption[7]. Fresh fruits and vegetables shall be free from coating of waxes, mineral oils and colours. However, there is provision for coating fresh fruits with food additives *viz.*, bee wax (white/yellow), carnauba wax or shellac wax as glazing agent in accordance with the good manufacturing practice (GMP) for use of food additives under proper label declaration.

ALTERNATIVES TO CALCIUM CARBIDE

Chemicals are commonly used for the artificial ripening of fruits. The use of calcium carbide is prohibited for the ripening of fruits. Ethylene is generally recognized as safe (GRAS) by Food and Drug Administration (FDA) of the United States. Ethylene has been found not harmful or toxic to humans in the concentrations found in ripening rooms. Ethylene was used historically as an important anesthetic in concentrations significantly greater than that found in a ripening room *i.e.*, at concentration of 85% with 15% oxygen. It is flammable and explosive at concentrations above 3%, as a fruit ripening hormone, effective at 0.1 to 1 ppm. One part of ethylene per million parts of air that's one cupful of ethylene gas in 2,50,000 litres of air - is enough to promote the ripening process in fruits[16]. However, ethylene is often targeted as the reason for difficulty in breathing in ripening rooms is usually due to (i) CO_2, is produced by the ripening fruit in the room, levels increase over time and/or (ii) oxygen levels, is taken in by the ripening fruit. The increased CO_2 and decreased oxygen levels make breathing in a ripening room difficult.

Ethrel or ethephon is a commercially available plant growth regulator, which is a source of ethylene similar to that naturally released by fruits during ripening process. Although dipping of fruits in diluted ethrel solution is recommended for enhancing ripening, it is a cumbersome process and may cause some problems if commercially available ethrel contains chemical impurities[1]. According to Environmental Protection Agency of the USA, ethephon has been classified as a Group D carcinogen based on its cancer-causing potential, which is reported as inhibitor of cholinesterase. The Food Safety and Standard Authority of India (FSSAI)[16] has advised to use only the ethylene in gaseous form for artificial ripening of fruits. To overcome these problems, ethylene gas is commercially used in modern ripening chambers which requires huge investment and is not economical for farmers or small traders. Catalytic reactors based ethylene generators are also available which produces ethylene gas using ethanol or methanol or ethrel. Mango fruits exposed to 100 ppm ethylene gas for 24 hrs can be ripened in 5 days as compared to 10 days in non-treated fruits without adversely affecting the quality. Similarly, bananas

exposed to 100 ppm ethylene gas for 18 hours can be ripened in 4 days at room temperature and 6 days at 20°C. Papaya fruits exposed to ethylene gas ripened with uniform surface colour and uniform firmness in 4 days at ambient temperature[3]. Therefore, use of ethylene is suggested as a safe alternative to calcium carbide for ripening of fruits.

Most ethylene gas today is created out of petroleum products such as natural gas liquids or crude oil by the use of heat, nitrogen, and steam that is converted into a liquid gas, and then stored in metal containers used for dispersing on food crops. Unfortunately, ethylene gas in the form of a liquid is most dangerous to humans who are applying the gas to crops or in fruit or vegetable ripening rooms because it can be very flammable and explosive. If a person is contaminated by ethylene gas by inhalation, it can cause dizziness, nausea, and even suffocation or asphyxia (through lack of oxygen).

growth of fruits and vegetables[11]. Adulteration in food stuff has been regarded as a major social evil and is a mind-boggling problem in society. The implementation of prevention of food adulteration Act and rules lies with the governments to keep a vigil to check the use of hazardous chemicals for ripening of fruits and vegetables.

MAINTENANCE OF QUALITY AND SAFETY IN SUPPLY CHAIN

Good practices

Food Safety and Standard Authority of India has advised to use gaseous ethylene for artificial ripening of fruits (Table 2)[15]. Ethylene is good but can accelerate aging and eventual spoilage of many fruits and vegetables. Therefore, it is advisable not to store ethylene-sensitive fruits and vegetables together

Table-2: Ethylene concentration, optimum storage and ripening temperatures for a few fruits are given below[15]

Commodity	Ethylene concentration (ppm)	Ethylene exposure time (hour)	Ripening temperature (°C)	Storage temperature (°C)
Avocado	10-100	12-48	15-18	4.4-13
Banana	100-150	24	15-18	13-14
Honey dew melon	100-150	18-24	20-25	7-10
Kiwifruit	10-100	12-24	0-20	0.5-0
Mango	100-150	12-24	20-22	13-14
Orange degreening	1-10	24-72	20-22	5-9
Stone fruit	10-100	12-72	13-25	-0.5-0

Gibberellic acid and ethylene are recommended for grapes, pineapples, banana and other climacteric fruits[16]. Oxytocin is also used for fast growth and ripening of fruits and vegetables, which has adverse health impact on human body. Oxytocin is a birth hormone showing uterotonic and galactogenic activity which occurs naturally in animals, but when it is injected into plant part such as stem, it functions as growth promoter. It stimulates the plant hormones such as cytokinin that invariably causes cell division which results into biomass accumulation and hence

with ethylene releasing fruits[17]. If an ethylene-sensitive fruit or vegetable is stored next to an ethylene-producing fruit, ethylene can affect the quality and reduce its shelf life. Some of ethylene-sensitive vegetables are: broccoli, cabbage, cauliflower, lettuce, *etc*.

In developing countries, strengthening of public-private partnership is needed to introduce new and modern postharvest technologies like refrigerated transport vehicle, low temperature storage and ethylene-induced ripening chamber. For

example, in the case of low temperature storage facilities for fruits and some vegetables, the government could start one or two in order to encourage the private sectors to do more.

Quality and grading standard

India lacks standardized quality assurance systems for horticultural produce. Therefore, proper arrangement should be made to develop national quality management system to train, and ultimately to accredit, growers and traders in the major international certification such as HACCP, ISO, GAP and GMP. Assistance can also be sought from the Government of India who already have their own standard quality management systems known as IndoGAP.

Safe use of chemicals

Delivery of high quality and safe produce to customers is the ultimate goal of efficient marketing. There is public outcry on food safety due to perceived health risk. Therefore, use of recommended pesticides, plant growth regulators and ripening agents must be ensured. Research, training, motivation and strong media campaign are necessary to improve the situation.

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SIGNIFICANCE OF DIFFERENT LEVELS OF GENE REGULATION IN EUKARYOTES

Amiya Ranjan Sahu*[1], Nibedita Nayak[2] and Sunil Kumar Dixit[3]

Synthesis of gene products is due to regulation of specific genes. But in some instances these actions are also modifiable by certain genetic mechanisms like epigenetic or gene imprinting. Certain genes are constantly expressed like housekeeping genes (metabolic functions) and some are expressed all the time in only those cells that have differentiated in a particular way (genes responsible for plasma cell for the synthesis of antibody). The genetic makeup of the individual is the most important part which can be changed due to certain mutagenic agents that ultimately alter the expression.

INTRODUCTION

Regulation of gene expression is the synthesis of specific gene products (protein or RNA). In eukaryotes, gene regulation drives the processes of cellular differentiation and morphogenesis, leading to creation of different cell types that produces different proteins. The gene regulation leads the concept of epigenetics where the heritable changes caused by activation or deactivation of genes without any change in DNA sequences. Gene imprinting is another condition where the expression is also determined by the parental origin.

Difference of eukaryotic gene regulation from prokaryotes

The organizational structure of a eukaryotic cell determines the mode of gene regulation which differs from prokaryotic regulation due to the following reasons[3];

1. Eukaryotic cells contain greater amount of DNA sequences complexes with histone and other proteins forming chromatin.
2. Genetic information is carried in many chromosomes enclosed inside double nuclear membrane.
3. Transcription is spatially and temporarily separated from translation, transcription occurs inside nucleus and m-RNA transported to cytoplasm for translation.
4. Transcripts of eukaryotic genes are processed and reduced in size before transported to cytoplasm.
5. Eukaryotic m-RNA has much longer half-life ($t_{1/2}$) than prokaryotes.
6. Eukaryotes are multi-cellular with differentiated cell types which use different sets of genes to make different proteins.
7. Generally operons are found in prokaryotes; whereas in eukaryotes each gene has its own promoter element and enhancer element

[1]Animal Genetics and Breeding, [2]Poultry Science and [3]Veterinary Immunology, Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh - 243122, E-mail: amiyawarrior37@gmail.com

Mechanism of gene regulation

Gene regulation in eukaryotes is more complex and it occurs in different levels in the cells as given below;

1. Control at the level of chromatin and genome structure
2. Transcriptional control
3. Post-transcriptional control
4. Translational control
5. Post-translational control

1. Chromosome level

DNA is packed tightly with nucleosomes (octamers

of histones) forming complex chromatin inside the nucleus. So the eukaryotic DNA is inaccessible to transcription factors and RNA-polymerase. To keep gene sequence active, the conformation of chromatin is altered so that proteins of nucleosomes are released from DNA allowing it for transcription and it is controlled in different ways like methylation, acetylation, phosphorylation, nitrosylation and sumoylylation. This process of chemical modification is known as chromatin remodelling.

a) Methylation

In most mammalian somatic tissue, cytosine methylation is modification that regulates gene expression in development, cancer, gene imprinting etc. only when cytosine is in dinucleotide context with guanine forming mCG complex. Methylation of DNA and histones causes nucleosomes to pack tightly together so that transcription factors cannot bind gene sequence retarding expression (inactive gene). Methylation occurs due to addition of methyl group by the enzyme DNA methyl-transferase. Stretches of very high frequency of cytosine guanine dinucleotide DNA pairs (CG) found in promoter sequence of genes called CpG islands and DNA molecules can itself be modified by methylation of this site. Methylation leads formation of Barr body (female) and nervous disorder (Rett syndrome).

Barr body is one of the two inactive X-chromosomes (inactive XIST gene) in mammalian female cells which remains condensed during the interphase and remains silent in transcription. This X-chromosome inactivation is termed as Lyonization, which is an epigenetic process that is a process which affects the expression of genes without any change in DNA sequence.

In adult brain non-canonical cytosine methylation in a non-CG context occurs at high level [mCH; where H = A, C or T]; whereas mCH is absent in newborn. Non-CG methylation occurs predominantly at -CA dinucleotide forming –mCA accounting about 70 per cent of non-mCG in frontal cortex of brain. The -mCH regulate neuronal gene expression through its recognition by methyl-CpG binding protein-2 ($MeCP_2$). So the disruption of $MeCP_2$ in the brain affects the long genes in distinct neuron type causing neurological disorder "Rett syndrome" [1].

b) Acetylation

Acetylation is the addition of acetyl group to the histone protein by the enzyme Histone Acetyl Transferase (HAT). Histone acetylation makes loose packaging of nucleosomes allowing the transcription factors to bind the DNA and genes are expressed (active gene).

c) Phosphorylation

It is the addition of phosphate group to the hydroxyl group of amino acids like serine and histidine by the enzyme kinases.

2. Transcriptional control

The control of transcription initiation is the predominant control level of gene expression in eukaryotes. This control is realised through binding of TRANS protein and CIS sequences. TRANS proteins are transcription factors that initiate and execute process of transcription. CIS elements include all the DNA sequences (promoter sequences, regulatory sequences like enhancers, silencers and insulators) involved in transcription.

Transcription factors (TFs) are having defined DNA-binding domains with up to 10^6 fold higher affinity for their target sequences. These highly conserved sequences are taken into consideration for categorizing the TFs into different "families," such as the MADS box-containing proteins, SOX proteins, and POU factors[2]. TFs have two domains, DNA binding domain (bind DNA sequences in regulatory regions including promoters and enhancers) and trans-acting domain (activates transcription via protein-protein interaction). Three types of structural motifs of transcription factors are helx-turn-helix (HTH), zinc fingers and basic leucine zippers (bZIP).

a) Helix-turn-helix (HTH) motif
   Two adjacent α-helices separated by a turn of several amino acids to bind the DNA.

Homeo-box (80 bp) is an extended HTH motif possessed by proteins coded by homeotic genes present universally in eukaryotic organisms. It specifies a homeodomain sequence of 60 amino acids containing many basic amino acids (histidine, lysine and arginine) that can form HTH structure.

b) Zinc fingers

This structural motif is first discovered from frog, *Xenopus laevis* in proto-oncogenes. There are many zinc finger proteins, out of which one protein contains clusters of two cysteine and two histidine residues at repeating intervals which form covalent bonds with zinc atom folding the amino acids in to loop (zinc fingers). Each finger consists of 23 amino acids with a loop of 12-14 amino acids between the cysteine and histidine residues and a linker between the loops consists of 7-8 amino acids. Zinc finger binds at the major groove of the DNA helix rich in guanine bases. Number of fingers in zinc finger transcription factor varies from 2-13.

c) Basic leucine zipper (bZIP)

This motif was first seen in the nuclear protein in rat liver having 35 amino acid stretches. In bZIP four leucine residues are spaced at seven amino acids aparts. The leucine rich regions form helix with leucine residues protruding at every other turn. When two of these molecules dimerize leucine residues are zipped together, looking like a pair of scissors.

Promoter is the part of DNA sequence consisting of RNA polymerase binding site and CAP binding site. In eukaryotes it is recognised by RNA polymerase II. The core region of promoter consists of TATA box sequence (20-30 bp upstream from transcription initiation point) which consists of 8 bp consensus sequence. Proximal elements required for transcription in promoter are CAAT box (70-80 bp upstream from initiation of transcription) and GC box (110 bp upstream to initiation point).

Promoter differs from enhancer or silencer by some features. Promoter sequence presents upstream and adjacent to the coding region whereas enhancer or silencer can exert their activities upstream, downstream or inside a gene, in an orientation and distance independent manner.

Insulators which prevent the random activation of promoters situated over a large distance between an enhancer and its regulated promoter. The role of insulator can be explained as regulation of Igf-2 and H-19 gene expression in chromosome 11. Both the genes compete for common enhancer element to be expressed. Methylation of paternal H-19 gene and CTCF insulator abolishes enhancer effect preventing paternal H-19 gene expression while allows expression of paternal Igf-2 gene. On the other hand regulatory protein CTCF binds to the insulator sequence of the maternal chromosome, thus inhibiting the enhancer effect on Igf-2 gene and H-19 gene can then be activated and transcribed. Thus Igf-2 gene is paternally expressed and H-19 gene is maternally expressed. Prader-Willi syndrome and Angelman's syndrome are due to deletion of paternal chromosome and maternal 15 [Del(15)(q11-q13)] respectively [4].

3. Post-transcriptional control

Eukaryotic nuclear RNA transcripts are modified prior to translation known as RNA processing. RNA processing is to generate mature mRNA (for protein synthesis) or a functional tRNA or rRNA from the primary transcript. The mRNA processing includes removal of non-coding introns, splicing of exons, addition of CAP at 5' end and poly-A tail at 3' end. This message is then complexed with proteins and exported to cytoplasm. Alternative splicing of mRNA is another method in which single mRNA transcript spliced to give different forms of a protein by the expression of miRNA or siRNA genes. There are four common modes of alternative splicing;

a. Alternative use of promoters which retains the first or second exon in the mature mRNA.

b. Alternative use of poly-A sites determines the retention of the 3' end of exon.
c. Intron retention which may contain stop codon giving rise to truncated protein when the mRNA is translated.
d. Alternative splicing of internal exons which encodes different polypeptides with similar or different functions.

Bovine pre-mRNA transcript is processed into one or two pre-pro-tachykinin mRNAs (PPT mRNAs) includes genetic information specifying two types of neuropeptide P and K. Processing of PPT mRNA transcript including both P and K exons yields β-PPT mRNA upon transcription results in both P and K neuropeptide. However, exclusion of K exon during processing results in the α-PPT mRNA upon translation yields only neuropeptide P. In nervous tissues α-PPT mRNA predominates while, in thyroid and intestine β-PPT mRNA predominates.

