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*Editorial***SELF RELIANCE : A POWERFULL TOOL TO LEAD A GOOD LIFE**

Life is neither a fixed or static state nor only mere living, rather filled with active involvement of the individual to fulfill the basic needs in personally expressive life spheres such as family, work and comfort. Life usually shaped by cultural possession, social circumstances and volunteerism to community to grow themselves and to assist and help those really need of it. A good life is striving towards a disposition to take a bright and hopeful view of things that involved in a continuous process of growth and development with a purpose and aim to gain competence as we grow, survive and actualize ourselves with competence. A good life may also be characterized by the ability to face the challenges in win-win situations and not to lose patience when could not be in win-win situations.

However, life is also afflicted with uncertainties, in-capabilities, selfish motives and dissensions, economic, environmental and cultural issues. To grow and save money or to cherish the gifts of cosmos without defending environment, all practices of social safety, health system and preparedness to meet any emergent condition may fall short in overcoming the concerned issue and may be accompanied with profound grief, sorrow and distress in any socio-politico scenario.

The same happened at the time of most contagious disease pandemic Covid- 19, that spread from one person and place to another over a very wide area, crossing international

boundaries and affected large number of people. Hundred thousands of lives were lost. World economy has faced world recession. The loss of income and employment causes further challenges to livelihood, health and survival. Public health emergencies occurred and every one found him/her in a state of imbalance not only physically but mentally too. It looked very difficult to protect with it, as it had never occurred before. Societies need to protect the people and would likely to overcome the crises with steps directed from World Health Organization or by the Government time to time. Lack of understanding, unpreparedness, false words, rumors and elaborations of print media further aggravate the situation more drastically. Every one became afraid with one another, even amongst family member as mask, sanitization and physical distancing (not at least social distancing) emerged or thought to be the basic protectors from the emerged virus, especially in lack of any proper medicine. A great need has arisen how to ensure a sound health in such a devastating situation when experts are still expecting second strain of the virus. The time has to come when man has to learn to live with these adversities by growing not only selfreliance but also indomitable self-reliance (अदम्य आत्मविश्वास) to cope with the situation and also to lead a good life. Being self-reliant means that one accepts his responsibilities, make his own decisions, learn more practical

skills, look after his own body and bodily changes, recognizing and accepting his own feelings adequately, finding healthy ways to express and control of emotions (both negative and positive) and at least not to compare him/her with one another, just only to make his/her own identity and to learn method and competence to remain highly connected and shared with other people to boost the inner confidence of himself even when one could not receive praise, complements and reassurances of others and try to help those highly perplexed, shocked and depressed when exposed to various crises of the life.

Initiating education and training for how one can be self-reliant should be provided from early childhood to adolescence period of life, that will explore the self-knowledge and ability to take right judgment in terms of what is right and what is wrong independently. The attempt would like to boost the self-reliance, where to self-reliant and where to dependent or to manage dependence might enhance a great vision to deal effectively. It may also promote in mobilizing the groups with skills to deal in any critical situation. However, self-reliance shall never be imbued with ignorances.

Dr. R. L. Bharadwaj

“A man may die, nations may rise and fall, but an idea lives on”

—John F. Kennedy

ELECTROMAGNETIC SPECTRUM IN FOOD PROCESSING

V. Geetha¹ and J. Gitanjali²

Electromagnetic radiation of all possible wavelength and frequency are electromagnetic spectrum. Depending on the wavelength and frequency energy level varies and its applications are in medical field, transmission and in food industries.

INTRODUCTION

Electromagnetic spectrum includes wavelength ranging from 10^{-5} nm to 10^3 nm and frequency ranging from 10^2 Hz to 10^{24} Hz. Based on wavelength and frequency electromagnetic spectrum shown in Fig. 1 are divided into gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves and radio waves. Electromagnetic spectrum has both ionizing and non-ionizing radiation.

The Electromagnetic plays a role in commercial application, medical, industrial and food industry. In food processing industries the role of electromagnetic spectrum is to preserve

foods by destruction of microorganism and enzyme inactivation, drying, frying, baking, extraction, thawing.

In both fresh and processed foods microorganism and enzymes play a major role in decreasing the shelf life by changing the food quality. Microbial destruction and enzyme inactivation can be done by both thermal and non thermal processing. Thermal methods involve heating the food to very high temperature for destruction of micro organism. By heating the foods to very high temperature the colour and organoleptic properties are destroyed.

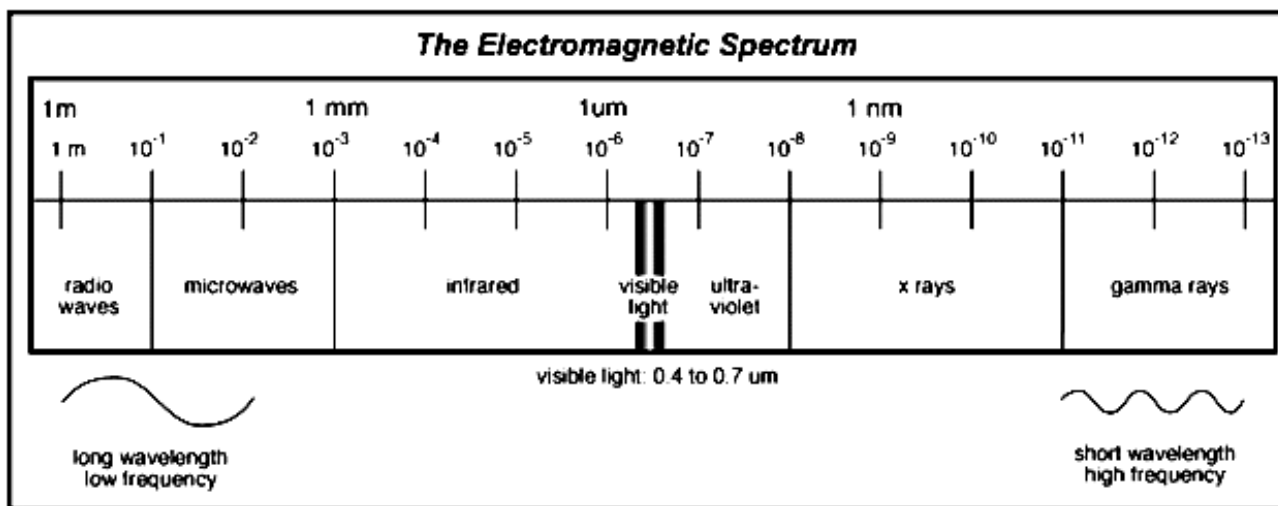


Fig. 1. : Electromagnetic spectrum.

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But consumers prefer fresh like appearance, colour, aroma and taste. To achieve these non thermal methods of processing are applied in food industry to satisfy the consumers. In non thermal

Table 1. Irradiation dosage level and treatment.

S. No.	Treatment	Dosage level
a. Low dose (<1 kGy)		
i.	Inhibition of sprouting of tubers, bulbs, rhizomes	0.02 – 0.2 kGy
ii.	Delay in ripening of fruits	0.2 – 1.0 kGy
iii.	Disinfestation of insect in cereals, legumes and their products	0.25 – 1.0 kGy
b. Medium dose (1 – 10 kGy)		
i.	Shelf life improvement of meat, fish, fruits and vegetables	1.0 – 3.0 kGy
ii.	Elimination of pathogens in various foods	1.0 – 7.0 kGy
iii.	Hygienization of spices	6.0 – 14.0 kGy
c. High dose (>10 kGy)		
i.	Sterilization of packaged food and hospital diets	5.0 – 25.0 kGy

methods of food processing electromagnetic spectrum has a significant role.

GAMMA RAYS

Gamma rays are produced by Co 60 or Cesium-137 which has greater penetrating capacity in thick or dense product. Gamma rays are used in different dosage level which is measured by gray (Gy or kGy). Depending on the dosage level application in food processing

varies and Table 1 presents the three main categories⁵:

Gamma rays kill the bacteria by breaking down the DNA, which inhibit further multiplication. All agricultural produces consists of water molecules. Gamma rays ionize the water molecule¹ (Fig. 2) and the free radical affect the biological functioning process which in turn inhibit sprouting, ripening.

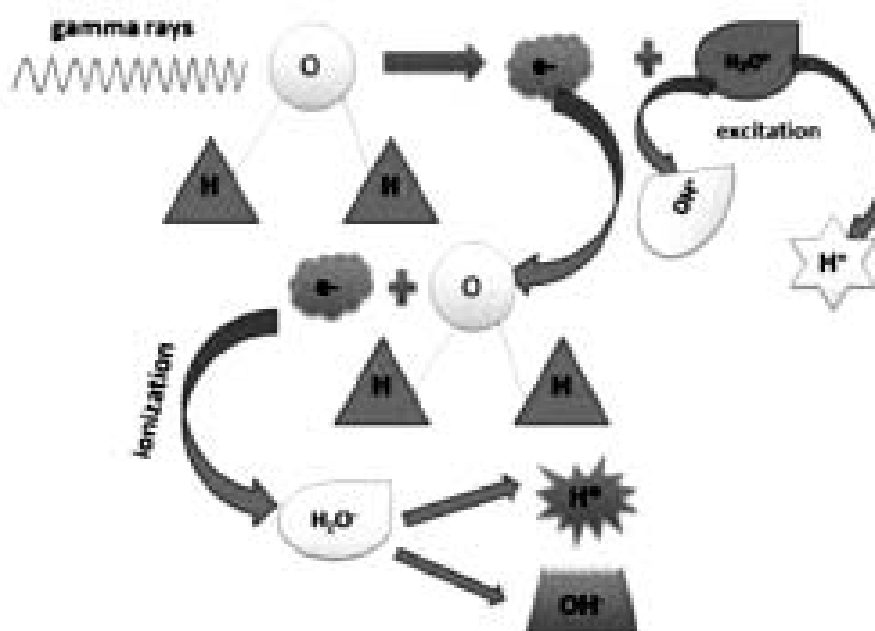


Fig. 2 : Effect of gamma rays on water molecule.

X-RAYS

Two ways to produce X-rays are synchrotrons produces high energy level of 10^9 eV is not suitable for food and agricultural applications whereas X-rays produced by deceleration of electrons in solid-state is used in food and agricultural processing and preservation⁴. The parts of X-ray generator are X-ray tube consists of cathode, filament and metal anode, an evacuated envelope of glass or metal-ceramic used to generate X-rays. When electric current is passed to the filament, electrons are emitted, to accelerate the electrons towards the anode, high voltage is applied between the cathode and the anode. Commercial applications are online grading of food inspection such as bone detection in meats, insect damage detection in grains and nuts, defect detection in fruits.

ULTRAVIOLET

In the electromagnetic spectrum UV are in three regions *viz.*, UV – A (315-400nm), UV – B (280-315nm) and UV – C(200-280nm). UV – C in the range of 200 – 280 nm has germicidal property. Microwave UV lamp produces rays at 254 nm when applied to the food the microorganism present are completely destroyed. The UV light penetrates into the outer membrane of the microorganism cells leading to tremendous damage to the DNA owing to the formation of thymine dimers. This will prevent the DNA transcription and replication when the favourable condition returns.³ Its applications are pasteurization of juices, post lethality treatment of meats, treatment of food contact surfaces and to extend the shelf life of fresh produce.

INFRARED

Infrared energy is emitted by hot objects. The emitted infrared energy is observed by the

food materials it gives up energy to heat. The rapid surface heating of foods seals in moisture and flavour or aroma compounds.⁷ Application areas are drying of vegetables, fish, pasta, rice, heating of flour, frying of meat, roasting of cereals, coffee, cocoa, baking of pizza, biscuits and bread.

MICROWAVES

Microwaves are produced by magnetron, travelling wave tube and klystron. The magnetron is used in production of microwave in industrial and domestic application. The microwaves are produced by applying high voltage current to cathode in vacuum. The cathode is surrounded by anode which forms cavities. The emitted electrons are accelerated radially and deflected by the magnetic field yielding a spiral motion. Both electric and magnetic field are in perpendicular direction. The emitted microwaves are directed to applicator by a waveguide. Waveguides are hollow conductors of rectangular and circular forms. Then the microwaves are applied to the target food materials. The microwaves are penetrated into foods and water molecules present in food which is dipoles will accelerate and tend to align to the magnetic field. Due to dipolar rotation and friction between water molecules heat is generated. The generated heat helps in heating of foods and the heat thus produced is used to destroy the microorganism present in it. ⁶Microwave ovens are used in households, in food industry for baking, cooking, thawing, tempering, drying, pasteurization, sterilization, blanching and wastewater treatment

RADIO FREQUENCY

An alternating current is converted into high voltage DC power by using a rectifier. The

oscillator drives the resonant circuit to generate RF energy at specific frequency. Radio frequency energy is transmitted to the food placed between the two electrodes, where heat is generated by dielectric loss factor². Radiofrequency is used in thawing, postbaking, drying, pasteurization, sterilization. RFID (Radio Frequency Identification Tags) are used in food packaging to provide information of the food product including manufacturing and compositional details. RFID is very useful in tracing the product.

CONCLUSION

The ultimate use of electromagnetic spectrum in food processing and preservation technology is to improve shelf life by microbial destruction and enzyme inactivation, maintain colour, flavour, nutritional property by reducing processing time and minimal usage of energy thereby reducing processing cost..