4. Translational control

This regulation occurs during the synthesis of proteins and their metabolism in body. One best example of translational control is the iron metabolism. Ferritin has a function in iron storage whereas transferrin receptor is responsible for iron import into the cell. When cytosolic concentration of iron increases, the synthesis of ferritin increases in order to bind the extra iron whereas the synthesis of transferrin receptors decreases in order to import less iron across the plasma membrane. Both the translational processes are regulated by regulatory protein aconitase which can bind iron. Aconitase can recognise and binds to a stem-loop structure at the 5'UTR of Ferritin mRNA blocking translational initiation of ferritin mRNA. Aconitase can also bind to a similar stem-loop structure located at 3'UTR of transferrin receptor mRNA. This binding enhances mRNA stability. Aconitase dissociates from the mRNA when it binds iron. So when iron concentration rises, translation of ferritin mRNA is initiated whereas transferrin receptor mRNAs are rapidly degraded.

5. Post-translational control

It is the regulation process in which the protein structure and function are modified after translation. These modifications involve chemical modification of amino acids and alteration of the order of amino acids in the polypeptide backbone. Most common chemical modifications of amino acids include phosphorylation (addition of phosphate), glycosylation (addition of sugar) and ubiquitination (degraded by proteosomes). Alteration of polypeptide backbone includes formation of active protein from precursors like trypsin from chymotrypsin, cleavage of insulin *etc*. Inteins are types of proteins which can direct their own excision and exteins leads ligation of flanking polypeptide chains.

CONCLUSION

The regulation of gene expression in eukaryotes is crucial for an essentially muticellular organism to develop harmoniously according to a pre-determined genetic program. The regulation is neither rapid nor synchronized for a group of genes but precise for each individual gene. The best example of RNA editing is ApoB48 in liver and ApoB100 in gut, where CAA is edited to TAA due to C>T mutation resulting in prematurely translated protein of 48kD size. Finally, gene expression can be controlled, not by proteins, but by RNAs, especially siRNAs (short interfering RNA) or miRNAs (microRNA). Their actions are varied, inhibiting transcription or translation, inducing RNA degradation or chromatin modification.

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AN OVERVIEW OF INDIAN POWER SCENARIO AND POTENTIAL OF ENVIRONMENTAL FRIENDLY FUEL BIOMASS

Anjum Ansari[1], Smita Joshi[2] and Sulbha Amlathe[3]

The conventional energy sources like fossil fuels, crude oil, natural gas etc. are dwindling fast. For India, biomass has always been an important energy source. Although the energy scenario in India today indicates a growing dependence on the conventional forms of energy, about 32% of the total primary energy use in the country is still derived form biomass & more than 70% of the country's population depends upon it for its energy needs. Higher value addition to biomass can be achieved by utilizing it for power generation. Bioenergy is the need of today which is cheap and desirable under Indian condition. This problem can be solved by Briquetting only.

INTRODUCTION

In many developing countries wood has been used as fuel. The situation is growing so desperate that wood is poached from forest reserves. As a result the ecosystem is degrading deplorably. So, in order to protect the natural environment, there is every necessity of producing alternative source of energy for the needs of the people. Biomass is the best alternative as it is available in plenty and production of energy from biomass is also less costly.

In India, the concept of energy as " Shakti " has been at the focus of philosophic, scientific and metaphysical thought from time immemorial. The conventional energy sources like fossil fuels, crude oil, natural gas etc. are dwindling fast. The world stock of non-renewable natural sources indeed has decreased. There is every necessity of going for renewable alternative resources for energy. The energy crisis of 1973 left scientists to accelerate the renewable energy programmes.

The important renewable energy sources are sun, wind, tides, waves, biomass, hydropower (from water) charcoal, peat, fuel wood, geothermal energy etc. The pattern of energy consumption in India shows that 56.5 % of total energy is from the commercial sources like coal, oil "electricity and remaining 43.5% is non-commercial energy. Fire wood, charcoal, agricultural residues, vegetable wastes, cow dung, urban and industrial wastes, forest residues are the main sources of this non-commercial energy.

The most efficient utilization of these resources comes when they are converted to biomass by appropriate technologies. The non-commercial biomass fuels are the main sources of energy available in the rural areas. The 80% of our population resides in villages are dependent on this non-commercial biomass fuels.

Biomass energy, or bio-energy, is the energy stored in non-fossil organic materials such as wood, straw, vegetable oils and wastes from the forest, agricultural and industrial sectors. Like the energy in fossil fuels, bioenergy is derived from solar energy that has been stored in plants through the process of photosynthesis. Municipal solid waste and sewage sludge can also be considered as biomass.

Biomass Ecology- Biomass, in ecology, is the mass of living biological organisms in a given area or ecosystem at a given time. Biomass is the mass of one or more species (community). It can include plants, animals or microorganisms.

Biomass is organic material derived from a wide

[1,3.]Department of Chemistry, BUIT, Barkatullah University, Bhopal- 462026 (M.P.), Telephone: 9179830432, E-mail- ansari.anjum@rediffmail.com, [2.]Department of Chemistry, Sarojini Naidu Govt. Girls PG (Autonomous) College, Shivaji Nagar, Bhopal-462016 (M.P.).

variety of plant matter that can be converted into electricity in an environmental friendly and sustainable manner.

Biomass energy comes from industrial waste, agricultural crop residues and energy plantation. Biomass energy originates from plants that converted the sun's energy through photosynthesis and stored it in different forms. This stored energy can be converted to fuel, heat and electricity.

Concept of Biomass- Biomass refers to all organic matter generated through photosynthesis and other biological processes. The ultimate source of biomass is the inexhaustible solar energy captured by plants through photosynthesis. It includes lots of matter, both terrestrial as well as aquatic like wood, herbaceous plants, algae, aquatic plants and residues, like straw, husks, corncobs, cow dung, saw-dust, wood shavings and other wastes such as disposable garbage, night soil, sewage solids, industrial refuse etc. They are not being properly utilized, in spite of all these biomass resources available in India. In fact, a huge amount of it is disposed off by burning in open fields causing serious air pollution.

Biomass Conversion- In order to utilize these resources properly, biomass should be converted to energy which can meet a sizeable percentage of the country's demands for fuel as well as energy. For generation and proper utilization three main approaches can be adopted.

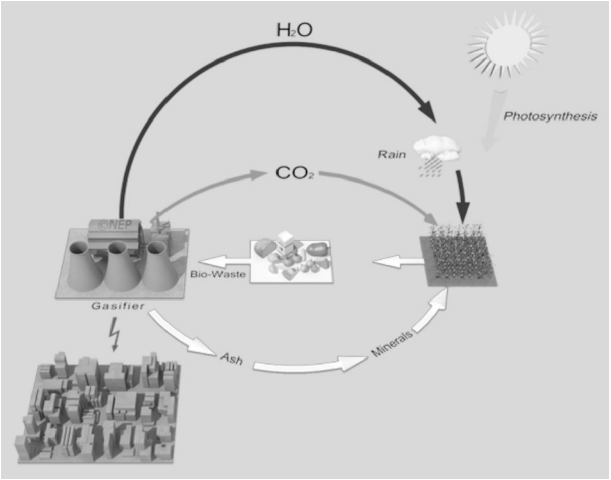

Fig. 1 Conversion of Sun's Energy into Biomass Energy

1. Collection of agricultural and forest residues to produce fuels, organic manures and chemical feed stock.
2. Collection of urban and industrial wastes as fuel in boilers and as a feedstock for producing methane and some liquid fuels.
3. Growth of some specific energy plants for use as energy feed stock and cultivation of commercial forestry, aquatic and marine plants for different products.

By a number of processes, the collected wastes can be converted into solid, liquid and gaseous fuels. The technologies include thermal, thermo-chemical and bio-chemical conversions. The actual processes in these technologies are combustion, pyrolysis, gasification, alcoholic fermentation, liquefaction etc.

The main products of conversion technologies are energy (thermal, steam, electricity), solid fuels (charcoal, combustibles) and synthetic fuels (methanol, methane, hydrogen gas etc.). These can be used for different purposes like cooking, lighting, heating, water pumping, electricity generation and as industrial and transport fuels.

Biomass Gasification- The government of India's Harayana state has decided to promote biomass power projects based on gasification in a move to help rural communities replace costly diesel and furnace oil. The news was announced during a meeting of the Haryana Renewable Energy Development Agency (HAREDA). Six pilot plants have demonstrated the efficiency and practicability of small-scale biomass gasification.

Among the renewable energy technologies, biomass gasifier-based decentralized power generation holds great promise for meeting rural energy needs due to the following-

1) Availability in different capacity scales- Biomass gasifiers are available in different capacities for decentralized applications from 5, 20, 100 to 500 KW in India.

2) Feasibility of installation in any location or village- Biomass gasifiers can be installed and operated in any village where biomass is available or can be grown, except probably

in desert areas. Such flexibility does not exist for other renewables such as solar, wind, micro-hydro and biogas systems.

3) Economic viability- The economic viability is yet to be proven for renewables in India based on monitoring of field-based systems. Preliminary assessments available show that biomass gasifiers are economically feasible and have lower cost per kilowatt-hour compared to other energy technologies.

4) Socio-economic benefits- Biomass gasifier-based power generation systems create jobs and skills in rural areas in biomass feedstock production, transportation and processing and in operation and maintenance of the gasifier engine genset systems as well as end-use systems.

5) **Climate change mitigation**- Biomass power is recognized as a prime option with high potential for reduction in carbon emission and climate change mitigation.

Despite the above advantages the rate of spread of biomass-based power generation technology in India is low, due to a number of policies, institutional and financial barriers. There is need to address such barriers to promote biomass power in India.

Agro/ Forest Waste Briquetting Plant-We can make briquettes from Agriculture Waste and Forestry Waste by setting up Briquette Manufacturing Machines. The machine compresses and binds the raw material from powder/ stalks /granular form to solid form by heating the material and using high pressure. It does not require any external source for heating or generating pressure. Finished product is easy to handle and transport to the desired destinations. Briquetting machines can also be designed as per the type of waste available locally. Presently Briquetting machines are designed basically on agro-waste as this is available in abundance in every part of the country as still 70 % of our population is engaged in agricultural activities.

Bioenergy is the need of today which is cheap and desirable under Indian condition. This problem can be solved by Briquetting only. The Briquetting is a process of transformation of highly voluminous agricultural waste into compact clean non-polluting fuel.

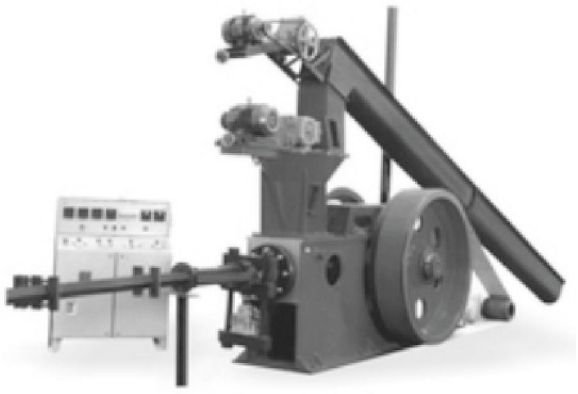

Fig. 2 Briquetting Plant

Brequetted fuel has a very high calorific value ranging between 3500/5000 K. Cals/Kgs. depending on raw materials. It leaves very low ash contents of 2 to 10% as compared to 20 or 40% in coal resulting pollution free environment. It has no fly ash. It burns very steadily and uniformly giving a long time heat. Due to its non-polluting quality demand is increasing day by day. It is widely used in Dyeing units. Bricks Kilns, Oil Mills. Chemical Plants, Paper Mill, Solvent Extraction Plants, Rubber Industry, Textile Industry etc.

Industrial biomass can be grown from numerous types of plants, including miscanthus, switchgrass, hemp, corn, poplar, willow, sorghum, sugarcane.

Advantages

- It makes sense to use waste materials where we can.
- The fuel tends to be cheap.
- Less demand on the fossil fuels.
- To control pollution
- Preserve agricultural land

Disadvantages

- Collecting or growing the fuel in sufficient quantities can be difficult.

- We burn the biofuel, so it makes greenhouse gases just like fossil fuels do.
- Some waste materials are not available all year round.

Plan and Projects-India to add 1700mw of biomass co-generation by 2012; 18,000mw potential from agro-residues. Under its 11th Plan period (2007-2012), the government of India aims to add 1,700 MW capacity through biomass and bagasse cogeneration in various states, including Maharashtra, Uttar Pradesh, Tamil Nadu and Karnataka.

As per the National Biomass Resource Atlas prepared by the Indian Institute of Science, Bangalore, under a project sponsored by the Ministry, a cumulative biomass power potential of about 18,000 MWe from surplus agro-residues has been estimated in the country. Under the new bioenergy plan, the states of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal have been estimated to have a potential to set up biomass based power projects of 100 MW or above.

The government is providing incentives for setting up of power generation projects based on biomass and bagasse cogeneration in the form of capital subsidy and fiscal incentives such as accelerated depreciation, relief from taxes and duties, term loans from Indian Renewable Energy Development Agency (IREDA).

Future Aspects

1) In impact of genetic engineering in the solution of bioconversion routes for high productive therefore bioconversion process are likely to be more economical than many synthetic process for organic feed stock production available now.

2) Bioconversion of lignocellulosic biomass to ethanol in an integrated system incorporating the production of biogas, biofertilizer and sugars for industrial application.

3) Small as well as large-scale chemical & thermo chemical conversion of biomass into gaseous & liquid fuels and bulk chemicals.

4) Conversion of non-edible oils to diesel substitutes and large-scale attempts to such possibilities.

5) Adoption of massive a forestation and energy plantation projects in arid and semiarid regions.

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CROSSING THE LIMIT: E-WASTE DYNAMICS, IMPACTS, AND LEGISLATION IN INDIA

Prashant Mehta

Rapidly changing technology and short product lifecycle make electronic products obsolete in quick time and ending up as e-waste that is either internally generated or is imported from other countries. Worldwide there is a growing debate on electronic waste (e-waste) which is a burgeoning problem in developed and developing countries and it is posing a new challenge to the environment regulators and policy makers to combat. E-waste comprises of a multitude of components with valuable materials, some containing toxic substances that can have adverse impact ecology, directly or indirectly on living beings, and pollute the environment if not handled properly. In India, e-waste management assumes greater significance due to lack of implementation of rules for effective processing of e-waste, inadequate infrastructure and procedures for its disposal and recycling, besides dumping of e-waste from developed countries. Most of the users are unaware of the potential negative impact of e-wastes which is ending up in dumping yards and recycling centers. This study provides a comprehensive overview of India's current e-waste scenario, environmental impact and health hazards, disposal and recycling methods, existing legal framework, and recommendations for immediate action to steer clear of its impact on all concerned.

INTRODUCTION

Following industrial revolution, advances in information technology in last two decades resulted in the human civilization to grow in a more efficient manner and has radically changed lifestyle of people. The Indian information technology (IT) industry has been one of the major drivers of economic progress in the last two decades both in terms of volume and applications and has significantly contributed to the digital revolution that have infiltrated every aspect of our daily lives, which is being experienced by increasing use of new electronic gadgets and appliances, thus providing our society with more comfort, health, security, easy information acquisition, and exchange all across the world. This coupled with rapid developments, innovation, miniaturization; replacement resulted into higher rate of obsolescence of electronics, information and communication technology (ICT) products which in turn has become the leading cause of fastest growing waste streams that is e-waste. Every year, lacks of old computers, mobile phones, television sets, radio equipment, and electronic appliances are discarded, most of which either end up in landfills or unauthorized recycling yard[1]. It is estimated that in 2014 world-wide 41.8 million metric tonnes (Mt) e-waste was generated and most of it was not collected and treated in environmentally sound manner[2].

The increasing 'market penetration' in the developing countries, 'replacement market' in the developed countries and 'high obsolescence rate' make e-waste one of the fastest waste streams. Much e-waste, however, is unaccounted for. It is either discarded into the general waste stream or, perhaps, illegally exported to crude e-waste recycling hotspots which have been identified in Asian countries, such as China, India, and Pakistan, and in some African countries, like Ghana and Nigeria[3]. Solid waste management, which is already an enormous task in India, is becoming more complicated by the invasion of e-waste. It is estimated that up to 80 percent of all e-waste sent for recycling in developed countries ends up in informal e-waste recycling sites in developing countries like India. In these countries, low public awareness of the

Faculty of Science, National Law University, Jodhpur (Rajasthan), Email: prashantmehta1@rediffmail.com

hazardous nature of e-waste, crude and hazardous methods of recycling are used, jeopardizing people's health and the environment[4]. All this has made e-waste management an issue of environment and health concern. Thus knowledge society of twenty first century is creating its own toxic footprint of e-waste and is the most debated issue amongst the environmentalists and environment forums worldwide.

WHAT IS ELECTRONIC WASTE OR E-WASTE

According to the Basel Convention, wastes are substances or objects, which are disposed of or are intended to be disposed of, or are required to be disposed of by the provisions of national laws[5]. Wastes can be of various kinds like municipal wastes, household wastes, organic wastes, metallic wastes, bio- medical wastes, radioactive wastes etc. Electronic waste (e-waste) comprises of waste electronics / electrical goods that are not fit for their originally intended use or have reached their end of life. This may include items such as computers, servers, main frames, monitors, CD, printers, scanners, copiers, calculators, fax machines, batteries, cellular phones, receiver's discs, CRT televisions, medical apparatus, electronic components, mother board, almost all house hold and consumer appliances. Computer circuit boards contain valuable metals such as copper, silver, gold, palladium, silver, indium and bismuth and platinum, cathode ray tubes and LCD contain lead, barium and other heavy metals, printed circuit boards and connectors use brominated flame retardants, poly vinyl chloride (PVC) coated copper cables and casing, plastics from computer hardware that release highly toxic dioxins and furans when burnt to recover valuable metals, mercury switches, mercury in flat screens, poly chlorinated biphenyl's (PCB's) present in older capacitors and transformers etc. Given below is a table showing the major pollutants occurring as waste in electrical and electronic equipments of different types in Table 1 below[6].

Table 1: Major Pollutants in e-wastes and their Occurrence

Pollutant	Occurrence
Arsenic (As)	Semiconductors, diodes, microwaves, LEDs (Light-emitting diodes), solar cells
Barium (Ba)	Electron tubes, filler for plastic and rubber, lubricant additives
Brominated Flame Proofing Agent	Casing, circuit boards (plastic), cables and PVC cables
Cadmium (Cd)	Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
Chromium (Cr)	Dyes/pigments, switches, solar
Cobalt (Co)	Insulators
Copper (Cu)	Conducted in cables, copper ribbons, coils, circuitry, pigments
Lead (Pb)	Lead rechargeable batteries, solar, transistors, lithium batteries, PVC (polyvinyl chloride) stabilizers, lasers, LEDs, thermoelectric elements, circuit boards
Liquid Crystals	Display
Lithium (Li)	Mobile telephones, photographic equipment, video equipment (batteries)
Mercury (Hg)	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
Nickel (Ni)	Alloys, batteries, relays, semiconductors, pigments

Pollutant	Occurrence
Poly chlorinated biphenyls (PCB)	Transformers, capacitors, softening agents for paint, glue, plastic
Selenium (Se)	Photoelectric cells, pigments, photocopiers, fax machines
Silver (Ag)	Capacitors, switches (contacts), batteries, resistors
Zinc (Zn)	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances

Incineration of e-waste produces potentially hazardous byproducts like dioxins, furans, and polycyclic aromatic hydrocarbons. Materials containing Poly Vinyl Chloride (PVC) are precursors to polychlorinated dibenzo-p-dioxins and dibenzo-furans (PCDD/Fs). These are classified as persistent organic pollutants (POPs) under the Stockholm Convention, a global treaty drawn up to protect human health and the environment.

IMPACT OF E-WASTE

Disposal of e-wastes is a particular problem faced in many regions across the globe more so in India. It is estimated that, by 2020, India could see a 500 percent rise in the number of old computers dumped[7]. E-waste is much more hazardous than many other municipal wastes because electronic gadgets contain thousands of components made of deadly chemicals, heavy metals brominated flame retardants and other potentially hazardous substances that are main risks to human health and the environment and particularly important routes of human exposure to dioxins, lead, copper, cadmium, chromium, mercury, polyvinyl chlorides (PVC), beryllium, antimony, phthalates, poly-brominated diphenyl ethers (PBDEs), polychlorinated biphenyl (PCB), mercury, and other carcinogens. If improperly managed, such substances may pose significant human and environmental health risks. There are three main groups of substances that may be released during recycling and material recovery, and which are of concern: original constituents of equipment, such as lead and mercury; substances that may be added during some recovery processes, such as cyanide; and substances that may be formed by recycling processes, such as dioxins.

In India recycling practices include manual disassembly, heating printed circuit boards to recover solder and chips, acid extraction of metals from complex mixtures, melting and extruding plastics, and burning plastics to isolate metals. Mixtures of concentrated nitric acid and hydrochloric acids have been reported to be used in Delhi for the extraction of gold and copper respectively. Various volatile compounds of nitrogen and chlorine are known to be emitted during such processes. The heating or incineration of printed circuit boards for desoldering and removal of chips exposes workers to fumes of metals, particularly those in solder (often lead and tin), and other hazardous substances that can be potentially released[8] thereby polluting the surrounding air. Working in poorly-ventilated or enclosed areas without masks and technical expertise can result in exposure to dangerous and slow-poisoning chemicals. Inhaling or handling such slow poisoning chemical substances on a regular basis can damage the brain, nervous system, lungs, kidneys, and the reproductive system. Inhalation and dust ingestion impose a range of potential occupational hazards including silicosis[9]. Computer wastes that are land filled produces contaminated leachate which eventually pollutes the groundwater whereas acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil.

Due to lack of awareness, workers (more so children) are risking their health and irreversible damage to environment as well. For example Lead (Pb) exerts toxic effects on various systems in the body such as the central (organic affective syndrome) and peripheral nervous systems (motor neuropathy), the hemopoietic system (anemia), the genitourinary system (capable of causing damage to all parts of nephron) and the reproductive systems (male and

female)[10], Mercury causes damage to the genitourinary system (tubular dysfunction), the central and peripheral nervous systems as well as the fetus. When inorganic mercury spreads out in the water, it is transformed into methylated mercury, which bio-accumulates in living organisms and concentrates through the food chain, particularly by fish[11], Cadmium is a potentially long-term cumulative poison. Toxic cadmium compounds accumulate in the human body, especially in the kidneys. There is evidence of the role of cadmium and beryllium in carcinogenicity[12,13] and Polycyclic Aromatic Hydrocarbons (PAH) which affects lung, skin and bladder. Epidemiological studies in the past on occupational exposure to PAH provide sufficient evidence of the role of PAH in the induction of skin and lung cancers[14]. Overall, human health risks from e-waste include breathing difficulties, respiratory irritation, coughing, choking, pneumonitis, tremors, neuropsychiatric problems, convulsions, coma and even death[15]. Listed in the table 2 below are the harmful elements in the compositions of electrical and electronic appliances that can be hazardous to health and environment[16]:

Table 2 – Harmful Metals and Hazards

Metal	Hazards
Lead (Pb)	A neurotoxin that affects the kidneys and the reproductive system. High quantities can be fatal. It affects mental development in children. Mechanical breaking of CRTs (cathode ray tubes) and removing solder from microchips release lead as powder and fumes.
Plastic	Found in circuit boards, cabinets and cables, they contain carcinogens. BFRs or brominated flame retardants give out carcinogenic brominated dioxins and furans. Dioxins can harm reproductive and immune systems. Burning PVC, a component of plastics, also produces dioxins. BFR can leach into and fills. Even the dust on computer cabinets contains BFR.
Chromium (Cr)	Used to protect metal housings and plates in a computer from corrosion. Inhaling hexavalent chromium or chromium 6 can damage liver and kidneys and cause bronchial maladies including asthmatic bronchitis and lung cancer
Mercury (Hg)	Affects the central nervous system, kidneys and immune system. It impairs fetus growth and harms infants through mother's milk. It is released while breaking and burning of circuit boards and switches. Mercury in water bodies can form methylated mercury through microbial activity. Methylated mercury is toxic and can enter the human food chain through aquatic.
Beryllium (Be)	Found in switch boards and printed circuit boards. It is carcinogenic and causes lung diseases.
Cadmium (Cd)	A carcinogen. Long-term exposure causes Itai -itai disease, which causes severe pain in the joints and spine. It affects the kidneys and softens bones. Cadmium is released into the environment as powder while crushing and milling of plastics, CRTs and circuit boards. Cadmium may be released with dust, entering surface water and groundwater.
Acid	Sulphuric and hydrochloric acids are used to separate metals from circuit boards. Fumes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin.

MAJOR WASTE LEGISLATION IN INDIA

The environmentally sound management of waste is a significant challenge for India. The issue of electrical and electronic equipment imports, recycling, and disposal in environmentally friendly way has become the subject of serious discussion and debate among the government organizations, environmentalist groups, and the private sector manufacturers of computers and consumer electronic equipments. The Department-related Parliamentary Standing Committee on Science & Technology, Environment & Forests in its 192nd report on the 'Functioning of the Central Pollution Control Board (CPCB)', has concluded that e-waste is going to be a big problem in the future due to modern life style and increase in the living standards of people and augmentation of economic growth. The Ministry of Environment and Forest (MoEF) of the government of India is responsible for environmental legislation and its control. The Central Pollution Control Board (CPCB), an autonomous body under MoEF, plays an important role in drafting guidelines and advising the MoEF on policy matter regarding environmental issues. The Regulations / Rules and Acts for waste control are primarily listed as The Environmental Protection Act 1986.

- The Environmental Protection Rules 1986
- The Hazardous Waste (Management and Handling) Rules, 2003
- The Batteries (Management and Handling) Rules, 2001
- Bio-Medical Waste (Management and Handling) Rules, 1998
- The Water (Prevention and Control of Pollution) Act, 1974, amended 1988
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- Air (Prevention and Control of Pollution) Act 1981, Amended 1987
- Air (Prevention and Control of Pollution) Rules, 1982
- The Ozone Depleting Substances (Regulation and Control) Rules, 2000
- The Noise Pollution (Regulation and Control Rules) 2000
- The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008
- The Plastics (Manufacture, Usage and Waste Management) Rules, 2009

Following Supreme Court directions[17], the states have notified a set of hazardous waste laws and built a number of hazardous waste disposal facilities in the last ten years. However, the CAG report found that over 75 per cent of state bodies were not implementing these laws[18]. In addition, despite a wide range of environmental legislation in India, there are no specific laws or guidelines for regulating e-waste. The Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, do apply to e-waste as amended in 2008 for toxic content which made registration mandatory for recyclers but deal primarily with industrial waste and lack elements to deal with the complexities of e-waste. The regulations banning the importation of hazardous waste for disposal are weak and imported e-waste still finds its way into the country. Though the trans-boundary movement of hazardous waste is banned under an international treaty called the Basel Convention, dealers sneak in consignments of electronic scrap as they are not properly classified. According to environmental activists, most electronic scrap that comes into the country is classified as plastic scrap or mixed waste. In 2007, separate guidelines on e-waste management were implemented, but they were voluntary and had limited impact. India is also a signatory to the Basal Convention. (Basel Convention is the United Nations Environment Programme) on the control of Transboundary Movement of Hazardous wastes and their disposal. Furthermore, although various laws regulating areas such as importation (foreign trade policy which restricted the import of second hand computers and does not permit import of e-waste),

the environment, labour and factories could have an impact upon e-waste in India, virtually none apply to the informal sector. The provision of environmental protection is delegated among India's various states, also, and this is known to give rise to sloppy enforcement of e-waste related legislation.

THE E-WASTE (MANAGEMENT AND HANDLING RULES) 2011

The government finally woke up to this growing problem a couple of years ago when studies by its information technology department estimated the e-waste burden on the country to touch 800,000 metric tonnes by December. It responded by framing the e-waste (management and handling) rules – 2011 which came into effect this month. While the rules seem impressive on paper, environmental groups have expressed concerns about its ability to bring about change due to the sheer oversight of the ground situation. To begin with, the rules put India along with a select club of nations like the United States and many in Europe to have legislation to regulate and manage electronic waste.

The primary objective of these rules is to channelize the e-waste generated in the country and to make the re-cycling of e-wastes in environmentally friendly. The e-waste (management and handling) Rules, 2011 recognize the producers' liability for recycling and reducing e-waste in the country. "These rules will apply to every producer, consumer and bulk consumer involved in manufacture, sale, and purchase and processing of electronic equipment or components," Personal Computer manufacturers, mobile handset makers, and consumer goods makers will be required to come up with e-waste collection centers or introduce 'take back' systems. The ministry is giving the producers of electrical and electronic equipment a breathing period of one year to set up their collection centers[19]. The rules will come under the Environment Protection Act (EPA). Under the new rules, producers will have to make consumers aware about the hazardous components present in the product. They will also have to give information booklets to prevent e-waste from being dropped in garbage bins. However, according to the rules, bulk consumers such as enterprises and government will be responsible for recycling of the e-wastes generated by them. The bulk users have to ensure that the e-waste generated by them is channelized to authorized collection centers or is taken back by the producers. They also have to maintain records of e-wastes generated by them and make such records available with State Pollution Control Boards or the Pollution Control Committees.

CONCLUSION

From the discussion above, it is aptly clear that India faces an enormous task of handling and disposing (managing) piles of e-waste in environmentally friendly way. Because of it the risk of damage to human health (more so of women and children) and natural environment increases manifold. This coupled with lack of strict enforcement of legislation is a worrisome situation. The awareness of people about e-waste needs to increase and the rules should be properly implemented to control the rise of e-waste in future. On the contrary e-waste recycling offers many opportunities like green design, innovation in product technology, life cycle analysis, public outreach, social policy and so on. It is time for us to look deep and ahead or tomorrow it will be too late to act.

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"TRUE POTATO SEED" (TPS): AN EMERGING ALTERNATIVE FOR POTATO PRODUCTION IN INDIA

Sukamal Sarkar

Potato is one of the most important staple food ranks behind the rice and wheat in India. Potato generally cultivated by planting of tubers, which is the costliest input in potato cultivation comprising upto 40-60% of total cost of cultivation. True Potato Seed (TPS) is one of the potential solutions of this problem by providing us disease free potato and low cost production technology.

INTRODUCTION

Potato (*Solanum tuberosum* L.) ranks behind the cereals rice and wheat as the 3rd most important food crop worldwide[1]. More than a billion people worldwide eat potato, making it a critical crop in terms of food security in the face of population growth. Per capita consumption of potato is upto 55 kg in industrial countries as compared to 11 kg in third world countries[2]. Across the world, approximately 19 million hectares (Mha) are devoted to potato production, with an average yield of around 17 tonnes per hectare [2]. Potato is not only an important source of starch[1] but also produce more dry matter and protein per hectare than the major cereal crops [3]. India is one of the largest potato producers in world. The 2010 rankings of the top 10 potato producing nations place India in second position after China[1].

Potato is mostly cultivated by planting of tubers. Purity of the cultivars and healthy seed tubers are the primary requirements for a successful cultivation of crop. However, seed tuber is the costliest input in potato cultivation comprising upto 40-60% of total cost of potato cultivation. It is a prerequisite that the seed tuber must be free from disease, viruses, well-sprouted and 30-40 g each in weight. The shortage of good quality seed tubers, high seed cost, transportation of bulky potato seed, and virus infiltration in seed tubers are some of the important problems associated with use of seed tubers as planting material. This problem can be successfully overcome by introduction of "True Potato Seed" (TPS) for potato cultivation.

Department of Agronomy, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya Mohanpur-741252, Nadia, E mail: sukamalsarkarc@yahoo.com

WHAT IS "TRUE POTATO SEED" (TPS)?

Sexual or botanical seed of potato commonly called "True Potato Seed" (TPS) is a radical alternative to seed tubers for raising a commercial potato crop.

The first attempt for production of TPS was started in the late 1940s. But the early day's attempt was unsuccessful. The true seeds of potato were not normally used for raising a crop due to it being more delicate than other similar seeds of the *solanaceous* crops. Therefore, except for breeding purposes where special care was taken to raise the seedlings, the true seed of potato was not used. However, as the cost of cultivation increased day by day and profit margins decreased in commonly grown (tuber planted) potato, research to use TPS for raising a crop was intensified in last two decades. This was because use of TPS has several advantages. Exploitation of the advantages is expected to make potato cultivation profitable and help extend its cultivation to other areas.