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THE ART OF BALANCING

V. Lakshmi

It is important to strike a balance between different aspects of life, like studies and play, professional life and personal life, human development and environmental sustainability etc. In addition to these, to strengthen immunity and to improve one's well being, there are other things that need to be balanced in human body.

INTRODUCTION

Balance, by definition, means having the right amount of anything which leads to harmony or peace. Often, at various stages in life, one encounters situations where it is important to maintain balance among different priorities, which we fix during our day to day activities.

Studies vs Sports

A student should have the art of balancing studies and sports as both are equally important. Education provides knowledge which can be useful throughout the life similarly sports is also important as it helps in relaxation, recharging and overall development of the individual. As the old saying goes - 'All work and no play makes Jack a dull boy, All play and no work makes Jack a mere toy.'

Profession vs Family life

Once an individual steps into a job and family life, it becomes very important to have a balance between the two i.e. balancing profession and family life. Though career helps in attaining a sense of satisfaction, status in society and a purpose to life, it alone cannot fulfill a person and often makes one lonely. It is the family which provides love and support needed for one's

existence. The ultimate goal of every one is to live happily and peacefully. This is possible by spending quality time with family members and not allowing work to creep in one's personal life.

Human development vs Environmental sustainability

Environment plays an important role in the overall development of a person and to keep good environment one needs to keep a balance between human activities and nature for a sustainable future. Over the past 50 years we have witnessed a significant development in the fields of science and technology. However, there is a rise in the environmental degradation due to activities like deforestation, excessive fishing, mining leading to severe consequences such as global warming, loss of biodiversity. Unchecked human activities also increase the risk of newer zoonosis (infectious disease that is caused by the jump of the pathogen from animals to humans) like Covid-19. If not addressed, these problems will reduce the benefits that the future generations may reap from nature.

Gut microbiota vs Immune system

While the above examples are quite apparent, there are others that need our attention like the balance of our gut microbiota, which influences

the balance of immune system. Human body provides a favourable habitat for growth of a number of microbes (bacteria, fungi, viruses etc.). The large and mixed collection of these microbes called as microflora or microbiota is acquired by an individual from his environment. These microbes tend to harbour inner surfaces of respiratory, digestive, urinary and genital tracts and are generally protective. Majority of the microorganisms live in our large intestines which are called as gut microbiota. There are about 500 different species of bacteria in a person's gut which varies from individual to individual. Though relatively stable, it fluctuates with age, change in diet, health, hygiene and usage of drugs. To be healthy we need to have a diverse and balanced gut microbiota. Microbial imbalances in the gut called as dysbiosis can cause immune dysregulation leading to autoimmune diseases, intestinal disorders, allergies, skin diseases and even cancer.

Our diet supplies most of the nutrients needed by the gut microbes. Therefore healthy interaction between immune system and the microbiota can be obtained by consuming a healthy, balanced diet. A diet which includes prebiotics (foods which help in growth of healthy microbes in gut) like oats, barley, honey, banana, tomato, onion, garlic etc. and probiotics (foods which contain live bacteria, which produce health benefits when consumed) like yogurt, milk, buttermilk etc. contributes to the development of healthy microbiota that prevents disease development. Other ways of promoting healthy gut are having good sleep, drinking plenty of water and lowering stress by meditation and yoga etc.

Prebiotics and probiotics are microbiota regulating tools which improve the health of the host¹ and currently a lot of research is happening in this field with an aim to explore new strains of probiotics and exploit them to improve human health².

Oxidants vs antioxidants

Similarly there should be a balance between free radicals or oxidants and antioxidants in the body. Free radicals are atoms or molecules that are highly unstable and react with other cellular structures due to their unpaired electrons. They are constantly generated in small amounts as by-products of cellular metabolism. At moderate or low levels, they have beneficial effects and involve in various physiological functions, such as in immune function.

Excess amounts of free radicals can be generated in humans due to stress, household chemicals, environmental stressors like UV radiation, microbes, allergens, cigarette smoke, physical stressors like intense exercise, use of certain drugs etc. At higher concentration these oxidants can not only damage the integrity of various biomolecules including DNA, proteins and lipids but also participate in damage caused by microbial infections, tumour progression and activate cell death.

Antioxidants are compounds which neutralize the free radicals by donating an electron. The body cells produce many of these by expressing genes encoding antioxidant enzymes (superoxide dismutase, catalase etc.) and endogenous antioxidants (vitamin C, vitamin E, glutathione etc) to counteract the extra oxidants. This complex antioxidant grid counters the damaging effects of free radicals on important biomolecules and eventually body tissues.

An imbalance between oxidants and antioxidants due to accumulation of free radicals results in oxidative stress. Oxidative stress may ultimately lead to impaired immunity, DNA damage which can cause mutations, and the development of several diseases like diabetes, cancer, neurological diseases etc. It is important to maintain the balance between oxidants and antioxidants in the body for good health. However, the free radicals or oxidants usually

outnumber the antioxidants naturally produced in the body. Therefore, it is important to have a continuous supply of antioxidants from an external source to maintain this balance. The potential role of nutritional antioxidants in reducing the damage induced by oxidative stress is also emphasized by Liu et al (2018)³.

Antioxidants also called free radical scavengers are naturally occurring in certain fruits and vegetables like beta-carotene in carrots and lycopene in tomatoes. Other dietary sources include tea (catechin), chocolate (flavanol), nuts, grains, spices etc. These exogenous antioxidants are vital for maintaining a healthy living.

Contrary to the single antioxidant supplements, fruits and vegetables have antioxidants along with many other substances like fiber, minerals, vitamins which work together collectively to prevent diseases. It is also necessary to include seasonal food in the diet to fulfil the body's requirement of antioxidants. A diet rich in antioxidants may help in anti-aging, countering diseases, promoting immunity, preventing DNA damage, keeping one's brain active and gut

healthy, all of these help in improving the quality and length of life.

CONCLUSION

Balancing is an art which varies from person to person. It is the choice of an individual to decide a better suited strategy based on one's values, priorities, existing commitments etc. Making the right choices ensure the well being of the individual. To reiterate, inclusion of antioxidant rich food like fruits, grains, vegetables, cumin, ginger, garlic, clove, turmeric and cinnamon etc. in one's regular diet is always good for health all stages of life including the present pandemic situation.

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BETA THALASSEMIA : AN INDIAN PERSPECTIVE

Pranab Roy

There are more than one thousand genetic abnormalities known in humans. Most are congenital, ie. these diseases are inherited from the parents. But some may be acquired during one's lifetime. Exposure to ionizing radiation, chemical carcinogens or different oncogenic viruses cause cancer which is of course due to mutations or genetic changes. In this article, we describe one of the most common inherited genetic diseases, thalassemia which produces insufficient or non-functional hemoglobin, the carrier protein of Oxygen in our blood. There are two different globin genes, alpha and beta, carried on chromosome 15 and 11 respectively. Beta globin mutations are more common and has been studied for the last thirty years. Blood transfusion at regular interval to the affected individual is the usual procedure but gene therapy to correct the mutational defect would be applied in future for permanent cure. Clinical diagnosis of the genetic disease is often aided by molecular detection of the mutational changes in the globin genes.

INTRODUCTION

Beta-thalassemias are a group of hereditary blood disorders which are characterized by anomalous synthesis of the beta chains of hemoglobin. They result in variable phenotypes ranging from severe anemia to clinically asymptomatic individuals. The total annual incidence of symptoms is estimated at about 1 in 100,000 individuals throughout the world¹. There are three main forms of thalassemia: thalassemia major, thalassemia intermedia and thalassemia minor. Individuals who have thalassemia major are seen to have severe anemia and require regular red blood transfusions. Observations in patients with thalassemia who were untreated or poorly transfused, as seen in some developing countries, are growth retardation, jaundice, poor musculature, pallor, hepatosplenomegaly, leg ulcers, and development of masses from extra

medullary hematopoiesis. Skeletal changes may also result due to the expansion of bone marrow. Regular transfusion therapy, although necessary for survival, can lead to iron overload-related complications including endocrine complications (growth retardation, diabetes mellitus, failure of sexual maturation, and insufficiency of the parathyroid, thyroid, pituitary, and less commonly, adrenal glands), dilated cardiomyopathy, liver fibrosis and cirrhosis). Thalassemia intermedia is seen in older patients with moderate anemia and they do not require regular blood transfusions. Main clinical features are gallstones, painful leg ulcers, increased predisposition to thrombosis, hypertrophy of erythroid marrow with medullary and extramedullary hematopoiesis and its complications which include osteoporosis, masses of erythropoietic tissue that primarily affect the liver, spleen, lymph nodes, chest and spine, and bone deformities and typical facial changes. Thalassemia minor is clinically asymptomatic but

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moderate anemia is observed in some individuals. Beta-thalassemsias are caused by point mutations or, more rarely, deletions in the beta globin gene on chromosome 11, leading to reduced (β^+) or absent (β^0) synthesis of the beta chains of hemoglobin. Transmission is autosomal recessive in most cases; however, reports have also shown dominant mutations. Diagnosis is based on hematologic and molecular genetic testing².

Presently prevalence of Thalassemia carrier in India is 3.7% of its total population. Annual increment of Thalassemia carrier is 50,000. Both Alpha and Beta Thalassemia are found in West Bengal, but Beta Thalassemia is most common in West Bengal.

Among the various Hemoglobinopathies, α - and β -thalassemia are common throughout the world. β -thalassemia is an autosomal recessive disorder of β -globin gene and about 7% of the global population are the carriers of this genetic trait. In Indian subcontinent, 2-3% of the general population and as high as 17% of certain high risk communities are affected by β -thalassemia. App. 20,000 children are born each year in India with β -thalassemia major³. Prenatal diagnosis

holds the key role in prevention of this disease. Diagnosis of β -thalassemia in the 1st trimester by DNA analysis is a popular test because of the safety of termination of pregnancy if needed. The identification of the mutations in the parents and the foetus is carried out using various techniques. Altogether 785 mutations are already identified in β -globin gene and its flanking regions, of which 232 mutations are in β -globin gene causing phenotype of β -thalassemia⁵. B-globin gene cluster is a segment of DNA on chromosome 11 in humans which is about 60 kilo basepairs long. The four related genes are arranged sequentially :

ϵ gene----- δ gene----- γ gene----- β gene

During embryonic development, these genes are switched on and off by selective methylation and demethylation of the genes (Epigenetics). The chronological order of expression of these genes from the conception to child birth is ϵ to δ to γ to β -globin sequence. Though fetal hemoglobin may persist after child birth, this genetic abnormality is known as Hereditary Persistence of Fetal Hemoglobin (HPFH). Both point mutations and insertion/deletion of DNA sequences are known in β -globin gene. The correlation between genotype and phenotype are

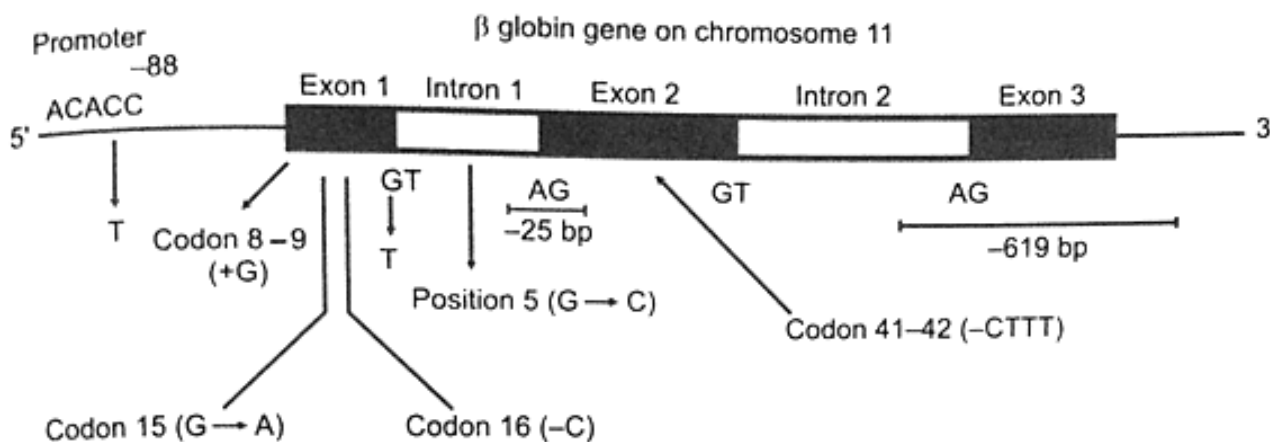


Figure 1 : Schematic representation of β thalassaemia mutations frequently observed in Asian Indians⁶.

Mutation analysis of three high risk groups of western India (n=371).