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AGRONOMIC PACKAGE AND PRACTICES FOR RISING OF TPS

TPS can be used in following three ways to grow the commercial potato crop.

- Direct seeding
- Transplanting TPS derived seedlings
- Planting seedling tubers rose from TPS

DIRECT SEEDING

Potato true seeds are small and seedlings are rather delicate, and as such make severe demands on horticultural skills. Thus, raising the crop from direct seeding is prone to risks and resulted in less germination of seedlings. This method is thus rarely recommended for raising a commercial potato crop. In most suitable condition, 200 g TPS per ha is sufficient for direct seeding of potato, and an emergence of 75% in well-controlled field conditions was reported.

However, in practical condition, direct seeding of TPS to grow commercial potato crop is not recommended due to the uneven and low percentage of germination, heavy weed problems and slow growth of the plants etc. leading to poor yield.

SEED PREPARATION FOR TPS SOWING

TPS is generally treated with 0.01% Benzemidazole or any other systemic fungicides before sowing. To produce seedlings for transplanting, the TPS may be sown either in the rows or by broadcasting on the surface of prepared beds. The line sowing is preferred because:

i) Seeds are placed at a uniform depth giving uniform seedling emergence

ii) Weeding and other cultural practices are performed easily.

PREPARATION OF NURSERY BEDS FOR TPS SOWING

Organic manure and soil are the main components mixed in 1:1 ratio (v/v) for preparing the nursery substrate to produce TPS derived seedlings. The organic manure consist well-decomposed animal dung, compost etc. The width of nursery beds is kept one meter to carry out easily the manual intercultural operations such as weeding, hoeing, earthing-up etc. and the length may be kept as per requirement. A shallow drainage channel of 4-5 inch is sufficient to remove the excess water. Fertilizers @ 7.5 g N, 8.0 g P_2O_5 and 10.0 g K_2O is added per square meter to above substrate and mixed properly.

PRODUCTION OF POTATO SEEDLINGS FOR TRANSPLANTING

Seedling transplanting is suitable in areas where production of healthy tuber seed and its storage is costly as well as temperatures are mild (between 15-25C 5C) for more than 120 days during the crop season and also irrigation facilities are easily available. Generally TPS germinated after 10-15 days of sowing. Seedlings are ready for transplanting after 20-25 days of sowing (4-5 leaf stage). After 10 days the beds may be watered as and when required. After one week of seedling emergence 0.1 % solution of urea (1g urea in 1 litre of water) is sprayed at 2-3 days interval till transplanting for proper vegetative growth of seedling. The seedlings must be transplanted before stolon initiation to avoid yield losses. Only 100 g TPS and a nursery area of 75 sq. m is sufficient to produce seedlings for transplanting a hectare area.

PRODUCTION OF SEEDLING TUBERS FROM TPS

In areas where winter is harsh with short crop duration, the use of first generation seedling tubers, derived from TPS is advocated. Only 50 g TPS is required for sowing 350 sq m nursery area to produce enough seedling tubers for planting a hectare of commercial crop in the succeeding crop season. Seedling tubers also need cold store facilities for their storage like conventional seed tubers before planting in the following crop season. However, the space required for seedling tubers is considerably less than needed for seed tubers of a variety.

MAIN FIELD PREPARATION

The field preparation for TPS is same to the traditional potato cultivation through seed tubers. The care needs to be taken that the soil has moisture at field capacity at the time of planting and there are not much clods in the field for transplanting seedlings.

AGRONOMIC MANAGEMENT OF TRANSPLANTED SEEDLING

Potato is a heavily fertilized crop for its high bulking nature. The general recommended dose of fertilizer (RDF) in irrigated plains of India is around 200:150:150 kg ha^{-1} of N: P_2O_5 : K_2O which may vary to some extent in different agro-climatic zones. 5 kg $ZnSO_4$ ha^{-1} is also recommended in Zinc deficient soil as basal application. Half of nitrogen and full doses of recommended P and K are applied at the time of final field preparation. Half ridges and furrows are prepared and light irrigation is given in furrows. After 3 to 4 days of 1st irrigation, bare rooted seedlings are transplanted at a spacing of 60 × 10 cm on north side of the ridges if temperature is high or in middle half of the ridges if temperature is normal. 2nd irrigation is applied in furrows soon after transplanting the seedlings. Subsequently, irrigations are given as and when required. After 10-12 days of transplanting, when seedlings are fully established, intercultural operations like earthing-up is done in such a way that the transplanted seedling comes in the centre of the newly formed ridge. The remaining half dose of nitrogen is given in two split doses: one at the time of first earthing up and second at final earthing up (20-25 days after transplanting). The average yields as high as 270q/ha in the transplanted crop may be obtained at 90 days after transplanting, producing 70-80 % marketable tubers (> 20 g). These seedling tubers can be used either as ware potato or seed for the next crop season.

ADVANTAGES OF TPS

- Only 100g of TPS can replace 2-3 tonnes of bulky seed tubers required for planting one-hectare land therefore transportation problems would be mitigated.
- TPS requirement for planting one hectare land cost 20 times less than (Fig.1 and Fig 2.) the seed tubers (TPS costs approx. Rs. 3000-3500/ whereas, seed tubers costs RS. 60,000-65,000/ for one hectare land)[5].

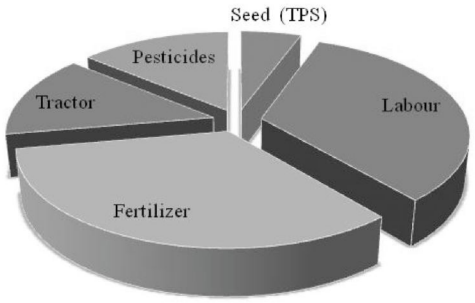

Fig. 1 Cost of cultivation under TPS system

- Except some potato viruses like potato virus T (PVT) and potato spindle tuber viroid (PSTVd), no other major pathogen can be transmitted through TPS as they are filtered out during pollination and fertilization[4]. So, growing of potato by TPS allows virus free plant.

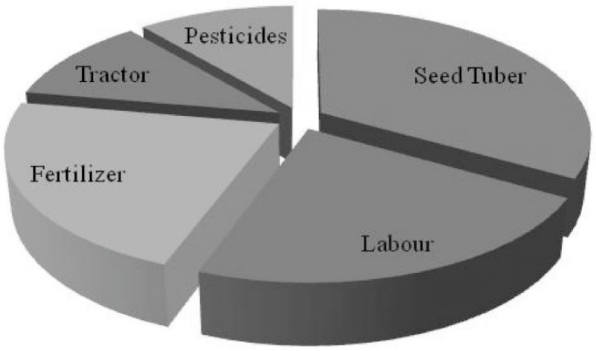

Fig. 2 Cost of cultivation under conventional system

- The tubers which are used presently as seed would be released for consumption since they no longer would be required for planting and thus more produce would be available for consumption.
- TPS with 3-5% seed moisture can be stored for many years under ambient conditions in dark with practically no loss in germination at least up to 5 years which is expected to reduce cost on storage.
- TPS crop possess multi-line effect, consequently less amount of pesticides is needed in TPS crop. Thus TPS is not only cost effective but also environment friendly.

CONSTRAINTS IN ADAPTATION OF TPS

TPS presents following disadvantages, which have been the major bottlenecks in adoption of TPS technology.

- Raising a crop from TPS requires more labour and greater skill. Therefore is has not found favour with farmers.
- TPS crop also takes about 20 -25 days more for maturity[6] than the conventional potato crop raised from seed tubers.
- Potato seedlings are vulnerable to environmental stress and need more care and input especially during the initial phases of growth and establishment in transplanted crop.
- Limited choice of hybrid TPS cultivars to meet the region and consumer specific demand.
- Crop from TPS populations are less uniform in plant type/maturity, tuber shape, size and dry matter.
- A wide gap in between the supply and demand of TPS throughout the season in various potato growing regions of the country as very limited amount of TPS is produced in the country for commercial potato cultivation.

TPS VARIETIES

Three TPS populations namely TPS C3, HPS-I/13 and 92-PT-27 have been so far recommended for commercial cultivation in India by CPRI, Shimla[4].

CONCLUSION

The TPS technology may be a potential alternative for growing virus and disease free potato at low cost in the area where good quality of seed tuber is not easily available. TPS technology is likely to gain momentum in future particularly in the non-seed producing areas viz. Karnataka, Maharashtra, Madhya Pradesh, Orissa and the states of north-eastern region where good quality seed tubers are either not available or are too expensive.

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103rd INDIAN SCIENCE CONGRESS : A BRIEF REPORT

The 103rd Indian Science Congress was inaugurated in the morning of January 3, 2016 at university of Mysore by Shri. Narendra Modi, Hon'ble Prime Minister of India, in the presence of Shri. Rudabhai Vajubhai Vala, Hon'ble Governor, Karnataka State; Dr. Harsh Vardhan, Union Minister of Science & Technology & Earth Sciences, Shri Y.S. Chowdhary, Union Minister of State (Science & Technology & Earth Sciences), Government of India; Prof. K.S. Rangappa, Hon'ble Vice Chancellor, Mysore University, Shri Siddaramaiah, Hon'ble Chief Minister, Karnataka, Prof. CNR Rao, Bharat Ratna and Dr. Ashok Kumar Saxena, General President, The Indian Science Congress Association.

Dr. Ashok Kumar Saxena, General President, Indian Science Congress Association welcomed the dignitaries and delivered his Presidential Address, on the focal theme "Science and Technology for Indigenous Development in India". Then Dr. Harsh Vardhan, Hon'ble Union Minister of Science & Technology and Earth Sciences, Government of India gave his speech. Shri Siddaramaiah, Hon'ble Chief Minister, Karnataka State delivered his address.

The Hon'ble Prime Minister of India, Shri Narendra Modi released the 103rd ISC Plenary Proceedings and and presented ISCA awards to scientists (including Award 2014-2015, Vikram Sarabhai Memorial Award to Dr. M.Y.S. Prasad, Sriharikota. He also felicitated and gave mementoes to Nobel Laureates Prof. John B. Gurdon, Prof. David J. Gross, Prof. Dan Shechtman, Israel, Prof. Serge Haroche, Prof. Arthur B. McDonald, and the winner of Field Medal Prof. Manjul Bhargava. He also presented special prize for scientific work done on addressing disabilities. He then delivered his inaugural address.

Prof. K.S. Rangappa, Vice Chancellor, University of Mysore gave vote of thanks.

The inaugural session was attended by a large number of foreign scientists, distinguished scientists, academicians, Vice Chancellors of various universities, Members of Parliament, senior functionaries from the State government, representatives from industry, students and scholars.

5TH WOMEN'S SCIENCE CONGRESS

The 5th Women's science congress was organized with the theme "Science & Technology for Indigenous development of Women in India".

Honorable Union HRD Minister Smt.Smriti Irani inaugurated the Women's Science Congress on 4th January 2016 and enumerated the contributions made by the leading past and present women scientists. In the keynote address Dr.Soumya Swaminathan, Secretary DHR, DG- ICMR, New Delhi, touched upon the role played by women in the areas of education, research, extension activities, management and policy making bodies.

The technical sessions were held on 5th and 6th January. Five plenary lectures were delivered by- Dr.Prema Ramachandran, Director, Nutrition Foundation of India, New Delhi, Dr.Kaiser Jamil, Head -Genetics Department, Hyderabad, Dr.Tessy Thomas, Project Director, DRDO, Hyderabad and Prof.Rajalakshmi Sriram, UGC-Emeritus Professor, MS university, Baroda. Eminent scientists from premier R&D institutes/Universities delivered lectures. Scientists from DST, New Delhi presented initiatives undertaken by Department of Science & Technology in promoting gender equality and empowering women to adopt Science & Technology.

During the event, women scientists discussed their scientific achievements on the following issues:-

a) Improving health of the community particularly at the rural level
b) Small scale entrepreneurship activities

c) Research on new biomarkers for the diagnosis and prognosis of diseases such as Chickungunya, Filaria, Leishmeniasis etc
d) Gender discrimination and gender bias aspects

Opportunities for women to overcome the trajectories and contribute to science & Technology were also covered. It is about time that women get support and recognition to pursue higher education and an environment for nurturing promoting women scientists in India.

Ms.Vasanthi Hariprakash, Former NDTV correspondent was the event anchor for the women's science congress. The women's science congress was sponsored by Department of Science & Technology, SEED division, Government of India.

The two day technical sessions were attended by more than 150 delegates including faculty, research scholars and students from various Universities/Institutions across the country. The event organization and quality of technical sessions was rated as excellent by the participants.

CHILDREN SCIENCE CONGRESS

The Inauguration was held at the Amphitheater, University of Mysore on 4th January 2016.After the invocation by the students of Fine Arts College, University of Mysore, Prof. Arun Kumar, General Secretary (Scientific Activities), ISCA welcomed the gathering. The Children Science Congress was formally inaugurated by lighting of the lamp by Nobel Laureate Prof. John Gurdon and other dignitaries on the dais. Vice Chancellor Prof. K S Rangappa, University of Mysore, delivered keynote address. On this occasion, He released `Billion Beats' the Pulse of India (Vol.1, Jan 2016) published by the Dr. A. P. J. Abdul Kalam International Foundation (Hq Rameshwaram) featuring the science stories and the dreams of the youth of India. The abstract book containing the selected project reports of the children scientists participating in the children science congress was also released on this occasion.

Dr. Achytha Samantha, Founder, KIIT and KISS, Bhubaneswar, spoke on the occasion and emphasized the significant contribution of the country in the field of science from times going back to the Harappa and Mohenjadaro civilization. He also lauded that in Mathematics, the ancient India had given to the world the great numbers zero, pi and negative numbers and thus provided a strong foundation to the scientific edifice of all nations.

Dr Ashok Kumar Saxena, General President, ISCA, remembered the late president Dr A P J Kalam in his speech and said that he himself a scientist was dearest to the whole children community. The great man always intended that the children should get inspired by science and should develop a liking for science. He added that the ISCA is therefore not only trying to light the lamp of science in every young mind but also striving to realize the dream of Dr A P J Kalam to make India a corruption-free nation.

Dr Amit Krishna De, Executive Secretary, ISCA conducted the Declaration of Infosys ISCA Travel Awards are given annually upto 12th standard students at the ISCA award session. Dr Ujjwala T. Tirkey, Coordinator, National Children Science and Technology Communication, DST, spoke on the occasion. The programme concluded with the vote of thanks by Dr N.B. Basu, General Secretary, ISCA. Prof C. Naganna was the master of ceremony for this inaugural function.

All in all, the children science congress was a very successful event with 58 entries under NCSTC from 30 states participating in this national mega event. Besides, there were 14 NCERT entries from 10 states, 4 entries from Kendriya Vidyalaya and 2 entries from Jawahara Navodaya Vidyalaya.

The valedictory marking the end of the event was held at Senate Bhavan Auditorium, University of Mysore on 6th January 2016 at 2.30 pm. The dignitaries for the valedictory were, Prof K S Rangappa, honorable Vice Chancellor of University of Mysore, Dr. Ashok K. Saxena, General President,

ISCA, Prof. Arun Kumar, General Secretary, ISCA and Dr. Ujjwala Tirkey, Scientist F, DST. Prof. K. S. Mallesh, Convener, RKVS subcommittee proposed the vote of thanks. Madam Sreemathi Hariprasad, member of the subcommittee compered the valedictory programme.

9TH SCIENCE COMMUNICATORS' MEET

The 9th Science Communicators' Meet was inaugurated on 5th January 2016 by Prof Dan Shechtman, Nobel Laureate, Israel Institute of technology, Haifa, Israel, in presence of Dr. Prabhat Ranjan, Department of Science and Technology, New Dehi, Prof Rangappa, Vice Chancellor of Mysore University, Dr Ashok Kumar, General President of ISCA, and Prof Arun Kumar, General Secretary (Scientific Activities), ISCA.

Defence Research Development Organization (DRDO), New Delhi, Director General (Life Sciences) Dr. Manas K Mandal delivered a talk on 'Opportunities and Challenges of Science Communication in India' and Professor in Forestry and Environmental Sciences K N Ganeshaiah delivered a talk on 'Role of Scientists in Extracting and Communicating Science from Traditional Beliefs and Practices'. On 6th January 2016, former vice chancellor of Manipal University B M Hedge spoke on 'Science, Business and the Reality' and Scientist at Head Science Communication Through Multimedia, New Delhi, Gauhar Raza delivered a lecture on 'Scientific Temper a Necessity for Indigenous Development'. In the afternoon session, Vigyan Prasar, New Delhi, Director R Gopichandran spoke on 'Is Science Popularisation in India Oversimplified?: Provide Strategically Important Support to Missions for Better Engagement', former VC of University of Mysore S N Hegde addressed on 'Science and Technology for Enhancing the Quality of Life' and Vinod Kumar of University of Delhi threw light on 'Communicating Basic Life Science Research to Stakeholders: A need for the Paradigm Shift'. Former VC J Shahshidhar Prasad, University of Mysore and R K Sharma of DRDO and Prof Raja Sabh Tumkur University and Prof Mewa Singh chaired the sessions.

Former University of Mysore VC Prof S N Hedge delivered an address at the valedictory function. Dr. Gopichandran, Director, Vigyan Prasar, University Registrar Prof C Basavaraju and the science communicator's meet convener Prof Ravishankar Rai were present. Vote of Thanks was presented by Dr Arun Kumar Pandey, Assistant Executive Secretary, ISCA.

VALEDICTORY FUNCTION

The 103rd session of the Indian science congress concluded on January 7 ,2016. Welcome address was delivered by Prof. K.S. Rangappa, Vice-Chancellor, University of Mysore followed by Report by Dr. Ashok Kumar Saxena, General President, ISCA. On the occasion, the General President (Elect) Dr. D Narayana Rao announced that the 104th Indian Science Congress would be held at SRM University, Chennai from January 3 to 7, 2017.

Shri. T.B. Jayachandra, Pro-Chancellor, Hon'ble Minister for Higher Education, Law and Parliamentary Affairs, Government of Karnataka delivered his address. On this occasion the Young Scientist Awards and Best Poster Awards were also presented.

Valedictory address was delivered by Shri. H.D. Deve Gowda, Hon'ble Former Prime Minister and Member of Parliament and Presidential address by His Excellency Shri. Vajubhai Rudabhai Vala, Governor and Chancellor, Karnataka.

Prof. C. Basavaraju, Registrar, University of Mysore presented the formal vote of thanks'

PUBLIC AND PLENARY PROGRAMME SCHEDULE

Sl. No.	Special Session	Name of Chair Person/ Speakers
1.	**Special Session I**: Panel discussion with Nobel Laureates – **Science and Technology: Present and Future**	**Chair**: **BharathaRathnaProf. C.N.R. Rao, Bengaluru** **Co-Chair 1. Prof. K. S. Rangappa, Vice-Chancellor, University of Mysore, Mysuru** **2. Dr. Ashok Kumar Saxena, General President, ISCA, Kolkata** **Speakers:** 1. Prof. Arthur B, McDonald, USA 2. Prof. Dan Schetman, Isreal 3. Sir Prof. John Gordan, UK 4. Prof. Serge Haroche, France 5. Prof. David J Gross, USA 6. Prof. ManjulBhargava, Fields Medallist, USA
2.	**Special Session II:** **"Value of Science for Society and Public"**	**Chair**: **Prof. Ashutosh Sharma, Secretary, DST, Government of India, New Delhi** **Co-Chair:** Prof. K. S. Rangappa, Vice-Chancellor, University of Mysore, Mysuru Prof. C.N.R. Rao, Bengaluru Prof. Arthur B. McDonald, Nobel Laureate, USA Dr. K. Kasturirangan, Bengaluru Prof. Dan Shechtman, Nobel Laureate, Israel
3.	**Special Session III:** **STI Policy**	**Chair: Dr. M. K. Bhan, Former DBT Secretary, New Delhi.** **Speakers**: 1. Prof. R. C. Sobti, Vice-Chancellor, - Babasaheb Bhimrao Ambedkar University, Lucknow 2. Dr.Baldev Raj, Director, National Institute of Advanced Studies, Bengaluru 3. Prof. K. B. Akhilesh, Indian Institute of Science, Bengaluru 4. Prof. AmbujSagar, Indian Institute of Technology, New Delhi 5. Prof. R. Tewari, Punjab University, Chandigarh 6. Dr. Neeraj Sharma, Advisor & Head, Department of Science & Technology, New Delhi

Sl. No.	Title	Name of the Chair Person/ Speakers
4.	**"Session of Nanoscience"**	**Chair: Prof. A. K. Sood,Bangalore** **Speakers:** 1-Prof. G. U. Kulkarni, Director, Bangalore 2- Dr. Ashok Ganguly, Mohali
5.	**"Space Science, Technology and Applications"**	**Chair:Dr.Kirankumar, ISRO, Bangalore** **Co-Chair: Prof. D.N. Rao, Chennai** **Speakers:** 1. S. K. Shivakumar 2. V. Koteswararao 3. Vinay K. Dadhwal 4. S. Somanath 5. M. Annadurai
6.	**Government's view Points On Science and Technology**	**Speakers:** Secretaries Of DST,DBT,DSIR/CSIR, MoES, MoEF,MNRE,DeITY, ICAR,ICMR, DRDO, DOS, DAE, Dept. of Pharmaceuticals, S&T Wing Of Niti Aayog (Dr. V.K. Saraswat, Sr. Adviser And Joint Adviser)
7.	**Recent Advances Towards Cellular Basis for Clinical Disorder**	**Chair: Prof. S. S. Parmar** **Speakers:** 1-Professor Andrew J. Greenshaw, Canada 2- Professor Jonathan D. Geiger, USA 3- Professor Anil Kumar,USA 4- Professor S. Jamal Mustafa, USA 5- Professor Madhavan Nair, USA 6- Professor Othman Ghribi, USA 7- Professor Joyce Ellen Ohm, USA 8- P.K. Seth –Lucknow
8.	**"Sustainability and Future Generation Wireless Networks"**	**Chair: Navarati Saxena, South Korea** **Co-Chair: Abhishek Roy, South Korea** **Speakers:** 1-Byeungwoojeon, South Korea 2-Prof. Jung Hyun Jun, IIT Ropar 3-Prof. Snehanshusaha, Bangalore 4-Vaskar Ray Chaudhary, IIT Roorkee 5- Hye Young Kim, South Korea 6-Ashish Srivastava, USA

Sl. No.	Title	Name of the Chair Person/ Speakers
9.	**Session of Diabetes**	**Chair: Prof. D. Shantaram Chennai** **Speakers:** 1-Dr.V.Seshiah, Chennaidr. 2-Dr. V. Mohan, Chennai 3- Dr. Prasanna Kumar, Bangalore 4- Dr.S.R. Aravind, Bengaluru
10.	**"Evolution: The Frontiers"**	**Chair- Prof. H.A. Ranganath Bangalore** **Speakers:** 1-Prof. Raghavendragadagkar, Bangalore 2-Prof. Rama Shankar Singh, Canada 3-Prof.Radhey S. Gupta. Canada
11.	**Novel Mechanisms Underlying Allergic Airway Inflammation and Bronchial Asthma**	**Chair: Devendra K. Agrawal-USA** **Co-Chair: Prof. H.P.Tiwari, Allahabad** **Speakers:** 1-Dr.Rajkumar- New Delhi 2-Dr.P.A.Mahesh- Mysore 3- Dr.A.Sanjiv Sur- USA
12.	**"Discovery & Development of Noval Drugs Make In India: Challenges and Avenues."**	**Chair: Prof. S Rajarajan, Sonipat** **Co-Chair: Prof. S.B. Mahato, Kolkata** **Speakers:** 1-Dr. V.K. Subburaj, IAS, New Delhi 2-Dr. Simon Craft, London 3-Tom Blundell, Cambridge 4-Alan P. Kozikowski, USA 5-Dr. G.S .Samathanam, Sonipat
13.	**"Bigdata Biotechnology : Challenges and Opportunities for India"**	**Chair Prof. Madan Mohan, Delhi** **Speakers:** 1-Dr.Vinay Panda, Bangalore 2-Dr. A.K. Mishra, New Delhi 3-Dr. Dinesh Gupta, New Delhi 4-Dr. M. Michael Gromiha, Chennai
14.	**"Atomic Energy."**	**Chair: Dr. R.K. Sinha, Mumbai** **Speakers:** 1-Dr.S.F.D'souza,Mumbai 2-Dr.K.B.Sainis-Mumbai 3-Dr.P.K.Tewari-Mumbai 4-Dr.S.Banerjee

Sl. No.	Title	Name of the Chair Person/ Speakers
15.	**"Biodiversity Conservation: Curent Status and Road Map for The Future"**	**Chair: Prof. R. Ramamurthi, Tirupati** **Speakers:** 1– Dr. M.S. Nagar, New Delhi 2-Dr. R.S.Rana,New Delhi 3-Dr.Giridhar A. Kilhal, Bhopal 4-Dr. S. Subramoniyan, - New Delhi
16.	**"Molecular Targets and Cancer Therapeutics."**	**Chair- Prof. Sir Tom Blundell, FRS, FMEDSCI, Cambridge** **Speakers:** 1- Prof. Peter E Lobie, Singapore 2-Prof. Peter J. Houghton-USA 3-Prof. Alan Fersht, Cambridge 4-Prof. Mary- Ann Bjornsti, USA 5-Prof. Shin-Ichiro Nishimura, Japan
17.	**"Safe Water and Sanitation"**	**Chair K.J.Nath** **Co-Chair:Dr.N.B.Basu, Kolkata** **Speakers:** 1-Dr.Bindeswar Pathak, New Delhi 2-Dr.Sunita Narayan, New Delhi 3- Dr.Pradeep P, Chennai 4-Dr.V.S.Chari- India
18.	**"A frontier in Science and Human Benefit."**	**Chair: Prof. B.P.Chatterjee** **Co-Chair: Prof. Abhijeet Banerjee, Kolkata** **Speakers:** 1-Dr. Hafiz Ahmed,USA 2-Prof.Jan Johansson, Sweden 3-Prof. G.V. Maksimov, Russia 4-Prof. S.Mukhopadayay, Kolkata 5-Prof.Kasturidatta, New Delhi 6-Asim K.Dattaroy,Norway
19.	**"Recent Advances in Male Reproduction."**	**Chair: Prof. P.P.Mathur, Bhubaneshwar** **Co-Chair: Manu Saxena, USA** **Speakers:** 1-Prof.Manuela Simoni-Italy 2-Prof.C.V.Rao. USA 3-Dr.Vassilios Papadopoulos. Canada 4-Dr.Dianne Creasy,USA 5-Dr.Martine Culty,. Montreal

Sl. No.	Title	Name of the Chair Person/ Speakers
20.	**"Preparing the Bioscience Workforce for Emerging Technologies"**	**Chair: Prof Sulatha Dwarakanath, USA** **Speakers:** 1-Dr. Russ H Read USA 2-Dr.Linnea Fletcher USA 3- Dr.Soniawallman USA 4-Dr.Elaine Johnson, USA
21.	**"Novel Translational Targets in Cancer and other Diseases."**	**Chair: Prof. Shrikantanant, USA** **Co-Chair: V.L. Saxena, Kanpur** **Speakers:** 1-Prof. George Weiner, USA 2- Prof. Roy Jensen, Kansas, USA 3- Prof. Victoria I. Seewaldt, USA 4- Prof. Vinata B. Lokeswar, USA
22.	**"Biodiversity Database Integration for the Benefit of Human Kind."**	**Chair: Prof. Sudarshan Kumar, Lucknow** **Co-Chair: Prof S.P. Singh, Kurukshetra** **Speakers:** 1-Dr. RC Agarwal, New Delhi 2-Dr. G.P.S Raghava, Chandigarh. 3-Dr. Anil Rai, New Delhi 4-Dr.Munazza Yousra-Pakistan
23.	**"Genetic Dissection of Complex Diseases."**	**Chair- Prof. H.S. Sharat Chandra, Bangalore** **Speakers:** 1-Prof. R.N.K. Bamezai, Delhi. 2-Prof. Aravinda Chakravarti,- USA 3-Dr. Sathees C Raghavan, Bangalore
24.	**"Insectbiology"**	**Chair- Prof. L.S. Shashidhara, Pune** **Speakers:** 1-Prof. Volker Hartenstein, USA 2- Prof. D. Channegowda-USA 3-Prof. L.S. Shashidhara**,** Pune
25.	**"Prevention and Therapeutic Approaches in Cancer and Other Diseases."**	**Chair: Prof. Animesh Dhar, USA** **Co-Chair: Dr. Manoj Chakraborty, Kolkata** **Speakers:** 1-Dr.Chendildamodaran, USA 2-Dr.Prajna Dhar, USA 3-Dr.Balkrishnalokeshwar, USA

Sl. No.	Title	Name of the Chair Person/ Speakers
26.	**"Biogas Production, Power Generation and Purification of Vehicullar Applications."**	**Chair: Prof. Virendra K. Vijay, Delhi** **Speakers:** 1-Dr.Varsha Joshi - Delhi 2- Dr.Hoysall N Chanakya, Bangalore 3-Dr.Deepak Sharma, Udaipur 4-Dr. Deben C Baruah, Tezpur
27.	**"Recent Advances in Medical and New Biology."**	**Chair: Dr. R. Ravi Kumar, USA** **Speakers:** 1-Dr. R.Lalitha, USA 2-Dr. Prasad Dhulipala, USA 3-Dr. Rohinidhulipala, USA 4-Dr. Krishna Dronamraju, USA 5-Dr. Arunaloke Chakravorti, Chandigarh
28.	**"Panel Discussion on Skill Development in Engineering Manufacture for Make in India Initiatives."**	**Chair: Prof. N.K. Aatre** **Co-Chair -Prof. L.S. Satya Murthy** **Speakers:** 1-Col. H.S. Shankar, Bangalore 2- Dr. R.M. Vasagam ,Chennai 3-Dr. H. Maheshappa, Belgaum 4-Dr. G. Raj Narayan, Bangalore
29.	**Diseases and Drug Development**	**Chair: Prof. Tej Pal Singh** **Speakers:** 1-M.R.S.Rao 2-Tapas K. Kundu 3-Prof. Tej Pal Singh 4-Manju Nathakini
30.	**Nano Materials and Biotechnology**	**Chair:K.N.Thimmaiah** **Speakers:** 1-K.J.Rao, Bangalore 2-K.Byppa, Mangalore 3-V.S.Chauhan, New Delhi
31.	**Public–Private Partnership for the Swachh Bharat Mission Initiative**	**Chair: Prof. Indra Chakravarty** **Speakers:** 1-Mrs. Santhasheela Nair 2-Mr. Nitish Kapoor 3-Mr. Sanjiv Mehta 4-Mr. Siraj Chaudhry 5-Dr. Saraswati Prasad

RECOMMENDATIONS RECEIVED FROM SECTIONS

AGRICULTURE AND FORESTRY SCIENCES

- Imbalanced and inadequate plant nutrient application is a major reason for low crop productivity, low farm profitability and low nutrient use efficiency in Indian farms. Precision nutrient management based on the 4R Nutrient Stewardship principles is required for optimizing nutrient use in farm fields.
- Precision nutrient decision supporttools such as Nutrient Expert, Green Seeker, GIS-based fertility maps, STCR etc. that help wide-scale dissemination of improved nutrient management tools must be up-scaled.
- Water scarcity is one of the biggest challenges that may compromise our food security. Participatory development of water conservation structures to store and use rainwater and excess canal water, and precision water management strategies that supply water near crop root zone will improve water use efficiency. In this regard, the quality of irrigation water (such as waste water, contaminated surface and groundwater, untreated sewage, industrial effluents, etc.) needs to be considered to address the bio-safety issues.
- Adoption of conservation agriculture and recycling of organic residues is essentialfor improvingthe soil organic carbon stock and soil health in general. Developmentof a national strategy on ***'Waste to Wealth'*** for providing potential and practical solutions to reduce residue burning and proper handling and recycling of rural and urban wastes is required. The latter may be linked with the***National Skill Development Mission*** for recycling of organic residues back to fields for improving soil health.
- Implementation of Land Resource Inventory at 1:10000 scale is necessary to catch the micro-specificities of agricultural production systems and propose the appropriate Land Use Planning, with special emphasis on land degradation and the corrective measures.
- Climate change will strongly affect our agricultural production systems. Research for development of heat, drought and other biotic and abiotic stress tolerant cultivars through public-private partnership, and easy access of quality seed for farmers remain critical for adaptation and mitigation of climate change impacts.
- The need for data acquisition from the ICAR and the Central Government- funded long-term multi-location research projects and their proper storage was strongly recommended. The access to data for analysis by multiple agencies should be ensured for agricultural policy guidance.
- Strong emphasis is needed on extension to harness the large-scale impact of improved technologies in farmers' fields. Synergy of technologies and target groups, use of modern audio-visual aids, as well as ICT-based decision support tools like Nutrient Expert in conjunction with the Soil Health Card Program is desirable.
- Popularization of Non-Tree Forest Products is necessary to help ensure livelihood security and women empowerment in tribal areas.
- The wastelands along canal bunds and coastal belts can be put to productive use by raising high oil yielding trees for promoting biofuel production, thereby reducing environmental footprint of commercial fuel use.