Mutations	Maharashtra	Gujarat	Sindhi	Total (Percentage)
IVS I,5(G>C)	159	56	3	218(58.7)
619 bp Del	3	18	36	57(15.4)
C15(G>A)	24	1	-	25((6.7)
IVSI,1(G>T)	-	9	14	23(6.1)
FS 8/9(+G)	-	4	10	14(3.8)
C30(G>C)	5	1	-	6(1.6)
Unidentified	6	-	-	6(1.6)
FS 41/42(-CTTT)	1	2	2	5(.1.3)
FS 16(-C)	1	3	-	4(1.0)
IVS II ,837(T>G)	4	-	-	4(1.0)
C30(G >A)	1	2	-	3(0.8)
IVSI,1(G>A)	2	-	-	2(0.5)
Cap+1(A>C)	1	1	-	2(0.5)
C5(-CT)	1	-	-	1(0.25)
IVS II,1(G>A)	1	-	-	1(0.25)
Total	209	97	65	371

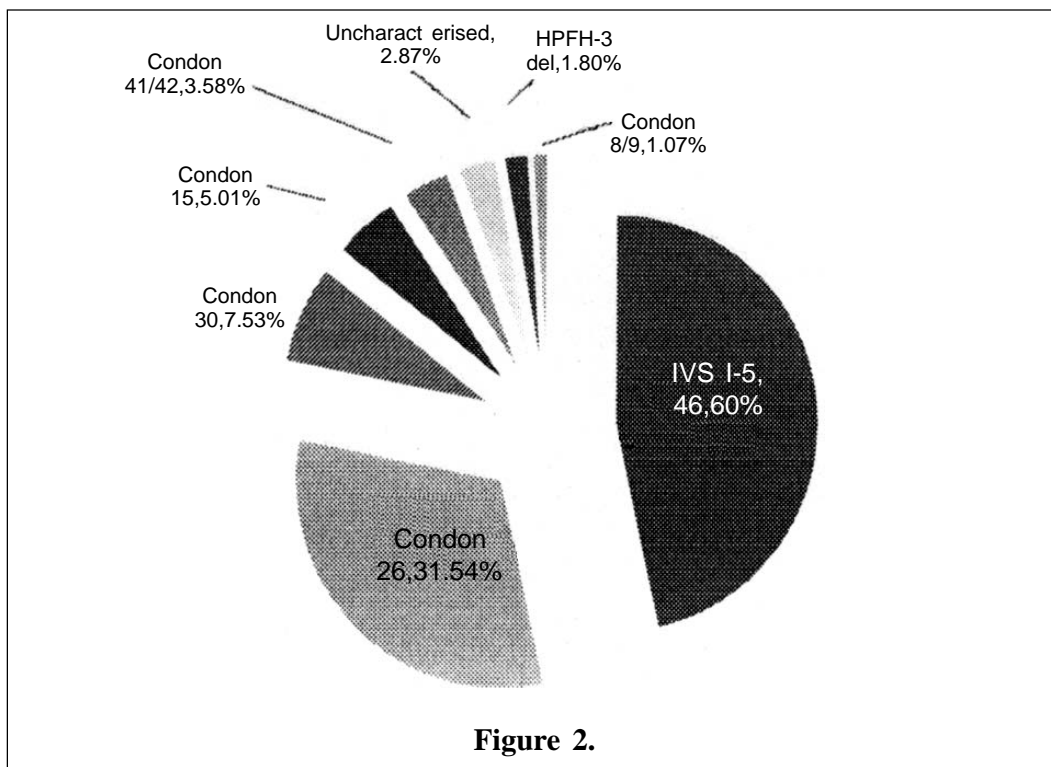


Figure 2.

known in some cases of β -thalassemia but a lot remains to be understood.

The most common mutation found in β -thalassemia both in western and eastern India is the point mutation G>C at position 5 in the first intervening sequence (IVS I, 5). The next most prevalent mutation is the deletion of 619 basepairs in the 3rd exon of β -globin gene in Sindhi population.

5' flanking sequence-----Exon 1-----IVS 1-----
Exon 2-----IVS 2-----Exon 3---3' flanking seq

The two intervening sequences or introns separating the three exons should be spliced out during the processing of the heterogeneous nuclear (hnRNA) or pre-mRNA. But splicing defects due to mutations in or around the splice junctions produce abnormal hemoglobin. The following table from the article by Dr Chitra Thakur (Mahadik) published in Cardiovascular & Hematological Agents in Medicinal Chemistry (2012) gives the distribution of the mutations in three groups of high risk population of western India (Total n = 371).

This study was carried out at Wadia Hospital, Mumbai with patients from Maharashtra, Gujarat having a sizable Sindhi population. A similar study was carried out at Kolkata⁴ with Eastern Indian population (n= 660). The distribution of the different mutations is somewhat different

(Fig.1) but the most prevalent mutation is the same IVS I-5 (G>C) all over India. However, not all the mutations were covered in both the studies.

Of all the genetic diseases encountered in India, hemoglobinopathies are the most common. Alpha and beta thalassemia and sickle cell anemia are more common in Mediterranean countries as well as in American black population. Indian subcontinent also faces this dreaded disease, for which blood transfusion is the only remedy. However, gene therapy to correct the mutational defects is a distinct possibility and in future, it should be the alternative and permanent solution for the affected people.

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REVISITING EARLY YEARS OF COMPUTATION AND THE INSTALLATION OF HEC-2M THE FIRST COMPUTER IN INDIA

Devaprasanna Sinha

The first computer HEC-2M came to India way back in the mid-fifties of the last century. Though much has been said and much remains to be told on these scores, the present article venturing in details, some of the scenarios prevailing at that time and the role of PCM before the installation of HEC-2M and also, around the installation and usages of HEC-2M in those days, hitherto untold.

INTRODUCTION

More than the last seven decades have witnessed the tremendous proliferation of computers and information technology in all parts of the world. Our lives and works have changed considerably. People use the terms 'computer revolution', 'internet evolution' these days from time to time. We have experienced and are still experiencing the impact and effectiveness of the digital significance in the days of Corona virus. We remember on several occasions, the continuing exercises of many personnel engaged in different aspects of this study and practice all over the world. This is all the more true now to revisit those years, for the benefit of posterity of young generations.

Prasanta Chandra Mahalanobis (PCM)'s pioneering role in computing and more so, in the design and development of modern computers in India is less known and less talked about compared to his works in other disciplines. The first computer HEC-2M came to India way back in the mid-fifties of the last century and the acquisition of the same resulting in the

development of numerical methods owe to PCM. Though much has been said and much remains to be told on these scores, the present article attempts to write in details some of the scenarios prevailing at that time and the role of PCM before the installation of HEC-2M and also around the installation and usages of HEC-2M in those days, hitherto untold.

PCM was born on 29 June 1893. PCM, though studied and taught Physics at the College level, he is best remembered as a renowned Statistician, for the Mahalanobis distance, a statistical measure and for being one of the members of the First Planning Commission of India. In his life of 79 years (died on 28 June 1972), he was actively and passionately involved in various programmes, including several literary activities and his Brahma linkages. He founded the Indian Statistical institute (ISI) in early thirties of the last century and contributed to the development of large scale sample surveys in India. The ISI was the first institution in India to have acquired and installed an electronic computer in the mid-fifties of the last century. The installation and later its widespread application facilitated many developmental projects.

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GENESIS, EARLIER SCENARIOS

During the 1920s, in fact till the middle of the 1930s, all or nearly all the statistical work done in India was done single-handedly by Mahalanobis. The early statistical studies included analyses of data on the stature of the Anglo-Indians, the meteorological data, the rainfall data, the data on soil conditions etc. Some of the findings of these early studies were of great impact on the control of floods, agricultural development *et al*, and led to the recognition of statistics as a key discipline.

The pioneering work on crop yield estimation done by the ISI attracted the attention of Prime Minister, Jawaharlal Nehru, who desired that a comprehensive information relating to social, economic and demographic characteristics be collected by conducting sample surveys on a countrywide basis. The ISI was directed by the government to take charge of the design of these surveys and of processing of data thereof. The National Sample Survey (NSS) was established in 1950. This led to the regular conduct of the most comprehensive sample surveys in the world at that time, under the guidance of Mahalanobis, by NC Chakravarti, JM Sengupta, DB Lahiri, Nimai Lal Ghosh, Mohanlal Ganguli, Ajit Dasgupta and S Raja Rao.

We are all familiar with number crunching, data mining and the use of supercomputers today. How did people handle large calculations before the advent of modern computers? They simply employed people who could compute or calculate. Such persons were called 'human computers.' PCM employed 'human computers' in his pursuits of statistical studies in the early twentieth century. From using human computers in 1920s, Mahalanobis graduated to mechanical calculating devices. Much before he founded the ISI in Kolkata in 1931, he had installed a mechanical

tabulator at his own expense at his home to help him in statistical calculations. Mahalanobis was the first Indian to have recognized the importance of using tabulating machines for scientific work. Once ISI was established, he introduced the use of mechanical desk calculators. Having realized the importance of mechanical calculating and tabulating devices, including unit record machines, Mahalanobis wanted to start local assembly and manufacturing of such equipment because it was difficult to import. This led to establishment of the Indian Calculating Machine and Scientific Instrument Research Society by Mahalanobis in September 1943. ISI had a full-fledged workshop for repair and maintenance of calculators.

In 1950, Mahalanobis consolidated computing related activities under the umbrella of an Electronic Computer Laboratory at ISI, with the objective of taking the next logical step – development of an electronic computer. He met Samarendra Kumar Mitra, a computer expert, in UK in July, 1950 and asked him to join IST. He engaged Samarendra Kumar Mitra and Soumyendra Mohan Bose to design and fabricate an analogue computer which could solve linear equations required for regression analysis. Importing components was still a difficult task, so Mitra and Bose had to look for used and discarded parts from junkyards in the city. The upshot of this effort was India's first 'analogue electronic computer' in 1953. The invention was announced in scientific journals and Prime Minister Jawaharlal Nehru visited ISI to see the achievement in December 1953.

While building up the indigenous capability in computing, Mahalanobis stayed in touch with contemporary technologies and scientists working in this field globally. He visited the Harvard Mathematical Laboratory met John von Neumann

and Howard H Aiken who were working on electronic computers. He was in touch with John Desmond Bernal, a Professor of Physics and crystallography at Birkbeck College, then working with Donald Booth, another pioneer in electronic computing.

Such friendships with leading scientists resulted in ISI acquiring some of the newest computers, such as the Hollerith Electronic Computer (HEC-2M) designed by Booth for British Tabulating Company. Just a handful of such machines were sold globally, and the one at ISI was Asia's first in 1955. In 1958, Mahalanobis used his connections with the Soviet Science Academy to get another large computer – Ural – installed later and funded under the United Nations Trade Assistance Programme.

The Board of Economic Enquiry which was set up by the Government of Bengal in February 1934 turned over to the Statistical Laboratory for analysis of a large amount of data collected by them in 1933-34 and sanctioned Rs. 975 for this work

The analysis was conducted under the supervision of PCM who had been appointed as a Member of the Board.

Preliminary analysis was completed during the period May to September 1934.

The work on computation started in ISI during this time, i.e. in 1934. Sudhir Kumar Banerjee was in charge of the computation and the general section. He worked out certain auxiliary tables for facilitating statistical calculations. There were others who assisted him.

As records show, examinations on Computers were held on a regular basis. In fact, ISI'S First Examination of Statistician's Diploma and Computer's Certificate Examination was held during 22-26 April 1938.

In 1945, the transfer of the entire Hollerith equipment including Tabulating and Multiplying Machines and Punching Units to Baranagar facilitated the work in projects like Population Data Enquiry, Enquiry into the Economics of Road Transport, Bengal Crop Survey, Bengal Rehabilitation Survey, Calcutta Diet Survey, Bengal Labour Enquiry and several other socio-economic enquiries. The number of computer months turned out were 3255.; this was exclusive of the work turned out by using the Hollerith equipment which was over 1500 computer months during the year.

The Hollerith Section first was opened in March 1944 at Cornwallis Street and was transferred to Amrapalli, 87 B T Road and was fully organised in November 1945. This section rapidly expanded its activities and possessed two 80-column Sorters, one Tabulator, one Multiplier, 15 Key Punchers and 13 Verifier Punchers. In addition to the above, 40 Hand Punches and an Automatic Summary Punch had been ordered, as per records. Hollerith Section had the power machines like Tabulators, Sorters, Reproducer and Multiplier.

The first installation of IBM machines in India was made in ISI. Machine Tabulation Section, a number of B T M (Hollerith) machines, e.g. 2 tabulators. 1 sorter and a collator were given up and IBM machines were installed, viz. 2 tabulators (of which one with alphabetical feature), 1 sorter, 1 collator, 1 reproducer (with mark-sensing device), 1 calculating punch, 1 Electronic Statistical Machine together with a summary punch and 1 Electric Alphaprint punch. Besides the expansion of the Machine Unit, a new unit of this section named the Technical unit was constituted to check up the work done on the Punching Unit and the Machine Unit. Gradually a good workshop was built up which

took over the servicing and repair work of all desk calculators of the Institute. Besides routine repair and servicing work the workshop continued with the developmental work on the manufacture of manual calculating machines. The numerous press tools necessary for the manufacture of such machines were constructed and components for a proto-type machine were fabricated.

In view of the drastic curtailment and cessation of import of calculating machines, PCM took initiative for repairing and constructing calculating machines in India.

The Council of ISI resolved and agreed on 30 April 1943 to establish one non-profit making society in the name of Indian Calculating Machines and Scientific Instruments Research Society. It was registered under the act of 1860 and work started.

Later on, for sampling and quicker enumeration of statistical analysis, he initiated the National Sample Survey which was started in 1950 by ISI, on behalf of Government of India, particularly at the instance of Prime Minister Jawaharlal Nehru, and in collaboration with Gokhale Institute of Politics and Economics, Poona. ISI started the vast project, namely, the Design and Analysis of the Data of the National Sampling Survey, which was collecting comprehensive information relating to social, economic and demographic characteristics on a countrywide basis in the form of two rounds of survey every year covering both rural and urban areas. The first NSS round was started in October 1950 and was completed in March 1951 - took a sample of 1883 villages. Much later in 1970, ISI Council took a note of the Government letter containing a resolution regarding the reorganisation of NSS and the tentative proposals of the Government in respect of the NSS Staff and a portion of the common service staff. NSS

had been taken over by Government of India, a bit later, after several negotiations and agreements on 1 June 1972.