ANIMAL, VETERINARY AND FISHERY SCIENCES

1. Animal behavioral studies pertaining to climate changes and natural disaster need to be taken as an area for potential research.
2. Bioresources are the wonderful gift of nature to the mankind whose sustainability can be effectively linked to rural livelihood and economic development, so science education should aim at attracting students for proper management and sustainable utilization of bioresources.
3. The assemblage of species with we share the planet represents a vast untapped genetic library, with undiscovered pharmaceutical and beneficial substances. So programme needed to be initiated for the exploration of other less known potential varieties of life forms with a view to ensure rural livelihood, food, health and financial security.
4. Promotion of Public awareness on biodiversity conservation role of individuals for minimizing ecological footprint and maintaining health and hygiene in the vicinity should be made.
5. Documentation of traditional technical knowledge (TTK) and indigenous technology, its revival and strengthening for sustainable development in the area of bioresources and adaptation to climate change should be made.
6. Public participation in decision-making should be ensured and integration of environmental, economic and social sustainability with food, health and livelihood security of the people.
7. Basic biology should be made integral part of undergraduate and post-graduate studies in biotechnology, microbiology, bio-informatics and modern disciplines.
8. Programme needs to be initiated for exploration of other less known varieties of life forms with a view to ensure livelihood and food security.
9. Application of molecular tools for wildlife conservation, especially of endangered speciesmay be given greater importance.
10. Multivoltine race of silkworm (*Bombyx mori*) should be tested under different agro-climatic zones of India for proper evaluation of their improvement efficiency.
11. Bio-economic modeling of different ponds and reservoir management with view to increase fish production should be carried out.
12. Various disease problems (in aquaculture and animals' husbandry etc.) and their management can be worked out in details.
13. Public-private partnership (PPP) should be encouraged to solve the environmental problems and conservation and proper exploitation of all such life forms, which ensure food, health and livelihood.
14. With a view to check population growth, amalgamation of booth indigenous and recent innovative research of male reproduction should be encouraged.

ANTHROPOLOGICAL & BEHAVIORAL SCIENCES (INCLUDING ARCHAEOLOGY, PSYCHOLOGY, EDUCATION AND MILITARY SCIENCES)

1. Social harmony is a prerequisite to both national development and integration Social harmony is disturbed by three Ps-Proverty. Prejedices and Politicization. Therefore, efforts should be made for eradieating poverty, deesealating inter-group prejudices and diseouraging politicization which lead to vote bank polities.

2. Indigenous knowledge of the country should be enriehed particularly in the areas of health sector, agriculture, art, crafts and handicraft. Indigenous skill development sanitation and cleanliness and economic activities.
3. Indigenous development of armaments on the lines of indigenous subsonic missile (Nirbhaya in Oct 2014) should be further encouraged. DRDO had developed many more armaments and missiles and greater need has arisen to develop new armaments in this direction.
4. Policy makers should implement 'Ayush' vehemently, particularly in the areas on 'Ayurveda' and 'Yoga'. Benefits of Yoga have been proved scientifically. There has been acceptance of Yoga but greater efforts are needed to prevent many physical and mental aliments. Promotion of mental health may be facilitated by Yoga.
5. Stress and depression are increasing in our country. This is resulting in the increase of suicide rates of farmers, students and other section of people. It is recommended that proactive policies be implemented by promoting mental health. Suieide has three phases Ideation. Attempt and Commitment by identifying the indeators through test like 'Suicide Ideation Scale'. The number of attempters and committers may be reduced.
6. Counseling should become a regular routine in our school system.
7. Development of men be based on the lines given by the then behaviorist (Vedic Philosophers) from individual to universe Yatpinde-tat-Brahmande.

CHEMICAL SCIENCES

1. Emphasis should be on the development of technology for cheap diagnostic kits for diagnosis of diseases at an early stage.
2. Research should be encouraged for the development of chemical and bio-sensors for various bio markers.
3. Research should be conducted in the field of nanomaterials to be used in display, imaging and lighting applications.
4. Green synthesis and electro organic synthesis should be adapted for the rapid and efficient synthesis of various heterocycles and heterocyclic scaffolds.
5. Graphene quantum dot conducting polymer for opto electronic and photovoltaic applicatons are the need of the hour.
6. Application of electrochemical and photocatalytic technology should be expanded for the mineralisation of various environmental organic pollutants.
7. Research on Photogalvanic cells for sustainable approach to harvest solar power should be in the priority area of research.

EARTH SCIENCES

1. Recent geoscientific research and development shall be incorporated and amalgamated with the mineral and mining based industries for the National development.
2. With the increase in demand of Energy and Water there is an urgent need to formulate strategies and modalities through geoscientific investigations for their proper management and utilization.
3. To enhance mineral and energy resources ongoing studies in Bay of Bengal, Arabian Sea and Indian oceans be rigorously taken up. Regions such as Antarctica and Artic be continued with reference to better understanding of Climate Change studies.

4. There is an urgent need to look into mitigation and management of Natural Hazards (frequent earthquakes, floods, cyclones and storms, tsunamis, mass movements, ground level fluctuations etc.) including Climate Change from geoscientific perspective.
5. Geoscientific concerns is necessary in planning of Smart Cities.
6. Geology be included as one of the optional Science subject in High and Higher secondary level School Curriculum to be taught by trained postgraduate's.

ENGINEERING SCIENCES

- Recent advances in Nano technology offer opurtunities to devolope next generation water treatement and supply system.There should be a coordinated effort between the government, University and research organizations to suuport and higlight projects on nano-technology enabeled water and wastewater treatement.
- Convetional proven technology needs to be improved and utilized in colaboration with modern techniques for costeffective solutions of drinking water supply for rural community particularly in the arsenic and fluoride affected areas.
- River rehabilaton and training structures are nowdayas one of the most important aspects of river engineering which contains all the hydro-envioromentals features such as river grade control, bank protection, water quality and aquatic habitat and these are needed to be employed for a sustainable environment. Serveral eco friendly hydraulic structures like W-weir, cross vane, J-Hook and log deflectors are being employed to attain this objective.
- The research on finding the potential of both cotton and coal ash as water holding materials was experimented with sandy loams in the difficult terrain of inner Mongolia and this can evaluated in Indian senerio to assess the positive effect of increase of water holding capacity. In addition the potential of coal ash, the effect of artifitial geolite as particle film sparayed over plant-leafs can also be evaluted to further diversify its potential use for salinity mitigation in arid soil.

ENVIRONMENTAL SCIENCES

1. It is recommended to create "smart green belts" model for promoting conservation of biodiversity in a sustainable way so that this new concept will promote the growth of indigenous industries harnessing the local resources and will provide various livelihood materials such as timber, firewood, fruits, vegetables, animal foods, silk, lac, honey, electricity, fertilizer and medicine for consumption as well as for generating incomes.
2. It is recommended to explore, document and reclamation of wasteland and conservation of wetlands for better livelihood and for maintaining sustainable ecosystem in a cost effective and implementable manner.
3. It is recommended to set up an all India co-ordinated Project on assessment and mitigation of air quality (indoor and outdoor air quality) in major cities of India in terms of inorganic (NOx. SOx, SPM, etc.,) and organic (pollen and spore causing allergy) pollutants.

MATHEMATICAL SCIENCES (INCLUDING STATISTICS)

1. Applicable mathematics should be given more stress.

2. Data analytics, coding theory, soft computing and machine intelligence may also be included in the mathematics section
3. There should be collaboration among mathematics, engineering and other science subjects.
4. The above is due to the fact that mathematical modeling and simulation of physical problems save time and cost of repeated experiments to succeed the 'Make in India' slogan.
5. Mathematicians (pure, applied, statistics) need to think a bit application with their research outcomes as per the need.
6. Technical (educational and research) institutes should keep the mathematics subject and related facilities in the forefront because this may be the only subject without which no other subjects may grow for breakthrough results.
7 Provide quality mathematics education for all.
8. Provide opportunities to all teachers, for continued professional growth in their mathematical knowledge.
9. Mathematicians should recognize the need for improving mathematics teaching at all levels.
10. A coherent professional development program for mathematics should be developed.
11. The teaching and learning of mathematics should keep pace with the needs of modern societies.

MATERIALS SCIENCE

1. Attention required for the Ganga river cleaning and to be encouraged by DST for research and development in the following thrust areas:

i. Developing simple techniques for the removal of above named chemical moieties from effluents from tanneries and other industries, so that the Ganga river turns clean.

ii. Research work for developing low-cast, eco-friendly alternate materials for substituting basic chromium sulphate for the tanning of leather without compromising the eventual quality.

iii. Portable test kits (conventional chemical sensors and sensors based on nano materials) for detection of chromium from the industrial effluents.

iv. Nano filters, dispersed with functionalized CNT to be developed.

MEDICAL SCIENCES (INCLUDING PHYSIOLOGY)

A) There must be improvement of health, hygiene, Nutrition and life style process in our country. Therefore topics are to be elaborately discussed and taken care of by the section also.

B) Proper hygiene is to be maintained echoing the prime Minister's slogan ie. "Swachh Bharat" meaning cleanliness and proper sanitation of our country.

C) Nutrition: India having one hundred thirty core populations, out of which more than 60% are suffering from under nutrition both from calorie point of view as well as formulation of diet including the micro nutrition. They are not having the proper kinds of foods. These eventually results in poor immune response to different infection diseases. Rather on the other hand invites diseases. Further, poor nutrition or over nutrition creates different types of non communicable diseases. This burden our society with i) Cardiovascular accident

ii) cerebral vascular accident iii) Cancer iv) diabetes. These should be properly addressed.

D) Population of our environment are leading to may human diseases of COPD, different cardiovascular diseases, hypertension, cancer, diabetes, infertility etc.

Not only the modern medical sciences, we should also given equal stress of the study on our indigenous medical practices, including Ayurvedic, Homeopathy, tradition medicinal practices and medicine. In connection to this, our folk medicines which also come to the center of these points are also need to be addressed.

Now a days, as for example, in rural area about 50,000 people are dying per year due to the poisons snake bite so it has been addressed by WHO that this is the most neglected diseases to Tropics. So this needs to be taken care of.

NEW BIOLOGY (INCLUDING BIOCHEMISTRY, BIOPHYSICS & MOLECULAR BIOLOGY & BIOTECHNOLOGY)

1. New Biology is a Broad Area. Accordingly, it was desired that presentations, hence fourth should be categorised on the basis of specific topics.
2. Area of Microbiome received much attention as it has many applications in the years to come. It was felt that this area should be encouraged.
3. Cell Biology and signalling mechanisms were an area of interest to many.
4. Presentations on diabetes were well appreciated starting from insights into molecular aspects.
5. Area of proteins and enzymes in relation to snake venom was an area of interest and needs to be encouraged.
6. Cell communication including glycosaminoglycans was an area of interest.

PLANT SCIENCES

1. Since plant-microbe beneath the earth's surface have been found be confer beneficial attributes, more research be carried out on plant-microbial root system in relation to crop protection from plant diseases and enhancement of productivity.
2. In order to develop and standardize microbial inoculants preparations and mass production for their application in farmer's field; Indigenous microbial strains may be screened and promoted at different agro-climatic conditions of specific region of country.
3. Indigenous knowledge available be considered for blending with modern scientific knowledge, so as to apply its practical application in increasing farmer's economy in terms of average yield of the crop plants.
4. Efforts may be made at the Govt. level to devise ways for skill development in this area through educational and implementing agencies.
5. Efforts should be made to make use of plant resource based technology for the benefits of rural communities, primarily in agriculture and handicraft industry.
6. There is need to impart skill based teaching-learning in the area of Plant Sciences through revision of curricula including environmental concern through introduction of 4-year Bachelors programme.
7. Research in the area of scientific validation of traditional knowledge related to medicinal plants and formulations should encouraged and indigenous development and standardization of herbal remedies be enhanced.
8. The depletion of biodiversity caused by anthropogenic stresses and luxuriant growth of invasive alien plants needs to be significantly reduced in order to maintain the ecosystem stability.

KNOW THY INSTITUTIONS

National Institute for Research in Environmental Health (NIREH), Bhopal

National Institute for Research in Environmental Health (NIREH), Bhopal, is one of the permanent institutes of the Indian Council of Medical Research (ICMR), a Government of India's apex autonomous organization for bio-medical research in the country.

HISTORICAL

Indian Council of Medical Research, an apex national body in biomedical research in India, after the Methyl Isocynate (MIC) gas/toxic gas disaster in the night of 2nd and 3rd December, 1984 in Bhopal set up, a Coordinating Unit in 1985 and initiated several research programmes. This Coordinating Unit was soon upgraded to Bhopal Gas Disaster Research Centre in 1986 to undertake long term epidemiological studies. Almost all Clinical research projects from 1985 to 1994 covering radiological , mental health, respiratory afflictions including pulmonary function and arterial blood gases, pregnancy outcome, neurological, immunological, mutagenic and genotoxic aspects were accomplished to their logical conclusions. The findings were published in Indian Journal of Medical Research Vol.86 (Supplement) of 1987. ICMR also took initiative to compile the studies into three technical reports e.g. 1. Technical Report on Long term Epidemiological Studies, 2. Technical Report on Clinical Studies, and 3. Technical Report on Pathology and Toxicology. Bhopal Gas Disaster Research Centre, ICMR, Bhopal was handed over to the Government of Madhya Pradesh in 1995 to continue research programmes under Centre for Rehabilitation Studies (CRS), under Bhopal Gas Tragedy Relief and Rehabilitation Department, Government of Madhya Pradesh, Bhopal. Studies on Bhopal gas victims were also undertaken by Bhopal Memorial Health Research Centre (BMHRC) and several Non Governmental Organizations. However, the demand for longitudinal studies was repeatedly made by several sections of the society at various fora. The Government of India took cognizance of the long standing demand of the people and directed ICMR in June 2010 to establish a permanent research centre at Bhopal. The ICMR set up its 31st permanent Research Centre " National Institute for Research in

Environmental Health" at Bhopal on 11th October 2010 to focus on the issues of environmental health research aimed at becoming a Centre of excellence in capacity building for research and health interventions to meet challenges in environmental disasters in the country.

SCOPE OF ACTIVITIES

1.1 Focus research on methyl isocynate (MIC) affected population of Bhopal in the areas of

- Respiratory disease;
- Eye related diseases;
- Kidney diseases;
- Cancer;
- Genetic disorders;
- Congenital disorders;
- Mental and neurological health;
- Women related medical issues;
- Second generation children related medical issues; and,
- Rehabilitation.

1.2 Improve environmental health research and play a leading role in tackling environmental health issues as an apex research institution on environmental health in India.

THRUST AREAS

2.1 NIREH will have a clinical research wing having the following departments

- General Medicine
- Respiratory Medicine/ Pulmonary Medicine
- Ophthalmology
- Paediatrics
- Obstetrics & Gynecology
- Psychiatry/Mental Health
- Neurology
- Radio diagnosis
- Epidemiology/ Community Medicine

2.2 The following facilities are in the process of being established at NIREH as part of Phase I of its development:

- Molecular Biology Laboratory
- Microbiology Laboratory
- Biochemistry Laboratory
- Pathology Laboratory
- Haematology Laboratory
- PFT Laboratory
- Central Equipment Facility
- Department of Epidemiology including biostatistics and computing programming
- Data base relating to research on toxic gas exposure, and environmental contamination

Contact :

Director

National Institute for Research in Environmental Health
Kamla Nehru Hospital Building,
Gandhi Medical College Campus,
Bhopal-462 001, Madhya Pradesh, India

Phone : 0755-2533106, Fax- 0755-2533976, Email: nirehbhopal@yahoo.in

CONFERENCES / MEETINGS / SYMPOSIA / SEMINARS

International Conference On Leadership for Sustainable Socio-Ecological Systems, 23rd-25th July, 2016, Andhra Pradesh.

Topics:

- Agriculture and livestock
- Make In india
- Green Technology
- Clean Environment
- Skill Development
- Health Care and Child Welfare
- Infrastructure and System Sustainability
- Education and Training Programs
- Conservation of Natural Ecosystems and their Resilience
- Engineering Systems for Sustainability
- Sensors for Sustainable System
- Assistive Technologies
- Internet of Things
- Cloud Computing
- Social Networking & Green Computing
- Eco Informatics
- GIS Tools
- Phylo Geography
- Big Data in Sustainability
- Watershed

Contact :
Dr N.S. Sampathkumar, Organizing Secretary, Assistant Professor, Department of Biotechnology, VFSTR University, Vadlamudi, Guntur, Andhra Pradesh, E-mail: lsses2016@vignanuniversity.org, Mobile: 9573883676.

International Conference on Nutraceuticals and Functional Foods-The Challenges and Opportunities along with The XIII Convention of the Indian Society of Agricultural Biochemists, December 6 to 8, 2016, at Anand, Gujarat.

Topics:

- Plant food ingredients and nutraceuticals.
- Food as medicine for health and wellness.
- Microbial significance for nutraceuticals and functional foods.
- Bioactive molecules of marine origin for human health.
- Preservation and processing for production of nutraceuticals and functional foods.
- Bio-fortified food products and Bio-safety.
- Quality enhancement through breeding and genetic engineering.
- Novel sources of protein foods.
- Improvement in the quality of milk and milk products.
- Extraction and preservation of bioactive molecules.
- General session including plant metabolism, Plant Biotechnology.
- Session for young scientists below 35 years of age.

Contact :
Dr. J.G. Talati, Organizing Secretary, Research Scientist and Head, Department of Biochemistry, B.A.College of Agriculture, Anand Agricultural University, Anand – 388 110 (Gujarat), Email : Jgtalati007@gmail.com, Fax : +91-2692-261076, Tel. +91-2692-225750, Mob. : +91-9426386681

20th WCCN (World Congress Clinical Nutrition)on Traditional Medicine, Functional Food, Nutrition, Natural Heath Product and Spiritual Healing: Additional Tools for Healthcare Delivery, December 14-16, 2016, Bangkok, Thailand.

This conference will bring together practitioners, researchers and educators from around the world who are engaged in the fields related to human health and wellness, such as agriculture, food, nutrition, medicine which includes traditional and alternative medicine, pharmacy, nursing and spiritual guidance.

Topics:

- Traditional Medicine
- Functional food
- Nutrition
- Natural Health Products
- Agriculture

Contact :
Assoc. Prof. Arunporn Itharat, Chairperson, Organising Committee, Thammasat University, Pathumthani, Thailand, E-Mail : info_20thwccn@yahoo.com, 20thwccn@tu.ac.th Website http://20thwccn.tu.ac.th/web/

3rd International Conference on Applications of Fluid Dynamics (ICAFD-2016), 19-21 December, 2016 Dhanbad, India

Topics:

- Fluid Mechanics
- Heat mass transfer
- Continuum Mechanics
- Hydromechanics
- Magnetohydrodynamics
- Non-linear Dynamics
- Computational Fluid Dynamics
- Coastal and Ocean Fluid Dynamics
- Environmental Fluid Dynamics
- Industrial Applications of Fluid Dynamics
- Dynamics of Ore-forming Fluids
- Dynamics of Water Jet Cutting

Contact :
M K Singh, Organizing Secretary-1, ICAFD-2016 Associate Professor, Department of Applied Mathematics, Indian School of Mines, Dhanbad-826004, Jharkhand,India, Email: drmks29@rediffmail.com, cafd2016@gmail.com PHONES: (0326)2235488(W); (0326)2235588(H); (091) 9431125817 (M) Fax:0326)2235488 Web page: http://ismdhanbad.ac.in/depart/math/ICAFD/conf.pdf

International Conference on Emerging Technologies in Agricultural and Food Engineering: ETAE 2016, 27-30 December, 2016, IIT Kharagpur, India.

Topics:

- Applied Computational and Statistical Methods
- Power and Machinery System
- Natural Resources Engineering and Management
- Food and Bio Process Engineering
- Agro Environmental Engineering
- Ergonomics Safety and Health
- Aqua and Fishery Science and Engineering
- Dairy and Poultry Engineering

Contact :
Professor H. N. Mishra, Organizing Secreatary, ETAE 2016, E-mail:etae2016@agfe.iitkgp.ernet.in, Ph:+91 3222 283130

International Conference on Computer Communication and Informatics, 5–7 January 2017, Coimbatore.

Topics:

Computer Science (CS)

- Geo-informative Systems
- Grid Computing
- Pervasive Computing
- Digital Image and Video Processing
- Computer Vision and Image Analysis
- Data Mining and Cloud Computing
- Mobile and optical Networks
- Wireless Sensor Networks
- Network Security
- Advanced VLSI Systems
- Embedded Wireless Systems

Electronics and Communication (EC)

- Broad Band Communication
- Computer and Intelligent Communication
- Mobile and Optical Communication
- Wireless Communication
- Mobile and Optical Networks

Electrical Engineering (EE)

- Geo-informative Systems
- Soft Computing Techniques in Power Systems
- Feedback Control Systems
- Power Electronics and Energy Efficient Drives
- Power Quality Improvement Techniques
- Expert Systems and Artificial Intelligence

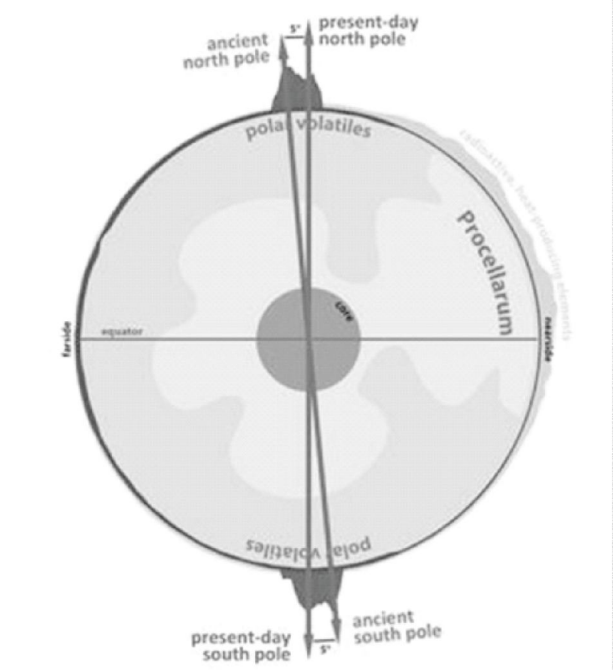
Contact:
Conference Chair, ICCCI 2016, Sri Shakthi Institute of Engineering and Technology,L&T Bypass Road,Chinniampalayam (Post), Coimbatore - 641062, Email : info@iccci.in, Phone : 0422 - 6450891 / 892 / 893

S & T ACROSS THE WORLD

THE MOON'S SPIN AXIS SHIFTED, SCIENTISTS SAY

New research suggests that the spin axis of Earth's moon shifted by about five degrees roughly three billion years ago. The evidence of this is recorded in the distribution of ancient lunar ice, according to scientists.

"The same face of the Moon has not always pointed towards Earth," said Matthew Siegler of the Planetary Science Institute in Tucson, Arizona, lead author of a paper in the March 23 issue of the journal *Nature*. "As the axis moved, so did the face of the 'man in the moon.' He sort of turned his nose up at the Earth."



This cross-section of the Moon highlights volatile, or easily evaporated, materials at the poles (in purple), and how they trace an ancient spin pole. The reorientation from that ancient spin pole (red arrow) to the present-day spin pole (blue arrow) was driven by the formation and evolution of the Procellarum a region on the near side of the Moon associated with a high abundance of heat-producing elements (green), high heat flow, and ancient volcanic activity. (Credits: James Tuttle Keane, U. of Arizona).

Scientists at multiple institutions did the research as part of NASA's Solar System Exploration Research Virtual Institute based at NASA's Ames Research Center in Silicon Valley, Calif.

Water ice can exist on Earth's moon in areas of permanent shadow. If ice on the moon is exposed to direct sunlight it evaporates into space.

The scientists reported evidence that a shift of the lunar spin axis billions of years ago enabled sunlight to creep into areas that were once shadowed and likely previously contained ice.

The researchers found that the ice that survived this shift effectively "paints" a path along which the axis moved. They matched the path with models predicting where the ice could remain stable and inferred the moon's axis had moved by about five degrees.

This is the first evidence that the moon underwent such a dramatic change in orientation, the authors said. It also implies that much of the polar ice on the moon is billions of years old.

The change in axis can only have been caused by a change in the mass, or "weight," distribution of material inside the Moon, the researchers said.

Astronomers also reported earlier this month that—around the same time the Moon's changes are supposed to have occurred—Mars' outer layers swiveled around the core of the planet by about 20 to 25 degrees. But in that case, the planet's spin axis didn't change.

(Courtesy of NASA and World Science staff March 25, 2016).

NEW SIGNS THAT ZIKA VIRUS MAY CAUSE MICROCEPHALY

Working with lab-grown human stem cells,

researchers suspect they have found out how the Zika virus probably causes microcephaly, or abnormally small heads, in fetuses.

The virus seems to selectively infect cells of the brain's outer layer, the cortex, the investigators say, making them more likely to die and less likely to divide normally and make new brain cells. The researchers say their experiments also suggest the lab-grown cells could serve to screen for anti-Zika drugs.

The virus began spreading throughout the Americas last year at about the same time as a jump in cases of fetal microcephaly, as well as other brain abnormalities. This led the World Health Organization to declare Zika a global public health emergency.

But proof of a Zika-microcephaly link has been lacking.

The virus isn't new; it was discovered in Uganda in the 1940s. Since then, small outbreaks have appeared in Asia and Africa, but symptoms were generally mild and didn't seem to have long-term effects. Zika largely spreads through bites of *Aedes aegypti* mosquitoes, but also sexually and through intrauterine infection.

The new work "doesn't definitely prove that Zika virus causes microcephaly," said neurologist Guo-li Ming at Johns Hopkins University Institute for Cell Engineering in Baltimore, one of the study leaders. But "it's very telling that the cells that form the cortex are potentially susceptible to the virus, and their growth could be disrupted by the virus."

Furthermore, Ming said, "studies of fetuses and babies with the telltale small brains and heads of microcephaly in Zika-affected areas have found abnormalities in the cortex, and Zika virus has been found in the fetal tissue."

The scientists reported their findings online March 4 in the journal Cell Stem Cell. Working quickly in light of the global threat, they compared Zika's effect on cells known as cortical neural progenitor cells to two other cell types.

Hengli Tang, a virologist at Florida State University who co-led the study with Ming, said that three days after virus exposure, nine in ten cortical neural progenitor cells were infected, and had been hijacked to churn out new copies of the virus. Furthermore, the genes needed to fight viruses had not switched on, which is highly unusual, he added. Many of the infected cells died, and others showed disrupted expression of genes that control cell division, indicating that new cells could not be made effectively.

Using specific, known types of cells allowed the researchers to see where the developing brain is most vulnerable, said Hongjun Song, a third leader of the research team, also at Johns Hopkins.

He and Ming are now using the cells to find out more about the effects of Zika infection on the developing cortex. "Now that we know cortical neural progenitor cells are the vulnerable cells, they can likely also be used to quickly screen potential new therapies for effectiveness," Song said.

(Courtesy of Johns Hopkins Medicine and World Science staff March 4, 2016)

RIPPLES IN SPACETIME DETECTED AFTER LONG SEARCH

For the first time, scientists say they have detected ripples in the fabric of spacetime called gravitational waves, generated by a collision of black holes.

The finding confirms a major prediction of Albert Einstein's 1915 general theory of relativity and opens an unprecedented new window onto the cosmos, according to physicists.

Gravitational waves carry information about their dramatic origins and about the nature of gravity that can't otherwise be obtained.

Physicists have concluded that the gravitational waves arose during the final instant of the merger of two black holes to produce one bigger, spinning black hole.

A black hole is an object so compact that its gravitational force becomes overwhelming and draws in anything nearby, including light.

The gravitational waves were detected on Sept. 14 at 5:51 a.m. Eastern Daylight Time by both of the twin detectors of the Laser Interferometer Gravitational-wave Observatory, or LIGO, in Livingston, Louisiana, and Hanford, Washington, USA.

The finding, accepted for publication in the journal *Physical Review Letters*, was made by the LIGO Scientific Collaboration and the Rome-based Virgo Collaboration.

Scientists with the project estimate that the black holes "weighed"—or more accurately, had mass—the equivalent of about 29 and 36 Suns. And estimates indicate the event took place 1.3 billion years ago, although the signals only reached us recently.

Because, as Einstein proposed, mass and energy are interchangeable, about three Suns' worth of material were converted into gravitational waves during the event, according to the authors.

By looking at the time of arrival of the signals—the detector in Livingston recorded the event seven thousandths of a second before the detector in Hanford—scientists determined that the source was located in the southern sky.

According to general relativity, a pair of black holes orbiting around each other lose energy by emitting gravitational waves, causing them to gradually approach each other over billions of years, and then much more quickly in the final minutes.

During the final fraction of a second, the two black holes crash at nearly half the speed of light and form one more massive black hole. The event converts a part of the combined black holes' mass, or "weight," to energy, according to Einstein's formula $E=mc^2$. This energy radiates out as a final strong burst of gravitational waves.

Joseph Taylor, Jr. and colleagues are credited with demonstrating gravitational waves exist, in the 1970s and 1980s. Taylor and Russell Hulse found in 1974 a double system composed of a pulsar, a type of star, in orbit around a neutron star. Taylor and Joel M. Weisberg in 1982 found that the pulsar's orbit was slowly shrinking because energy was leaking as gravitational waves. Hulse and Taylor won the Nobel Prize in Physics in 1993 for their work.

The new finding is the first observation of gravitational waves themselves, made by measuring the tiny disturbances the waves make to space and time as they pass through the earth. This "accomplishes an ambitious goal set out over five decades ago to directly detect this elusive phenomenon and better understand the universe, and, fittingly, fulfills Einstein's legacy on the 100th anniversary of his general theory of relativity," said Caltech's David H. Reitze, executive director of the LIGO Laboratory.

The U.S. National Science Foundation-funded observatory was conceived, built, and is operated by the California Institute of Technology and the Massachusetts Institute of Technology.

(Courtesy of LIGO and World Science staff Feb. 11, 2016)

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भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

दूरभाष/Telephone : (033) 2287-4530, 2281-5323 फैक्स/Fax : 91-33-2287-2551

वेबसाइट/ Website : http://sciencecongress.nic.in ई-मेल/E-mail : iscacal@vsnl.net

es.sciencecongress@nic.in

सदस्यता की शर्तें और सदस्यों की विशेषाधिकार/Terms of Membership and Privileges of Members :

संस्था की सदस्यता उन सभी लोगों के लिए खुली हैं, जो स्नातक या उसके समान स्तर पर शैक्षणिक योग्यता अर्जन कर चुके हैं, और जिन्हें भारत में विज्ञान की तरक्की में रूचि हैं।

Membership of the Association is open to person with Graduate or equivalent Academic Qualifications and interested in the advancement of Science in India.