The sense of urgency in computation with regard to analysis of data helped bring about the innovation of the first analogue Computer in 1953. Samarendra Kumar Mitra who went abroad with a UNESCO fellowship to study electronic computers, stated the Unit in 1950 with the help of a part-time technician. The need for high speed computations led to the establishment of Electronics Laboratory on experimental basis in 1950. The Research Group rendered useful services by tackling problems that arose in connection with large scale of complex tabulations

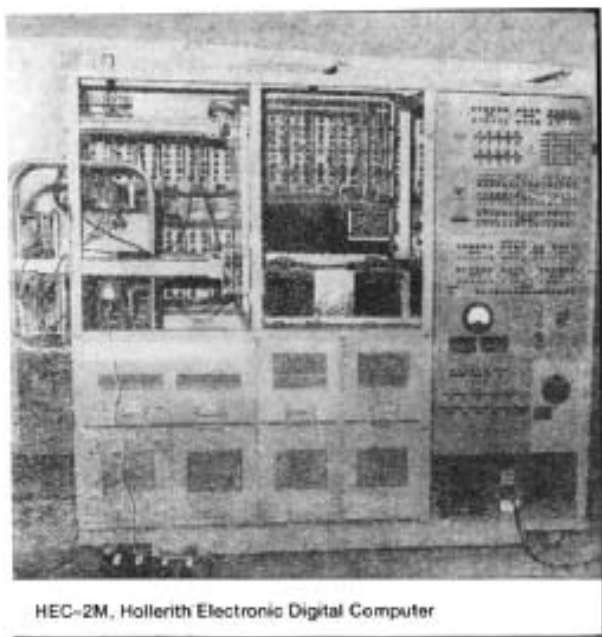
Later he was assisted by Debdas Chaudhuri, Amaresh Ray, Ashis Sen, Ajoy Sen, Mrinal Kanti Pal, Prabhat Kumar Mitra, D S Kamat, Dwijesh Dutta Majumder, Jnan Saran Chatterjee and Soumeyendra Nath Bose.

Way back in 1953, Mr N K Roy attended a course as a Trainee in Unit Record Machines (URM) at ISI, Kolkata, and in course of time, got acquainted myself with the panel wiring of various applications. According to him, , "...at that time, there was a system called Powersemes. Many applications were done using URM. We learnt that and spent almost 24 hours at ISI. I still remember the 45 column car punch.... "

PCM was one of the one of the very few persons in India to recognize the importance of computer technology and its uses, particularly in the academic institutions. The physicist-turned-statistician, in fact, played a key role in the advent of design, development and use of modern computing machines in India. His work in computing precedes the efforts of Homi Jehangir Bhabha who also needed modern computers for research relating to atomic reactors. Mahalanobis'

contributions led to development of capacity and skills in computing necessary for statistical research and applications.

HEC-2M



HEC-2M, Hollerith Electronic Digital Computer

In 1950 PCM planned to purchase Hollerith Computer. In August 1950, he met Thomas Watson Sr, IBM President and talked about MARK-I , automatic high speed calculator/ electromechanical computer. . A small electronic digital computer HEC-2m (Hollerith Electronic Digital Computer-2M) produced by British Tabulating Machine Works, Letchworth Ltd, UK had been ordered in 1954.

Monimohan Mukerji (also known as Mohi Mukerji) and Amaresh Roy completed their training in the British Tabulating Machines Works at Letchwork and visited different computing machine laboratories in Europe and returned to India in early 1956.

Technically, India's first computer was a small analogue device *built* in 1953 at Calcutta's Indian Statistical Institute. It was used to solve linear equations. But a year or so later (c.1954–1955),

the institute imported a British-built HEC-2M for a princely sum of ¹ 10 lakh and it is this device which is considered India's first true computer. The computer was a behemoth measuring 10 feet in length, 7 feet in breadth, and 6 feet in height. It had no keyboard, monitor, or even a processor, and was armed with a generous 3KB worth of memory. Input was fed into it using punched cards and output was printed out via an attached printer. This was specially crafted and designed by Professor AD Booth at Birk

Bak College in the UK. The computer took around 15 minutes to calculate the square root of a 16-digit number. But it was still used (among other things) to solve complex differential equations sent to the institute by Homi J Bhabha of the Tata Institute of Fundamental Research (TIFR).

The HEC-2M was received in February 1956 and installed by Mohi Mukerji and Amaresh Roy in about a month in an AC room situated on the ground floor of the Institute building. It was ready for operation by the end of March 1956. Thus how the first electronic computer to be installed in India.

The HEC-2M was part of the *APE(X)C*, or *All Purpose Electronic (X) Computer* series designed by Andrew Donald Booth of Birkbeck College in London and manufactured by the British Tabulating Machine Company. The "HEC-2M" stood for *Hollerith Electronic Computer (model 2M)* with the M denoting that the machine was 'marketable' and suitable for commercial use.

With the undertaking of large-scale projects and surveys, computational facilities also started improving. The ISI was the first institute in India to have acquired an electronic computer. The Hollerith electronic computer, HEC-2M, was in operation at the ISI since 1956. Acquisition of

this electronic computer resulted in the development of numerical methods and facilitated data processing

ISI staff not only maintained the HEC-2m Computer but also designed and carried out a number of modifications and attachments which had considerably increased its speed and reliability. BTM did not provide any manual except a circuit diagram and measured voltage-values at chosen nodes. Amaresh Roy and Mohi Mukerji arranged in-house learning sessions and soon made in-house manuals and programmers started inventing their own tricks, for instance, programs for floating point arithmetic.

Workers like Reba Bhattasali, Asish Maity, Deb Kumar Bose, Ajit Halder, Amal Roy (Past Chairman, CSI, Kolkata Chapter) comprised the first batch to master the user-unfriendly art of binary machine language programming. Mukerji and Roy did a lot of work on floating-point arithmetic.

SPECIFICATIONS, COST, DELIVERY, INSTALLATION

In March 1951, the British Tabulating Machine Company (BTM) sent a team to Andrew Booth's workshop. They then used his design to create the Hollerith Electronic Computer 1 (HEC 1) before the end of 1951. The computer was a direct copy of Andrew Booth's circuits with extra Input/output interfaces. The HEC 2 was the HEC 1 with smarter metal casings and was built for the Business Efficiency Exhibition in 1953. A slightly modified version of the HEC 2 was then marketed as HEC2M and 8 were sold. The HEC2M was succeeded by the HEC4. Around 100 HEC4s were sold in the late 1950s. The HEC used standard punched cards; the HEC 4 had a printer, too, and it featured several instructions (such as divide) and registers not found on the APEXC.

Brief specifications of HEC-2M

Word capacity : 32 binary digits inclusive of sign

Address code : One plus one address

Memory capacity : 1024 words.

Number of orders : 16

Memory : Magnetic drum (serial), speed 300 RPM, 64 tracks, 16 words in each track

Input : Standard 80 column Hollerith cards; data cards punched in decimal, instruction cards punched in binary.

Output : Also punched cards.

India bought its first computer in 1956 for a princely sum of Rs 10 lakh.

(Letter from Archives : 21st June 1954)

From the British Tabulating Company Limited, London

....the price of the equipment ex Letchworth is as follows: -

Hec2M with type 581 Feed and type 582 pinch output £ 16, 500.)

It was nothing more than a number crunching machine and was huge in size. The dimensions of this monster were 10 ft in length, 7 ft in breadth and 6 ft in height.

It went on to turn out India's first generation of computer professionals. It was at least ten thousand times slower in solving even simple problems than today's machines. But it set the stage for the development of computers in India. It was maintained and its operational speed was doubled Institute engineers.

APPLICATIONS AND USAGES

We reproduce the first paragraph from a paper by Amaresh Ray entitled "ELECTRONIC DIGITAL COMPUTER -HEC2M".

"The small general purpose HEC2M purchased from the British Tabulating Machine Co. Ltd., England, arrived at the Indian Statistical



Institute, Calcutta on the 7th February 1956. The installation work took little over a month and the machine was put on commission for regular work from the middle of April 1956. Since then, quite a considerable amount of valuable computation work has been done on the machine – important among the matrix inversion and other computations in respect of large-order matrices, solution of differential equations, computations for Fourier analysis, determination of correlation factors, scrutiny of statistical data under various criteria, making of function tables and others...”

Journal of the Institution of Telecommunication Engineers, Vol. 4, No. 3, pp. 137-142

Some highlighted works were :

- Track switching problem
- Use of 1024-word capacity memory drum.
- Modification of relay tree
- Automatic track delay circuit
- Development of new circuits to provide additional facilities

The fast multiplication circuit

Professor Mohi Mukerji wrote later : BTM (British Tabulating Machines) agreed to sell their machine, called the HEC-2M (Hollerith Electronic Computer model 2M) to ISI but would not undertake either to install and commission it or to maintain it in India. ISI appointed two engineers in December 1954, Amaresh Roy and the present author..Roy and I were back by mid'55 from UK and the crates containing the HEC-2M arrived in late July 1955. We lost time and HEC-2M was operational by end August 1955.

R & D work began in Jan 1954 to construct an Electronic Digital Computer using a magnetic drum as high speed memory unit. 1954-55. The maintenance of desk calculators of different types has continued as usual. More than 730 calculators were reported in 1954-55. The prototype model of the desk calculator designed in the Workshop was completed in Nov 1954. The precision work for transferring information from 65-column Power-Samas punched cards to 80-column IBM cards was successfully completed. The development work on the punched card sorter machine was well under way in 1957-58.

This account will be complete if we do not mention the names of Reba Bhattasali and Asish Maity who tended and operated the machine with loving care, and the above two and Deb Kumar Bose, Ajit Halder and Amal Roy who comprised the first batch to master the user-unfriendly at of binary machine language programming.

It played a critical role in formulating annual and five-year plans by the planning commission, and in top-secret projects of India's nuclear program. Further developmental work was continued which led to the construction of a prototype desk calculator in 1954 and magnetic drum and electronic equipment and accessories for electronic computers from 1955.

A high-speed electro-mechanical sorter was designed and constructed in 1958. About 8 or 9 such sorters have been constructed. "Since then, some of which have been in operation in the Army Statistical Office for more than a year and others within the Institute. These sorters are giving entirely satisfactory service.", as per a Report in the Archives. An improved unit Record Sorter was designed, constructed and small batch was produced. Some were used by ISI, some were used at Army Statistical Office in New Delhi or other places. A prototype desk calculator designed and laboratory model we constructed.

NAMES AND NATURE OF JOBS, ACADEMIC AND OTHER ASSIGNMENTS

Scientific problems poured in from all parts of the country, including a lot of work from the Defense, mostly for trajectory analysis for artillery cannons.

The HEC-2M also played a pivotal role in the statistical data processing that formed the bedrock of the five-year plans. India's weather forecasting model, too, based on statistical analysis of meteorological data, was developed on it.

It may not be out of place to write a little bit of installation of another computer URAL-1. In the summer of 1954, PCM and SKM went to USSR to explore possibilities of securing electronic equipment from SSR. A number of Soviet expert - D Y Panov, B A Ditkin and others came to to ISI in the same year and

discussed the possibilities of building a large scale computer to meet requirements of the Institute. In 1955 Government of India arranged through United Nations a large electronic computer URAL-1 and was installed in December 1958. The detailed of the installation of URAL-1 require a different story, though the usages are, in many cases, are common.

HEC-2M and URAL-1 used not ISI alone but by many other organisations such as Ministry of Defence, the Atomic Energy Dept, TIFR, a large number of universities etc. during the period of 1956 to 1963 and later.

It is not possible to list down all the applications and works undertaken in HEC-2M and URAL-1. This list is not exhaustive but varied.

Some of the typical problems are listed here :

-Fourier analysis, 64 constants for each of 18 sets of data – IACC

-A problem on elasticity reducible to evaluation of determinant - IISc, Bangalore

-A set of seven functions (algebraic and trigonometrical) each for 600 sets of data on cosmic-rays - PRL, Ahmedabad

-Solution of eigen-value like problem of a non-linear differential equation – TIFR, Bombay

-Latent roots of real symmetric matrices of orders : 6,12,16,22 and 28 - Andhra University, Waltair

-Numerical integration problems – Def. Res. Lab., Kanpur

-Determination of latent roots of a real symmetric matrix of order 7 - Banaras Hindu University

-Evaluation of two-functions of equations for a rotational flow of a non-Newtonian fluid – IIT, Kharagpur

-Linear programming problem on large range economic models - Mr J Sandee, UN expert to ISI

- Least square solutions of 32 linear equations in 9 variables for flood prediction - Dr N K Bose, Flood Research, West Bengal
- Eigen-values of real symmetrical matrices upto an order of 28x28 – Saha Institute of Nuclear Physics, Calcutta
- Mean, standard deviation, correlation coefficients of rainfall data of 65 stations – Meteorological Department, Government of India
- Calculations for the design of the Surge Tank of the Jaldhaka Hydroelectric Project – Bengal Engineering College, Shibpur
- Roots of a 9th degree equation with two variable parameters – Prf. J B S Haldane
- Ballistic Trajectories – Armament Research Establishment, Ministry of Defence, Poona
- Energy spectra of atmospheric turbulence - Atomic Energy Establishment, Trombay, Bombay
- A number theory problem – Punjab University
- Numerical integration for a problem of solid state physics – Science College, Calcutta University
- Non-linear differential equations – Maulana Azad College, Bhopal

CONCLUSION

Both HEC-2M and URAL-1 were used well till 1964 when IBM installed the 1401 at ISI Calcutta and with that event, India's first two computers were given a rest. As a result, India's first digital computer was unfortunately scrapped in the mid-1970s. Later both were dismantled and thrown irretrievably in some godowns long back.