1. **वार्षिक सदस्य :** जो व्यक्ति नये रूप से वार्षिक सदस्यता ग्रहण करना चाहता है उसे वार्षिक सदस्यता शुल्क ₹ 200/- के साथ भर्ती शुल्क ₹ 50/-* (विदेशियों के लिए** U.S. $ 70) मात्र देने पड़ेंगे। वार्षिक सदस्यता शुल्क प्रत्येक वर्ष के 01 अप्रैल को देय हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं अदा कर पाएगा वह उस साल के लिए अपनी वोट देने की क्षमता से वंचित हो जाएगा और/या वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल 15 जुलाई के भीतर बिना शुल्क दिए पुनः अपनी सदस्यता प्राप्त कर सकता हैं।

   सदस्यगण अपना पेपर कांग्रेस सत्र के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सत्र की कार्यविवरण की एक प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा ''एवरीमैन्स साइंस'' की प्रति भी बिना मूल्य उस साल के लिए प्राप्त कर सकते हैं। सदस्यता के नवीकरण के लिए कृपयाISCAवेबसाइट से फार्म डाउनलोड करें।

1. **Annual Member :** A person willing to be enrolled as new Annual Member has to pay an annual subscription of ₹ 200/- along with an admission fee of ₹ 50/-* (for foreign ** U.S.$ 70) only. The annual subscription of a Member shall become due on the 1st April of each year. Anyone who fails to pay the subscription on or before the 15th July in any year shall lose the right of voting and/or holding any office of the Association for that year. A member failing to pay the annual subscription by the end of March of the following year shall cease to be a Member. Annual members can renew their Membership without paying the admission fee in the next year by remitting subscriptions in time i.e. within 15th July. Members may contribute papers for presentation at the Science Congress. They will receive, free of cost, reprints of the Proceedings of the Session of any one section of their interest and also the bi-monthly journal of the Association Everymans Science for that year only.
   For Renewal of Membership please download the form from ISCA website.

2. **सत्र सदस्य :** यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराना भूल जाएँ, तो उनकी सदस्यता, सत्र सदस्यता के रुप में बिना वोट डालने की क्षमता में सीमित कर दिया जाएगा। सत्र सदस्यको ₹ 200/- (विदेशियों के लिए $ 50) अदा करना पड़ेगा। एक सत्र सदस्य को लेख/पोस्टर प्रस्तुतीकरण का अधिकार प्राप्त होगा जिस कांग्रेस सत्र का वह सदस्य हैं। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं हैं। सत्रसदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

2. **Sessional Member :** If for some reasons, Annual Members fail to renew their Membership by remitting subscription prior to 15th July each year, their Membership for the year would be restricted to Sessional Membership without voting right. Sessional Member has to pay ₹ 200/- (for foreign $50). A Sessional Member shall have the right to present paper / poster at the session of the congress of which he/she is a member. A Sessional Member shall not be eligible to participate in the voting process. A Sessional member shall not be eligible to participate in the Business meetings of the Sections and the General Body.

3. **छात्र सदस्य :** जो व्यक्ति स्नातक स्तर से नीचे पढ़ाई कर रहा हैं, उसे वार्षिक सदस्यता शुल्क₹ 100/- मात्र देने पड़ेंगे अपना नाम छात्र सदस्य के रुप में लिखवाने के लिए, बशर्ते उसके आवेदन पत्र पर उसके प्राचार्य/विभागाध्यक्ष/संस्थान के प्रधान के हस्ताक्षर हों। एक छात्र सदस्य को यह अधिकार दिया जाएगा, कि वह अपना पेपर कांग्रेस सत्र के समय पेश कर सकें, बशर्ते वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश करें। उसे वोट करने का या कार्यालय को नियंत्रण करने का अधिकार पाप्त नहीं होगा। छात्र सदस्य को विभगों के व्यवसायबैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

3. **Student Member :** A person studying at the under - graduate level may be enrolled as a Student Member by paying an annual subscription of ₹ 100/- **only provided his/her application is duly certified by the Principal/Head of the Institution/Department.** A student member shall have the right to submit papers for presentation at the Session of the Congress of which he / she is a member, provided such papers be communicated through a Member, or an Honorary Member of the Association. He/She shall not have the right to vote or to hold any office. A student member shall not be eligible to participate in the Business Meetings of the Sections and the General Body.

4. **आजीवन सदस्य :** एक सदस्य अपने भविष्य की सारी वार्षिक सदस्यता शुल्क एक बार में ₹ 2,000/- (विदेशियों के लिए U.S.$ 500) मात्र अदा करके पा सकता हैं। एक व्यक्ति जो 10 साल या उससे अधिक नियमित रूप से सदस्यता प्राप्त कर चुका है, उसे उसकी संयुक्त सदस्यता शुल्क के ऊपर प्रतिवर्ष ₹ 50/- की छूट दी जाएगी, बशर्ते कि उसकी संयुक्त शुल्क ₹ 1,200/- से नीचे न हों (विदेशियों के लिए U.S.$ 12.50 और U.S.$ 300 क्रमशः)। एक आजीवन सदस्य को उसके पूरे जीवन काल में सदस्यता की सारे विशेषाधिकार प्राप्त होंगे।

4. **Life Member :** A Member may compound all future annual subscriptions by paying a single sum of ₹ 2,000/- (for foreign** U.S.$ 500) only. Any person who has been continuously a member for 10 years or more, shall be allowed a reduction in the compounding fee of ₹ 50/- for every year of such membership, provided that the compounding fee shall not be less than ₹ 1,200/- (for foreign** U.S.$ 12.50 and U.S.$. 300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.

5. **संस्थान सदस्य :** एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के रुप में दे वही संस्था के संस्थान सदस्य उस वित्तीय वर्ष के लिए बन सकता है, (विदेशियों के लिएU.S.$ 2,500)। इसमें वह विज्ञान कांग्रेस के वार्षिक सत्र में अपने एक व्यक्ति का नाम नामांकित कर सकता हैं, जो उनका प्रतिनिधि हों। एक संस्थान सदस्य को वार्षिक विज्ञान कांग्रेस

सत्र की कार्यविवरण की एक पूर्ण प्रति बिना मूल्य में प्राप्त हो सकती है। इसके साथ वे संस्था के रोज़नामचा''एवरीमैन्स साइंस'' की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

5. **Institutional Member :** An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S.$ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.

6. **दाता** : कोई भी व्यक्ति जो एकसाथ ₹ 10,000/- (विदेशियों के लिए U.S. $ 5,000) मात्र दें, वह संस्था के दाता बन सकते हैं। एक **व्यक्तिगत दाता** को वह सारे अधिकार और विशेषाधिकार मिलेंगे जो एक सदस्य को उसके पूर्ण जीवन काल में प्राप्त होते हैं।

एक संस्थान जो एकसाथ ₹ 50,000/- (विदेशियों के लिए U.S. $ 25,000) मात्र दें, सदा के लिए इस संस्था के **संस्थान दाता** बन सकते है, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रुप में विज्ञान कांग्रेस के वार्षिक सत्र में भेज सकते हैं। एक संस्थान/व्यक्तिगत दाता वार्षिक विज्ञान कांग्रेस के कार्यविवरण और संस्था के रोज़नामचा ''एवरीमैन्स साइंस'' की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

6. **Donor :** Any person paying a lump sum of ₹ 10,000/- (for foreign ** U.S.$ 5,000) only, can become an Individual Donor of the Association. An ***INDIVIDUAL DONOR*** shall have all the rights and privileges of a member during his/her lifetime.

An Institution paying a lump of ₹ 50,000/- (for foreign ** U.S.$ 25,000) only, can become an ***INSTITUTIONAL DONOR*** of the Association forever, which shall have the right to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional/ Individual Donor shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also the Associations journal Everymans Science.

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* भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रुरी है। यह सत्र सदस्य/आजीवन सदस्य/ संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रुरी नहीं है।

* *Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.*

** (एक विदेशी सदस्य का अर्थ है, जो भारतवर्ष के बाहर का नागरिक हों।)

** *(A Foreign Member means one who is normally Resident outside India).*

(अ) **पेपर पेश करना :** एक पूर्ण पेपर की प्रति उसके साथ तीन सारांश की प्रति जो 100 शब्दों से ज्यादा न हों और जिसमें कोई आरेख या फार्मूला न हों, वह प्रत्येक वर्ष 15 सितम्बर के अंदर अनुभागीय अध्यक्ष तक पहुँच जाना चाहिए।

(A) **Presentation of Papers :** A copy of complete paper accompanied by an abstract in triplicate not exceeding one hundred words and not containing any diagram or formula, must reach the Sectional President latest by September 15, each year.

(ब) सभी वर्गों के सदस्य जो विज्ञान कांग्रेस सत्र में भाग लेने के पश्चात लौटते समय के टिकट में रियायत प्राप्त कर सकता है, बशर्ते कि उनकी यात्रा के खर्च का थोड़ा भी भाग सरकार (केन्द्रीय या राज्य),

कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नगरपालिका न उठाएँ और उनकी कुल कमाई या परिलब्धियां ₹ 5,000/- (प्रति माह पाँच हजार रुपए) से अधिक नहीं हैं। कृपया ISCA वेबसाइट से रेलवे रियायत फार्म डाउनलोड करें।

(B) Members of all categories are entitled to **Railway Concession** of return ticket by the same route with such conditions as may be laid down by the Railway Board for travel to attend the Science Congress Session provided that their travelling expenses are not borne, even partly, by the Government (Central or State), Statutory Authority or an University or a City Corporation and their total earning of or emoluments drawn do not exceed ₹ 5,000/- (Rupees Five Thousand per month). Please download the Railway Concession form from ISCA Website.

(स) संस्था के पुस्तकालय में सभी वर्गों के सदस्य को पढ़ने की सुविधा सुबह 10.00 बजे से शाम को 5.30 बजे तक सभी काम के दिनों में (शनिवार और रविवार) को छोड़कर प्राप्त होगी।

(C) Members of all categories are entitled to reading facilities between 10.00 a.m. to 5.30 p.m. on all weekdays (except Saturdays & Sundays) in the library of the Association.

(ड) समय समय पर संस्था द्वारा तय की गई मूल्य दरों पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य कर सकते हैं।

(D) Members of all categories may avail Guest House facilities, Lecture Hall hiring at the rates fixed by the Association from time to time.

(ई) भविष्य में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंवाद, सम्मेलन और वार्षिक कांग्रेस में सभीवर्गों के सदस्यों द्वारा भाग लेने के लिए अपनी—अपनी सदस्यता पत्र को लाना ज़रुरी होगा।

(E) Members of all categories should bring the Membership Card always for attending any Seminar, Conference and Annual Congress organized by ISCA in future.

ध्यान दें : (1) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, और जो कोलकाता के किसी भी शाखा में देय हों। सदस्यों से यह निवेदन किया जा रहा है, कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के वक्त अवश्य करें।

(2) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा। कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन–पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(3) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

Note : (1) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata. Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(2) No money order, I.P.O., ECS or cheque will be accepted by ISCA. No Membership will be taken without duly filled in prescribed Membership Form (Application From for New Membership/ Application for Renewal of Membership).

(3) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the Cash by Post within the envelope.

भारतीय विज्ञान कांग्रेस संस्था

14, डॉ० बिरेश गुहा स्ट्रीट, कोलकाता - 700 017, भारत

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata-700 017, INDIA

दूरभाष/Telephone : (033) 2287-4530, 2281-5323
फैक्स/Fax : 91-33-2287-2551
वेबसाइट/Website : http://sciencecongress.nic.in
ई-मेल/E-mail : iscacal@vsnl.net
es.sciencecongress@nic.in

सदस्यता के लिए नया आवेदन पत्र / Application Form For New Membership

सेवा में/To
महासचिव (सदस्यता कार्य)/ The General Secretary (Membership Affairs)
भारतीय विज्ञान कांग्रेस संस्था/The Indian Science Congress Association
14, डॉ० बिरेश गुहा स्ट्रीट/14, Dr. Biresh Guha Street,
कोलकाता - 700 017/Kolkata - 700 017

स्टैम्प आकार का फोटो / Stamp Size Photograph

महोदय/Dear Sir,

मैं भारतीय विज्ञान कांग्रेस संस्था का आजीवन सदस्य/वार्षिक सदस्य/सत्र सदस्य/छात्र सदस्य/संस्थान सदस्य/व्यक्तिगत दाता/संस्थागत दाता अपना नाम लिखवाना चाहता/चाहती हूँ।

I like to be enrolled as a Life Member/Annual Member/Sessional Member/Student Member/Institutional Member/Individual Donor/Institutional Donor of The Indian Science Congress Association. (Pl. Tick)

मैं इसके साथ ———— सदस्यता शुल्क के रूप मे नक़द ₹ ————/बैंक ड्राफ्ट संख्या ———— दिनांकित ———— प्रचालक बैंक ———— 01 अप्रैल 20–– से 31 मार्च 20–– तक भेज रहा/रही हूँ।

I am sending herewith an amount of ₹ in payment of my subscription by Cash/Bank Draft No. dated issuing bank from the year 1st April 20 to 31st March 20.

मैं निम्नलिखित विभाग में रुचि रखता/रखती हूँ (कृपया किसी एक में निशान लगाएँ)/ I am interested in the following section (Please tick any one).

विभाग/Sections

1. कृषि और वानिकी विज्ञान/Agriculture and Forestry Sciences
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान/Animal, Veterinary and Fishery Sciences
3. मानवशास्त्रीय और व्यवहारपरक विज्ञान (जिसमें सम्मिलित हैं, पुरातत्व-विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)/Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)
4. रसायन विज्ञान/Chemical Sciences

5. भू-पद्धति विज्ञान/Earth System Sciences
6. अभियन्ता विज्ञान/Engineering Sciences
7. पर्यावरण विज्ञान/Environmental Sciences
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)/Information and Communication Science & Technology (including Computer Sciences)
9. भौतिक विज्ञान/Materials Science
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)/Mathematical Sciences (including Statistics)
11. चिकित्सा शास्त्र (जिसमें शरीर विज्ञान भी सम्मिलित है)/Medical Sciences (including Physiology)
12. नया जीवविज्ञान (जिसमें जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी भी सम्मिलित है)/New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)
13. भौतिकीय विज्ञान/Physical Sciences
14. वनस्पति विज्ञान/Plant Sciences

(कृपया टंकित करें या ब्लॉक अक्षरों में भरें/Please type or fill up in Block Letters)

नाम/Name (ब्लॉक अक्षरों में/in Block Letters) :

श्री/सुश्री/श्री/श्रीमती/डॉ॰/प्रो॰/Mr./Ms./Shri/Shrimati/Dr./Prof (कृपया टिक करें)/(Please tick)

कुलनाम/Surname प्रथम नाम/First Name मध्य नाम/Middle Name

शैक्षणिक योग्यता/Academic Qualifications :

(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वत:सत्यापित जिराक्स प्रति संलग्न करना है / Self attested xerox copy of last educational certificate/marksheet must be attached)

पदनाम/Designation

सम्पर्क का पता/Address of communication :

(राज्य, शहर/नगर और पिन कोड सहित/including state, city/town and pin code)

दूरभाष संख्या/मोबाईल संख्या और ई-मेल/Phone No./Mobile Number & E-mail :

स्थायी पता/Permanent Address :

टिप्पणी (अगर कोई)/Comments (if any)

दिनांक/Date : भवदीय/Yours Faithfully

हस्ताक्षर/Signature

ध्यान दें : (i) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ और जो कोलकाता के किसी भी शाखा में देय हों।

Note : (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association* Payable at any branch in Kolkata.

(ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराके करने चाहिए न कि देखभाल के पते प्रस्तुत करने चाहिए।

(ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.

(iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रुरी है। यह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रुरी नहीं है।

(iii) Admission fee of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.

(iv) सदस्यों से यह निवेदन किया जा रहा है कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के समय अवश्य करें।

(iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.

(v) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा।

(v) No Money order, I.P.O., ECS or Cheque will be accepted by ISCA.

(vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।

(vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership)

(vii) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।

(vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.