One can also say that ISI was the first in India to turn out trained programmers.

The author would like to put on record some names here, besides the names mentioned earlier:

T T Krishnamurthi, Ambarish Ghosh, E V Krishnamurthy, Dwijesh Dutta Majumder, Ranen Bihari Banerjee, S K Dutta, Mrinal Kanti Paul, Biswaranjan Nag, Biswajit Nag, Prabhat Kumar Mitra, Mohit Kumar Roy and earlier periods, N K Roy, Amal Roy, A K Raychaudhuri, J V Ranga Rao, P C Palit, A K Roy and others who received formal training at ISI, called certificates training on EDP and Unit Record Machines, at that time. They all were paid some stipends in attending and working there after graduation and/or postgraduation, besides also others associated formally worked there from departments of statistics, physics, applied mathematics and allied disciplines.

At the end, I must mention the name of The Charles Babbage Institute (CBI) is a research center at the University of Minnesota, USA specializing in the history of information technology, particularly the history of digital computing, programming/software, and computer networking since 1935.

The Computer History Museum in Mountain View, California, USA is the world's largest museum dedicated to computers and computing devices. Unfortunately, in India, there is hardly any Museum that houses the significant parts of yesteryears computers and other equipment.

ACKNOWLEDGEMENTS

At the outset, I must thank Dr Nibedita Ganguly, Former Deputy Librarian, ISI, Kolkata, who have given the opportunity to access various relevant pages available in Professor PRASANTA CHANDRA MAHALANOBIS Memorial Museum and Archives so as to enable me to deliver lectures in different platforms on varied topics, including one at ISI. I am grateful to Professor Dilip Kumar Sinha, former Upacharya, Visva-Bharati, who have provided many writings, from time to time, and for the constant

encouragement and discussions to prepare this note.

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MALARIA - A JOURNEY REVISITED

Bireddy Srinivasa Reddy* and Pramod Kumar Dubey**

Malaria has been one of humanity's oldest and deadliest diseases. Malaria is caused by the bite of an infected, female, anopheline mosquito. Mosquito is at the root of several vectorborne diseases including malaria. The mechanism of spread of malaria in the human body has been well studied. Symptoms show up based on the type of organism involved in infection. Eradication of malaria and related diseases depends on eradication of the mosquito. Treatment options involve drugs, natural and synthetic, of which chloroquin occupies the prime position.

INTRODUCTION

General : Malaria has been one of mankind's most dreaded, crippling and, at times, lethal diseases. The history of malaria is as old as mankind itself¹. In modern times, malaria affects several countries of Latin America, Africa and Asia. It is very common to tropical and subtropical regions, being less common in countries with snow bound areas, desert climates and very cold climatic conditions². More than 500 million people have died on account of malaria and an even greater number have suffered ill-health from the disease in the last 100-150 years or so². About 20 million people suffer from this disease annually, in India alone³, although exact figures cannot be given or documented because most patients opt for treatment in private/corporate hospitals in cities and lesser number go to Government hospitals, most notably in rural & semi-urban areas. As a result, many clinically treated cases are not documented clearly. As of

now, year-wise and country-wise statistics are not available but even vague approximations of casualties make malaria dwarf all other diseases. Besides causing harm to the health of the person and his family, malaria severely reduces the work capability and efficiency of persons thereby doing great damage to society in economic terms. The losses suffered by countries during malaria epidemics in socio-economic terms are unestimable¹.

Causes : Malaria is caused by the bite of a female anopheles mosquito on human beings⁴. There are several species of mosquitos known today, over 3000 of them, and the anopheles mosquito is one of them. Incidentally, the male anopheles mosquitos do not show any tendency to feed on vertebrates/human blood. The female anopheline mosquito is a nocturnal feeder, i.e., bites only during night times⁴. Flying at one mile per hour, it senses exhaled carbon dioxide or heat/infrared radiation reflected from the skin of the person to zoom in on its target i.e., you and me⁴. The female mosquito does this because she feeds on the protein found in the blood to survive and to develop her eggs. The other species, "Aedes

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aegypti” and “Aedes albopicto” mosquitos, are day feeders causing other choicest ailments like Dengue Fever and Chikugunya whereas Yellow Fever, Japanese Encephalitis etc. are caused by the “culex” mosquito.

Spread of the disease : The name “malaria” is derived from the Latin name “malaria” meaning bad or foul air. During winter season, the mosquito populations grow in huge numbers as the weather, especially in tropical countries, is very favorable for the growth of mosquitos. The winter season comes immediately after the rainy season when large quantities of water ponds are formed due to stagnant waters leading to accumulation of dirt, filth and microorganisms in them. These ponds often produce a foul/peculiarly-unpleasant-smelling air. The female mosquitos, especially the anopheline type, find these ponds/water bodies suitable breeding grounds for laying down their eggs. It is while incubating on these eggs that the protozoal microorganisms in water ponds/bodies, especially of the type “Plasmodium”, enter into the bodies of the anopheline mosquitos. Once entered into the body of the anopheles mosquito, the protozoal microorganisms are stored in the stomach/belly of the mosquito from where they migrate into the salivary glands⁵.

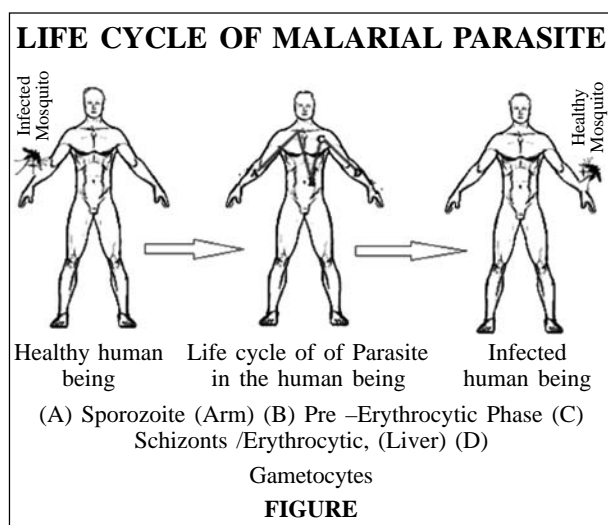
The body of the mosquito seems to offer excellent resting place for these micro organisms. When the female anopheline mosquito bites a human being, the organisms are transferred from the mosquito to the human being. Malaria is thus caused by the protozoal microorganism “Plasmodium” and mosquito is only an insect-vector carrying the organism from the water pond to human body. Alternatively, malaria may also be caused by the bite of a “healthy” anopheline mosquito on a malaria-infected human being and then a second bite by the “freshly” infected anopheline mosquito on another “healthy” human being.

This discovery⁶ was made by Major Ronald Ross in Aug 1897 when he was posted as a British Army Surgeon at Secunderabad Cantonment in the then “Hyderabad Deccan” part of India, under a treaty signed between the British Indian Government and the then Nizam (i.e., ruler of the erstwhile Hyderabad State of India). For this discovery, Ross was honoured⁶ with the coveted Nobel Prize in Physiology or Medicine for the year 1902. It is believed that “Plasmodium” organisms do not survive in the bodies of other animals/creatures like chicken, goats, dogs, cats or even flies etc and so the latter cannot act as carriers/vectors of this disease. Even if water contaminated with “Plasmodium” from a pond or even if water from a container in which malarious mosquitos have died is drunk by a healthy human being, malaria does not occur. Malaria is caused by the bite of a mosquito and mosquito alone, wherein it transfers “Plasmodium” from its salivary glands into the blood of a human victim—man, woman, child, adult or Senior Citizen. By logic, this also implies, malaria to be a noncontagious disease.

Life cycle of Malarial Parasite : A “parasite” is a species responsible for causing a particular type of disease or ailment or a biological condition. (Literally, a parasite means an unwanted guest who creates trouble for its host). Malarial parasites i.e. the Plasmodium group have a very complex life cycle and can exist in many different forms like sporozoite, schizont, merozoite, trophozoite and gametocyte. These forms vary in terms of the structure of their cell's constitution and different stages of evolution. When a human being is bitten by an “Anopheles” mosquito, the parasite is introduced in its sporozoite form. The latter rapidly invades the liver where it matures first into a schizont form and then into a merozoite. The merozoite form of the parasite leaves the liver and then invades

red blood cells (Erythrocytes). Within erythrocytes, the merozoite is sequentially transformed into a trophozoite, then into a schizont and finally back to a merozoite which ruptures out of the erythrocyte to moulate other erythrocytes. Within the erythrocyte, some merozoites also develop into gametocytes which are taken up by mosquitos, whereby they are matured back into infective sporozoites—thereby initiating the infective process, in a cyclical form, all over again⁷. This circuitous life cycle, shown in Figure, drawn below, is used very advantageously for targeting the disease using a variety of anti-malarial drugs.

Types of Organisms : The organisms normally responsible for malaria belong to the genus “Plasmodium” which belongs to the class of protozoa known as “sporozoa”. Of these, there are four different species which are believed to be responsible for human malaria. These are Plasmodium malariae, the parasite of quartan malaria; Plasmodium vivax, the parasite of benign, tertian malaria; Plasmodium falciparum, the parasite of malignant or subtertian malaria and Plasmodium ovale—the parasite that causes a mild type of tertian malaria. The feverish effects caused by various species of plasmodium in human body are shown below :



- P. vivax* : Widely distributed throughout the world; New generation of merozoites formed every 48 hours; Fever comes every third day in the patient.
- P. ovale* : Found in West Africa and South America; New generation of morozoites formed every 48 hours; Fever comes every third day in the patient.
- P. malariae* : Found in tropics and temperate zones; New generation of merozoites formed every 72 hours; Fever comes every fourth day.
- P. falciparum*: Found in tropics including India; Very dangerous; shows lot of resistance to several conventional drugs; Fever comes every day.

Prevention and Treatment of Malaria : It is obvious from the discussion given above that the great “Mosquito” is central to the cause and spread of malaria. You eliminate mosquito and you have eliminated malaria. However, this is more easily said than done. It is an irony of life that even the largest of animals like the gigantic “Dinosaurs” have vanished from the surface of the earth but not the “tiny mosquito” as shown by Steven Spielberg in the famous Hollywood feature film “Jurassic Park”⁸. Nevertheless, several mosquito eradication or control programmes have been undertaken by Governments all over the world. Removal of stagnant water ponds or water bodies coupled with effective mosquito control measures using insecticides like DDT etc., have been central to these programmes. Furthermore, use of mosquito nets, several commercially available anti-mosquito/mosquito-repellant creams, anti-mosquito smoke coils/agarbathis etc., at individual levels, have been adopted for effective prevention of mosquito bites. If, inspite of all these measures, a malarious mosquito were to

bite a human target making him/her malaria infected, a choice of drugs, synthetic and natural, are available now both for prophylaxis and treatment. Among the synthetic drugs, "Chloroquin", which should have been called "Chloro Queen," occupies the prime position as anti-malarial drug or the largest used drug compared to any antimicrobial drug known to man today. It may be mentioned here that Opium/Morphine has been recognised for centuries as the "Queen of Drugs" in view of its beneficial analgesic and narcotic activities. Nevertheless, chloroquin outdoes morphine in terms of its ability to save millions of lives over decades, tonnage and manufacturing challenges. Several other synthetic antimalarial drugs such as Amidoquin, Hydroxychloroquin etc. are structural modifications derived from a crucial intermediate used in chloroquin manufacture. Developed during the Second World War, chloroquin is a generic name as the drug contains⁹ in its chemical constitution a chlorine substituent attached to a quinoline ring. Chloroquin has the advantages of being less toxic compared to other anti-malarials, it is longer lasting and has the ease of administration. Today, India is a world leader in the manufacture, formulation and distribution of chloroquin despite the fact that chloroquin manufacture involves costly raw materials, sophisticated technology, rigorous quality control and serious environmental problems.

The synthetic antimalarials led by its prime candidate "chloroquin" did great service to mankind, over a period of decades, in the treatment of malaria even outdoing the natural drugs like "Quinine" and "Quinidine". The latter¹⁰ are plant products, alkaloidal in character and isolated, in relatively smaller quantities, from the bark of the Cinchona plant after a long and tedious extraction process. Prolonged use of synthetic antimalarials leads to "resistance" among most of the malaria types, especially the one caused by species Plasmodium falsiparum.

The latter was not only highly resistant strain of malaria but even proved to be lethal. Based on a request (around 1967-68) by Vietcong leaders during the Vietnam War, the Chinese authorities set out¹¹, as a Secret Project, for a natural cure for malaria. It may be stated here that Vietnam is a country, under the Mekong Delta, full of bushes and stagnant waters with a huge spread of mosquitos carrying Plasmodium falsiparum causing great fatalities among its soldiers at that time. Extensive and intensive studies were carried out by Chinese Scientists, led by Mrs. YouYou Tu¹¹, under a programme code-named "Project 523", to find a traditional-naturalherbal cure for malaria culminating in the discovery of "Artemisinin" (or Quinghaosu) in 1986. The latter is an active principle/chemical compound, a sesquiterpene lactone in chemical constitution, isolated from the plant "sweet wormwood" belonging to the family Artemisiaannua, called "Quinghao" in Chinese. Other semi-synthetic derivatives such as Dihydroartemisinin, Artemether etc. were also found to be antimalarials active against P. falsiparum. Dihydroartemisinin, obtained by the simple sodium borohydride reduction of the lactonic carbonyl group in artemisinin, was found to be ten times more active than artemisinin and also the bioactive metabolite. For her outstanding, dedicated and committed work, Mrs. YouYou Tu was honoured with many Chinese and international awards including the most coveted Nobel Prize (getting ½ the prize money on sharing basis) for Physiology or Medicine in 2015^{11,12}. Again, as in the case of any drug (natural or synthetic), resistance comes in sooner or later and so Artemisinin-based Combination Therapies (ACTs) are recommended for malaria treatment. Low bioavailabilities, poor pharmacokinetic properties and high cost are some of the disadvantages of artemisinins. (The present cost of Artemisinin is around Rs. 9000/- per 100 mg bottle).

Vaccine Development : There is an old adage which says “Prevention is better than Cure” and vaccines justify this saying most admirably. Vaccines are Medical Agents which have served mankind as one of the most effective means of preventing the spread of infectious diseases, most notably Smallpox, Polio, Measles and several others, thereby saving millions of lives. Vaccination involves inoculating/injecting the highly weakened/partially dead form of the pathogen so that the body quickly develops an ability (called immune response) to fight the organism and retains the structure of the pathogen in its memory for long time to come. In the case of malaria too, attempts have been made to develop a suitable vaccine. Considerable success has been achieved with the development¹³ of a vaccine called RTS, S known by its trade name “Mosquirix”. The latter has been found to fight against Plasmodium falciparum, which, of late, is very predominant in the countries of Sub-Saharan Africa especially afflicting children below 5 years. Developed over a period of 10 to 12 years by GlaxoSmithKline (GSK) Laboratories¹³, Belgium, on a No-Profit-No-Loss basis with a generous financial support from PATH Foundation and Melinda & Gates Foundation (both based at Seattle, Washington, USA), the vaccine is administered to children in 4 doses, first three smaller and the fourth one in booster form. The **R** stands for Repeat region of P. falciparum circumsporozoite protein (CSP), **T** stands for T-cell epitopes of CSP, **S** for hepatitis B Surface antigen and free “**S**” protein assembling to RTS, S. Approved by European Medicines Agency (EMA) in 2015 and launched by WHO under a UN subsidy programme, the vaccine has an efficacy of only ~ 50% at best¹⁴. This low efficacy is because Malaria is a complex disease with the parasite passing through multiple life stages/forms present in different body parts. Nevertheless, vaccine RTS, S or Mosquirix is in use because the benefits outweigh the risks.

Further work on malaria vaccines is in progress¹⁵.

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STUDIES OF SELF-RELIANT FARMING SYSTEM

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Adoption of self-reliant farming system (SRFS) helps to meet the requirement of plant nutrients, water, animal feed and energy from farm. Moreover, safe and fresh food produced with such system is useful in enhancing disease immunity.

INTRODUCTION

Now it is high time that we must know 'what we eat'. How the food grain, vegetable, fruit, fish, egg or the meat were produced in the farm, processed and finally reached our plate. A lot of discussion occurs regarding the adverse effects of pesticides on food, environment and beneficial organisms (honey bees and earthworms). Commercial food chain has helped in easy availability of a variety food products at door step. However, this has also promoted the use of agrochemicals during production, processing, packaging and storage. These processes are energy and transport intensive. Over use of agrochemicals and energy is traditionally criticized due to adverse effect on environment and human health. In this background, we have to re-look to system of food production and consumption.

According to Gandhi, "My idea of Gram Swaraj (self-governance at village level) is that it is a complete republic, independent of its neighbor for its own vital wants and yet interdependent for many in which dependence is necessity"¹. Gandhi's Gram Swaraj is man-centered, non-exploiting, decentralized, and a

simple village economy providing for full employment to each one of its citizens on the basis of voluntary co-operation and working for achieving self-sufficiency in its basic requirements of food, clothing, and other necessities of life. Every village should be a democracy in which they will not depend even on neighbor for major needs. People should be self-sufficient and no one should be without food and clothing. Gandhi's ideal village should be basically self-reliant, making provision for all necessities of life - food clothing, clean water, sanitation, housing, education, and other requirements, including government and self-defense⁴.

Recently, in the year 2018 we celebrated 150th birth anniversary of Mahatma Gandhi and the next year humanity faced the Covid-19 pandemic. Gandhian philosophy is more relevant today as humanity is suffering from low immunity to overcome the virulence of pathogens and also due to unavailability of food under lock-down. Environment is suffocating with pollution problems due to over dependence on chemicals and energy. A huge amount of energy (diesel as fuel for truck, production of packaging materials, loading and unloading, machineries, etc.) is

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consumed in production, packaging and transportation of agricultural products. We must minimize such unnecessary use of energy and agrochemicals. Global climate change and uncertain political and economic changes, especially after Covid-19 have serious implications on food availability in several countries. Employment generation for masses is another important problem. Self-reliant farming system is one option to get assured and healthy food involving mass employment. There is little chemical use in such farming. Loss in production of one component is compensated by production from another component of the farming system indicating stability and sustainability of such practice.

SELF-RELIANT FARMING SYSTEM

A self-reliant farming system is envisaged as a system where the requirement of water, plant nutrient, animal feed and energy is produced largely within the farm itself³ The dependence on external sources for meeting such needs is minimal. For achieving the objective of sustainable agriculture, there is a need to develop such a system which will conserve soil, water, and nutrients; and minimize the use of fossil fuels, chemical fertilizers, and synthetic pesticides. Organic farming practices are closer to such a practice on sustainability. One has to rely on crop rotation, animal manures, legumes, green manures, reduced tillage, mineral-bearing rocks, and biological pest control to maintain soil health and productivity, provide plant nutrients, and manage pests. In this system, *in-situ* water harvesting and use of solar energy reduces the requirement of external sources for meeting the water and energy need. This system is important in the context of increased population, cost of land, water, nutrients and energy.

PRACTISING SELF-RELIANT FARMING SYSTEM

Farm animals constitute one of the important components in self-reliant farming system. The sustainability of integrated crop livestock system relies on the complementarities between crops and livestock. Animal manure represents the main nutrient input in small holder farms. Compost or vermicompost production is very useful for soil health and good quality food grain, fruits and vegetables. Animal manure can also be used as low cost fish feed. Use of legume crops like green gram, black gram, grass pea, horse gram, cowpea, etc. after rice in rotation is useful for soil health and supplying 10 to 20 kg nitrogen per hectare (ha) for the next crop. Green manures are very useful for soil health when incorporated before rice crop. Growing of *in-situ* green manure crop of *Sesbania* for rice supplies at least 10-12 tonne (t) of fresh biomass/ha which upon decomposition provide about 45 kg nitrogen, 3 kg phosphorus and 12 kg potassium. Boundary plantation of *Glyricidia* may provide 10 t fresh vegetation from 4 cuttings of 500 trees @ 5 kg per tree. Fresh cowdung and bedding material from 3 cows and 1 calf may provide 14 t per year to meet the need for vermicompost (10 t) and fish feed (4 t). Maize stover and other crop residues may provide 4 t by-products for vermicompost production. Crop residues, cowdung and other wastes of biological origin (about 24 t) can be effectively recycled to produce 8 t vermicompost. This much vermicompost is enough for 1-ha crop area for meeting plant nutrient needs when used in combination with a green manure crop before rice. Cultivation of hybrid napier bajra in 1800 m² area (on dyke sides), 0.45 ha under spring/summer maize and 0.8 ha area for ground nut cultivation may largely meet feed requirement of 3 cows. Fish feed can be met from rice bran, oil cake and raw cowdung produced from a farm

family. Thus, a farmer may not depend on market for food and feed.

It is important that production of 1 kg N fertilizer (2.22 kg urea) requires 61 mega joule energy which is very energy intensive. Fertilizer alone accounts about 50% of total energy consumption in rice cultivation. Present day urea factories use natural gas as raw material. We know it is an exhaustible and non-renewable energy resource and is used for domestic cooking. It is largely imported from other countries and its price is rapidly rising. For one US dollar rise in natural gas costs, the cost of production for urea rises by Rs1.8 to Rs 2.0/kg. Similarly, the value of Indian Rupees is constantly decreasing in recent years, and for every one rupee depreciation against US dollar, the fertilizer manufacturing price rises by Rs 0.24/kg at a constant gas price. Actual cost of urea fertilizer manufacture is about Rs 22/kg. Government is providing a subsidy amount of Rs16.60/kg and the remaining amount of Rs 5.40/kg is paid by the farmer. Annual subsidy on urea fertilizer is around Rs 40,000 crore and our country is producing over 24 million tonnes (Mt) of urea. In spite of subsidy, average farmers face difficulty in purchasing chemical fertilizers from market. Also, fertilizer manufacture being an industrial process releases harmful gasses to atmosphere. Diesel consumption for transporting fertilizers to the individual farm releases toxic gasses like carbon monoxide (CO) and carbon dioxide (CO₂) to atmosphere. Moreover, continuous use of chemical fertilizers over activates soil microorganisms and soil organic matter level is depleted with concomitant decrease in crop yield. On the other hand, continuous use of organic manures under self-reliant farming system improves soil health and good quality fruits and vegetables.

Water reliance at farm level can be achieved in high rainfall areas through water harvesting

farm pond. If farm pond is excavated in a clayey soil, the rate of seepage percolation loss is minimal and water is retained up to April-May. On the other hand, extraction of ground water is energy expensive and constantly depletes the ground water resource in absence of enough recharge. Also, ground water is sometimes saline containing high salt or even may contain toxic concentrations of iron, arsenic, fluoride or heavy metals creating problem for crops, animals and human beings. Rain water is free from such problems. The cost on creating water harvesting farm pond can be compensated by multiple use of harvested water for crops, fish, animals and human beings. Creation of large number of water harvesting structures will also help in conserving water, soil and associated mineral nutrients which would otherwise be lost into ocean. This will mitigate drought like situations.

A part of *in-situ* energy requirement in farming can be met from solar energy. Solar energy may be used for lifting water from farm pond. For running a 2 hp pump operated by solar energy, 150 volt DC Pump is required. Installation of solar power station requires an expenditure of Rs 2.3 lakh. For promotion of solar energy, Government provides subsidy up to 90%. We should avail such facility for a reliable, clean and sustainable source of energy. Biogas is another source of reliable and renewable energy which can be generated within farm itself using the raw cowdung and some easily decomposable and carbon rich vegetation wastes. The by-product of biogas plant known as biogas slurry is also very useful as a nutrient source for crop.

EXPERIENCE WITH A SELF-RELIANT FARMING SYSTEM DURING 2015-16 TO 2017-18

The farm size was 1.584 ha with water harvesting pond of 3894 m² area and 3 m depth². Green manuring with *Sesbania* 14.1 t/ha

(58:10:19 kg N: P₂O₅:K₂O) and vermicompost 3 t/ha (22:30:21 kg N: P₂O₅:K₂O) could produce rice grain yield of 4.3 t/ha and Rs. 30426 as net return per year. A total of 8.1 t vermicompost was produced from the vermicompost unit located on pond dyke. Out of this, 3 t was used for paddy crop and the remaining 5.1 t was used for dry season crops and dyke crops. After harvest of rice, dry season crops (cabbage and cowpea as vegetables, groundnut as oil seed, blackgram as pulse and maize for grain) were grown using vermicompost as manure. The mean net return from these dry season field crops was Rs 28656/ha. Water harvesting farm pond (3894 m²) provided a net return of Rs 27995 from fish and Rs 5000 from lotus. Papaya and banana grown on pond dyke (5 m wide at top) with drip irrigation resulted in net return of Rs 49296 per year. The dyke crops (papaya and banana) did not require irrigation during rainy season and early parts of post-rainy season due to capillary water from farm pond. The net return of the self-reliant farming system was Rs 150197 from 1.584 ha (Rs94821/ha). After considering the annual cost on pond making, the net return from the self-reliant farming system was Rs 70141/ha. This was higher by 2.6 times as compared to the rice-fallow (the common practice in rainfed areas).

CONCLUSIONS

Self-reliant farming system produces the plant nutrient need of the farm from green manure,

vermicompost and legume crop. Fish feed could be provided using rice bran, oilcake and cowdung. Farm animal feed could be provided from rice straw, groundnut haulm, rice bran, oil cake and maize grain. Water need was met from water harvesting farm pond while solar energy was useful for lifting water from farm pond. Thus, the farming system was self-reliant. Avoidance of synthetic fertilizers and pesticides are useful in producing safe and fresh food for a healthy life.

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SYNTHETIC SEEDS : AN ALTERNATIVE TO THE CLONAL PROPAGATION

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Synthetic seed is most commonly described as encapsulated somatic embryos. In recent years, the nodal segments and shoot tips from *in vitro* cultured plants have also been employed as an alternative to somatic embryos. The synthetic seed has applications such as multiplication of plants in which propagation through normal seeds are not possible, large-scale clonal propagation, germplasm conservation, easy storage, handling, transportation and exchange of desirable genotypes etc.

INTRODUCTION

A seed is the fertilized and matured ovule of a plant, containing a rudimentary plantlet closed with nutritive tissue (endosperm) and several layers of protective outer covering. The formation of the seed is part of the process of reproduction in flowering plants. By means of seed, plants are able to transmit their genetic constitution from generations to generations. Seeds are desiccation tolerant, long-lived and quiescent due to the protective coating.

The synthetic seeds (also called artificial seeds, clonal seeds, somatic seeds, synseeds, someseeds) are an analogue to botanic seeds consisting of micropropagules *viz.* somatic embryos, nodal segment or shoot tip etc., encapsulated by an artificial seed coat (Fig. 1). The naked micropropagules are very sensitive to pathogens attack and/or desiccation when exposed to the environment. Hence, some protective coatings would necessarily require for protecting the

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micropropagules used in the production of synthetic seed.

The artificial seed is 'a nutrient capsule prepared by coating somatic embryos, tissue or an organ which can grow into a complete plant'⁶. The synthetic seeds concept comprised of an artificial external film which possibly implies the botanical seed coat, which protects the seed and internal layer containing nutrients required for growth of the encapsulated plant material, which probably simulates the endosperm tissue. Several studies reported the production of synthetic seeds in different plant species including vegetables, medical plants, ornamentals, orchids, fruits, forest trees and cereals^{4,5,7}.

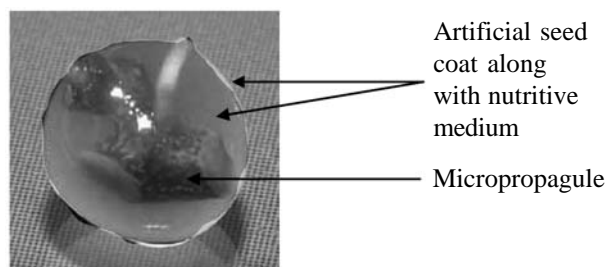


Figure 1 : Cassava synthetic seed⁴

ADVANTAGES OF SYNTHETIC SEED

Synthetic seed production is an applied technology which allows rapid multiplication of an elite plant. It has been suggested as a low cost propagation method of true-to-type plants. For this reason, it is a powerful tool for mass propagation of elite crop species with high economic value and rare or endangered taxa. The encapsulation (coating) protects the explants from mechanical damage and drying of plant propagule during handling and storage thus having practical application in germplasm conservation and exchange. The encapsulation technique coupled with cryogenic procedures are reliable methods for the long-term storage of plant genetic resources without the risk of genetic instability by using minimum space, labour and less maintenance cost. An additional advantage of synthetic seeds includes low production costs, easy handling, transportation of propagules to distant places, short and long-term storability there by facilitating the easy exchange of germplasm between laboratories and subsequent propagation across the globe.

The propagule encapsulation method is meant to be an alternative propagation of plants which cannot be easily reproduced via botanical seeds like transgenics and tree species, non-seed producing species, polyploid plants with elite traits and male or female sterile ornamental hybrids. The synthetic seed technology can also be regarded as an important tool for mass-production or micropropagation of cross-pollinated crops since the heterozygous nature makes it impossible to obtain true to type elite clones by natural seeds.

SYNTHETIC SEED PRODUCTION

Important and basic hindrance to the direct use of micropropagules is lack of important supplement tissues like protective coatings and endosperm, which makes difficult to handle and

store them. Further, the semicropropagules are vulnerable to dehydration and pathogen attack. Therefore, the primary goal of this technology is to produce synthetic seed that resembles more similar to the botanical seed in handling and storage characteristics, so that they can be effectively utilized as a unit for clonal propagation and germplasm conservation. The choice of the encapsulation material for making artificial seeds is also an important aspect in the production of synthetic seeds. In attaining these, the encapsulation technology has been emerged as the first major step for the production of synthetic seeds. Later it has been thought that the synthetic seed should also contain nutrients, plant growth regulators and/or other components necessary for the optimal development of micropropagules.

Hydrated and desiccated are the two types of synthetic seeds established so far. The hydrated synthetic seeds are produced in those plant species where the somatic embryos and/or micropropagules are recalcitrant and sensitive to desiccation. In hydrated synthetic seeds, encapsulation was accomplished by mixing the micropropagules into the sodium alginate solution and dropping these into the calcium chloride solution. When sodium alginate drops along with micropropagule, surface complexion begins and firm round beads are formed immediately after coming in contact with calcium chloride solution. The beads containing the entrapped explants were retrieved from calcium chloride solution and washed 2-3 times with sterilized distilled water. The sizes of the beads are controlled by the inner diameter of the pipette nozzle. The firmness of the synthetic seed is regulated with the concentrations of encapsulation solutions like sodium alginate and calcium chloride as well as the polymerization time. Usually, 2% sodium alginate and 100 mM calcium chloride solutions were used by several researchers and were found

to be satisfactory⁵. However, that 3% sodium alginate, 100 mM calcium chloride solution and 30 to 35 min polymerization time were optimum for the production of round and sufficiently hard synthetic seeds of cassava with the maximum *in vitro* germination⁴ (Fig. 1 and Fig. 2).

The desiccated synthetic seeds are made from micropropagules encapsulated in polyoxyethylene glycol followed by their desiccation. Such types of synthetic seeds are produced only in plant species whose micropropagules are desiccation-tolerant. Desiccation can be achieved either slowly over a period of one or two weeks sequentially using low humid chambers or rapidly by leaving over night on an incubator with specific temperature and humidity.

CHALLENGES

In spite, the synthetic seed technology reported promising by the several types of research for

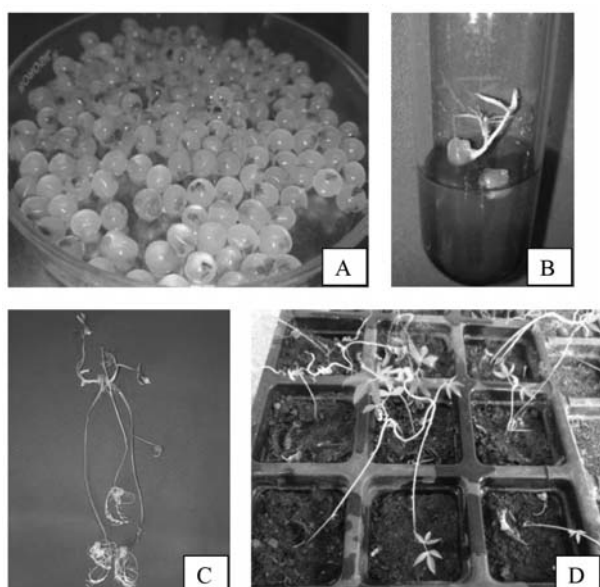


Figure 2 : Different stages of plantlet development from synthetic seeds of cassava⁴, (A) Encapsulated nodal segments, (B) Germinating synthetic seed under *in vitro*, (C) Plant with well-developed shoot and roots, (D) Acclimatized cassava plants.

propagating a number of plant species, practical implementation of this technology is constrained due to several reasons. The large-scale production of micropropagules suitable for the encapsulation at the low cost per unit culture is most essential for an efficient synthetic seed production protocol. Although the development of such systems was achieved in some plant species, the micropropagation protocol is still one of the major limitations of the development of synthetic seed technology in several important crop plants.

The use of somatic embryos has been widely reported in various plant species for the production of synthetic seed¹, however, there are some major challenges that need to be solved. Challenges such as anomalous and asynchronous development of somatic embryos, improper production of viable mature somatic embryos, limitations in storage of synthetic seed caused by lack of dormancy and stress tolerance in somatic embryos as well as the reduction of viability and plant recovery when the synthetic seeds are stored at low temperature². Somaclonal variation is the genetic variation arising through tissue and cell culture. If it happens during micropropagation and production of somatic embryos, the basis of uniformity of synthetic seed will be defeated.

The possibility of using micropropagules (non-embryogenic propagules) for the production of synthetic seed was investigated in different plant species that are recalcitrant to somatic embryogenesis and reported to be a promising technology as a vegetative-propagation method. However, this method also has some challenges such as the overcoming the difficulties in achieving the rooting and very low levels of plant conversion. Moreover, the problems involved in getting a complete plant from the synthetic seeds when sown directly in soil or in commercial potting substrates such as vermiculite, cocopeat, compost etc., under non-sterile conditions are

considered to be the one of the main limitations of the practical use of this technique³.

CONCLUSIONS

Synthetic seeds were developed successfully in different plant species by optimization of encapsulation procedures. This technique has great advantages such as; simple methodology with high potential for mass production of true to type plants, a cost-effective propagation system, conservation of elite lines and endangered species, facilitation of germplasm exchange between laboratories, easy handling, transportation of propagules to distant places and subsequent propagation.

However, despite the advantages of synthetic seeds and considerable research input into the production of synthetic seeds, several major limitations persist with regard to its commercialization. The major limiting factor for the practical application of the synthetic seed technology is the large-scale production of high quality micropropagules. Poor *ex vitro* germination, microbial invasion and mechanical damage of micropropagules are the other limitations with the synthetic seed technology.

Hence, further research is needed to perfect the technology so that it can be used on a commercial scale.

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NEW AND ALTERNATIVE APPROACHES TO COMBAT ANTIBIOTIC RESISTANCE

Tania Gupta¹, Rajat Varshney^{1,2*}, Ritu Varshney³ and Balendri Sonkar¹

Inappropriate, indiscriminate and widespread antibiotic use escalates antibiotic resistant cases and generates public health predicament due to limited synthetic approaches for manufacturing newer antibiotic and limited resource of antibiotic production as most of the environmental bacteria are uncultivable. Newer promising approaches such as catalytic antibiotic, use of DNazymes or antisense oligonucleotide (ASO) for inactivating m-RNA that encode for antibiotic resistant protein, inactivation of efflux pump and disruption of the MecR1 regulatory pathway and exploration of newer antibiotic resources *via* screening of soil bacteria or other methods, may help in combating the existing gigantic antibiotic resistance issue.

INTRODUCTION

Over the years, antibiotics have saved lives, eased the suffering of millions of people and animals, contributed to the major gains in life expectancy. However, these wonder drugs have started to lose ground rapidly due to the evolution of drug resistance bacteria. Inappropriate, haphazard and widespread antibiotic use establishes a selective pressure, a driving force in evolution of Antibiotic Drug Resistance (ADR) such as penicillin-resistant *Streptococcus pneumoniae*, vancomycin-resistant enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin resistant *S. aureus* (VRSA), glycopeptide-intermediate *S. aureus* (GISA), vancomycin insensitive *S. aureus* (VISA), linezolid-resistant *Enterococcus* (LRE), extended spectrum beta-lactamase (ESBL) producing *Klebsiella* spp., *Pseudomonas*

aeruginosa, *E. coli*, metallo-beta-lactamase producing *Pseudomonas aeruginosa*, MDR-salmonellae, and MDR-*Mycobacterium tuberculosis*, *Pseudomonas* and *E. coli*. Farm's wastage, nosocomial infection, unused antibiotics flushed down in the toilet, chemical discharges from pharmaceutical companies, *etc.* are various sources for the evolution of drug-resistant bacteria. The spread of drug resistance among bacteria has greatly outpaced the rate of drug development. Escalating number and variety of drug-resistant pathogens are a serious public health problem now a day. There is no place on the earth's surface where potentially dangerous, drug-resistant bacteria have not got in touch with.

MECHANISM OF RESISTANCE

Drug resistance in bacteria may be natural or acquired. Bacteria may exhibit the cellular level resistance (i.e., mutation and horizontal gene transfer) or the community level resistance (i.e., persists and biofilms). Bacteria acquire drug resistance via conjugation, transformation and transduction. Bacterial conjugation is the

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horizontal transfer of genetic material between bacterial cells by direct cell-to-cell contact. Transformation is the direct uptake, incorporation and expression of exogenous genetic material from its surroundings. Transduction is the process by which DNA is transferred from one bacterium to another via a virus. Bacteria have evolved the various drug resistant mechanisms such as Efflux pump, decrease affinity for the target/ alteration in the binding site, development of alternative metabolic pathway, elaboration of a drug inactivating enzyme such as beta-lactamases, decrease drug permeability etc¹. Bacteria may limit the influx of substances from the external milieu via outer membrane as a barrier (for example, Gram negative bacteria show resistance towards vancomycin as it is unable to penetrate the outer membrane of bacteria) or may alteration of porin via a shift in the type or level of porins expressed or impairment of the porin function (for example, OmpF, OmpC and PhoE of *E. coli* and OprD of *P. aeruginosa* are classical examples of porin-mediated antibiotic resistance).

TOWARDS CATALYTIC ANTIBIOTICS

The potent bactericidal drug like aminoglycosides binds with ribosomes and inhibit protein synthesis. The appearance of drugs resistant bacterial strains, as well as relative toxicity of the drug, has encouraged an extensive search towards the goal of obtaining novel molecular designs. The development of catalytic antibiotic will be able to induce fast and irreversible inactivation of a specific target site *via* the cleavage of a crucial chemical bond at their binding site in a catalytic manner. This strategy is based on a chemical modification of existing antibiotic in order to make it a catalyst. The possible benefits include activity at lower dosages and subsequent elimination of side effects, activity against drug-resistant bacteria, and reduced potential for generating new resistance. Plazomicin is a bactericidal aminoglycoside, with enhanced activity against

MDR Gram-negative bacteria and MRSA. Plazomicin is generally impervious by aminoglycoside-modifying enzymes elaborated by drug resistant strains².

AMINOGLYCOSIDES

These antibiotics inhibit protein synthesis by binding to 30S subunit and 50S subunit of the ribosome as well as their interface and freeze initiation, inhibit translocation and cause misreading of m-RNA code. Bacteria acquire resistance to aminoglycosides by alterations in ribosomal proteins, decreased permeability to the antibiotic or by induction of bacterial drug-inactivating enzymes such as Aminoglycoside nucleotidyl transferases (ANT), Aminoglycoside acetyl transferase enzyme, Aminoglycoside phosphotransferase etc³. The novel strategies in order to combat aminoglycosides may be the development of inhibitors of the enzymatic action or of the expression of the modifying enzymes.

β -LACTAM ANTIBIOTIC

The key catalyst in the synthesis of β -lactam antibiotics like penicillin involves enzyme IPNS & DAOC and for clavulanic acid is a clavamate synthetase (cas) enzyme. Insight into the machinery of the β -lactam biosynthetic enzymes now offers a unique opportunity for experiments aimed to develop new biosynthetic routes to β -lactamase, cephalosporinase. By combining information on the 3-D structure of active sites of different biosynthetic enzymes, new classes of compound that are active against the resistant bacteria could be developed⁴. Alternatively, the usage of promising inhibitors (cephalosporin/penicillin/carbapenem/thiol derivative, cyclobutanone β -lactam analogs etc.) or compounds with the β -lactam core scaffold may be attractive strategies to combat beta-lactamase⁵.

VANCOMYCIN

Shi and Griffin (1993) discovered that vancomycin has a catalytic (chemical-degrading action) activity, and they are chemically altering

vancomycin to develop a molecule that will not only bind to the cell-wall precursor and inhibit cell-wall synthesis but destroy the precursor as well. If this is attained, it should increase the potency of vancomycin; the catalytic antibiotic should be able to move to another cell-wall precursor after destroying the first, and so on. Griffin (1994) is also looking for alteration in vancomycin molecule so that it regains its binding affinity to the altered cell wall precursors that are present in vancomycin-resistant bacteria. Once affinity is restored, the antibiotic can bind to the cell wall precursor, inhibit the synthesis of the wall, and kill the bacteria⁶.

CATALYTIC ACTIVITY OF L, D-TRANSPEPTIDASE

β -lactams inhibit D, D-transpeptidase enzyme responsible for cross-linking of peptidoglycan chains and also inhibit carboxypeptidation reaction. L, D-transpeptidase enzyme of *Mycobacterium tuberculosis* catalyze the formation of 3-3 peptidoglycan cross-links of the cell wall and facilitates resistance against β -lactams⁷. Carbapenems inactivate these L,d-transpeptidases, and meropenem combined with clavulanic acid is bactericidal against extensively drug-resistant *M. tuberculosis*.

DEOXYRIBOZYMES

DNAzymes are the catalytic single stranded DNA molecules with enzymatic activity. Many deoxyribozymes catalyze DNA phosphorylation, DNA adenylation, DNA deglycosylation, porphyrin metallation, thymine dimer photoreversion and DNA cleavage. Common infectious agents such as *S. aureus* in response to antibiotic selective pressure encode m-RNA that encodes the protein accounting for antibiotic resistance. The intracellular introduction of the deoxyribozyme may lead to a decrease or destroy in the levels of the targeted mRNA that encode the proteins responsible for antibiotic resistance and increase the antibiotic sensitivity of treated bacteria. This strategy may be useful for resolving

the problem of antibiotic resistance. DNAzymes targeting HIV-1 Gag region RNA sequence and VEGFR/c-Jun/Erg-1 may also helpful in combating HIV and tumor respectively. However, DNAzymes are prone to nucleolytic degradation in body fluids. To prolong the half-life of oligonucleotides for *in-vivo* usage, to enhance biostability, to reduce toxicity and improve target affinity modified nucleotides such as LNA (locked nucleic acid) are usually incorporated⁸.

ANTI-SENSE OLIGONUCLEOTIDE

“Antisense” oligonucleotide (ASO) may be another novel strategy in order to combat drug-resistant bacteria *via* inactivating mRNA and inhibiting efflux pump that is associated with drug resistance. This synthesized nucleic acid is termed an “anti sense” oligonucleotide (ASO) because its base sequence is complementary to the gene's messenger RNA (mRNA), which is called the “sense” sequence Fluoroquinolone-resistant *Escherichia coli* (FREC) is one of the leading causes of Gram-negative bacterial infections short of effective antibiotics, thus necessitating development of novel antibacterial agents such as antisense resistance inhibitors. Antisense targeting of AcrAB–TolC efflux pump system may be a feasible and potential strategy to treat FREC infections.

DISRUPTION OF THE MecR1 REGULATORY PATHWAY

Methicillin resistance in *Staphylococcus aureus* is mediated by the *mecA* gene which encodes a penicillin-binding protein (PBP2a) possessing low beta-lactam affinity under regulatory signal transduction system MecR1. Disruption of the MecR1 regulatory pathway may inhibit *mecA* expression and restore methicillin-resistant *Staphylococcus aureus* (MRSA) susceptibility to beta-lactams⁹.

OTHER WAYS TO COMBAT ANTIBIOTIC RESISTANCE:

Antibiotic resistance is spreading faster than the introduction of new compounds into clinical

practice, causing a public health crisis. To discover a newer antibiotic *via* screening soil microorganism may resolve this problem up to some extent. However, most of the environmental bacteria are uncultivable (approx. 99 %) and limited synthetic approaches for producing a newer antibiotic are helpless. Teixobactin, a newer antibiotic discovered *via* screening of uncultured bacteria, inhibits cell wall synthesis by binding to a highly conserved motif of lipid II (precursor of peptidoglycan) and lipid III (precursor of cell wall teichoic acid)¹⁰. Teixobactin resistant *Staphylococcus aureus* or *Mycobacterium tuberculosis* has not been reported yet. The properties of this compound suggest a path towards developing antibiotics that are likely to avoid development of resistance. The bacteria that can be grown in the laboratory are only a small fraction of the total diversity that exists in nature. At all levels of bacterial phylogeny, uncultured clades that do not grow on standard media are playing critical roles in cycling carbon, nitrogen, and other elements, synthesizing novel natural products, and impacting the surrounding organisms and environment¹¹. Uncultured organisms have recently been reported to produce interesting compounds with new structures/modes of action—lassomycin, an inhibitor of the essential mycobacterial protease ClpP1P2C1¹².

CONCLUSION

Catalytic antibiotics may be used as a strategy to inhibit antibiotic resistance and evolution of superbugs via modifying the existing antibiotic or via knowing the biosynthetic machinery for the synthesis of the antibiotics and their active sites of binding of these antibiotics with the inhibiting enzyme. Antibiotics from new source using DNAzymes and antisense oligonucleotide can also reduce antibiotic resistance. Discovery of a new antibiotic from the uncultured microorganism may be another promising approach for fighting drug resistance. However, more novel promising approaches are needed to be explored out for combating drug resistance.

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MIRACLE OF NUMBER THEORY

Atul Chaturvedi* and Varun Shukla**

Cryptography is an art of keeping data communication secure¹. It is the requirement of modern world where data communication becomes necessity of life. In cryptography, number theory is a very important tool². In 1976, Diffie and Hellman³, in their path breaking paper used number theory and after that many algorithms and protocols have been proposed based on number theory. Much recent advancement like cryptocurrency and block chain methods is also based on number theory⁴. So the motivation is that for learning security algorithms, students must understand the basic concepts of number theory. So in this paper we present a unique process to find the occurrence of any day (like Monday, Tuesday etc) using Fermat's theorem in number theory which even computer cannot find.

MATHEMATICAL BACKGROUND

Integers and properties

The set $Z = \{0, \pm 1, \pm 2, \pm 3, \dots\}$ is called the set of integers. We say that the integer a divides another integer b if $b = am$ for some integer m and we denote it by $a|b$. This relation of divisibility has the following properties^{1,2}:

- (i) $l|l$ for all $l \in Z$
- (ii) $l|m, m|n \Rightarrow l|n$ for all $l, m, n \in Z$
- (iii) $l|m, l|n \Rightarrow l|mx + ny$ for all $x, y \in Z$
- (iv) $l|m, m|l \Rightarrow l = \pm m$.

Division algorithm for integers: For any two integers l and m , $m \geq 1$, $l = mq + r$, $0 \leq r < m$, q is called quotient and r is remainder.

A non negative integer d is called *greatest common divisor (gcd)* of two given integers a and b , denoted by $d = \gcd(a, b)$ if

- (i) d divides a and b both
- (ii) and if any other integer c divides both a and b , then c must divide d .

A non negative integer d is called *least common multiple (lcm)* of two given integer a and b , denoted by $d = \text{lcm}(a, b)$ if

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(i) both the integers a and b divides d

(ii) any integer which is divisible by a and b must be divisible by d .

If $\gcd(a, b) = 1$, then a and b are said to be *relatively prime* or *coprime*. An integer $p \geq 2$ having only two divisors 1 and itself is called a *prime number* otherwise *composite*.

Fundamental theorem of arithmetic: Every integer $n \geq 2$ can be uniquely written as a product of primes or product of powers of primes. For example, $100 = 2^2 \cdot 5^2$.

Euler's phi function

For any positive integer n , the number of integers less than n and relatively prime to n is called the Euler phi function and is denoted by $\phi(n)$.

For $n = 12$, relatively prime numbers are : 1, 5, 7, 11. Therefore $\phi(12) = 4$.

Properties:

- (i) $\phi(n) = n - 1$, for any prime n .
- (ii) $\phi(ab) = \phi(a)\phi(b)$ if $\gcd(a, b) = 1$.
- (iii) $n = p_1^{e_1} p_2^{e_2} \dots p_k^{e_k} \Rightarrow \phi(n) = n \left(1 - \frac{1}{p_1}\right) \left(1 - \frac{1}{p_2}\right) \dots \left(1 - \frac{1}{p_k}\right)$.

Group

Let G be a non empty set and 'o' is a binary operation on

G (i.e. $a, b \in G \Rightarrow aob \in G \forall a, b \in G$, Closure Property).

Then this algebraic structure (G, o) is called a group if the operation 'o' satisfies the following three properties:

(i) o is *associative*, that is,

$$(aob)oc = ao(boc) \text{ for all } a, b, c \in G.$$

(ii) There exists an element $e \in G$ such that $aoe = eoa = a$ for all $a \in G$. This element is unique and called as *identity* of G .

(iii) For every element $a \in G$, there exists $a^{-1} \in G$ such that $aoa^{-1} = a^{-1}oa = e$, where e is the identity element.

This element a^{-1} is called the *inverse* of a .

That means a nonempty set G must satisfy closure property, associativity, existence of identity and existence of inverse of every element of G in order to be a group with respect to given binary operation.

A group is called *abelian* (or *commutative*) if 'o' is commutative, that is for all The number of elements in a group G is called the *order* of G and denoted by $o(G)$. A group G is called a *cyclic* group if $G = \{g^k : k \in \mathbb{Z}\} = \langle g \rangle$ for some element $g \in G$. This element g is called a *generator* of G . The *order* of an element $g \in G$ is the smallest positive integer m such that $g^m = e$, identity of G and order of every element in a finite group divides the order of the group (*Lagrange's theorem*).

Congruence modulo a positive integer (n) and its properties

For $n \geq 2$ an integer a is said to be congruent to another integer b modulo n , if n divides $(a - b)$ and we write $a \equiv b \pmod{n}$.

For example: $23 \equiv 11 \pmod{12}$, $4 \equiv -3 \pmod{7}$.

This relation has the following properties:
For all $a, b, c, d \in \mathbb{Z}$.

(i) Reflexive: $a \equiv a \pmod{n}$.

(ii) Symmetry: $a \equiv b \pmod{n} \Rightarrow b \equiv a \pmod{n}$.

(iii) Transitivity: $a \equiv b \pmod{n}$, $b \equiv c \pmod{n} \Rightarrow a \equiv c \pmod{n}$.

(iv) $a \equiv c \pmod{n}$, $b \equiv d \pmod{n} \Rightarrow a + b \equiv c + d \pmod{n}$ and $ab \equiv cd \pmod{n}$.

The equivalence class of $a \in \mathbb{Z}$ is, $[a] = \{x \in \mathbb{Z} : x \equiv a \pmod{n}\}$. It can be seen that for a fixed positive integer n , the relation of congruence modulo n is reflexive, symmetric, transitive and hence an equivalence relation on \mathbb{Z} and it partitioned \mathbb{Z} into n equivalence classes $[0], [1], \dots, [n-1]$. Thus, $\mathbb{Z}_n = \{0, 1, 2, \dots, n-1\}$ is the set of integers modulo n . Addition, subtraction and multiplication in \mathbb{Z}_n are performed modulo n . For example, in $\mathbb{Z}_{25} = \{0, 1, 2, \dots, 24\}$, $13 + 16 = 29 \equiv 4 \pmod{25}$ and $13 \times 16 = 208 \equiv 8 \pmod{25}$. For $a \in \mathbb{Z}_n$, the integer b such that $ab \equiv 1 \pmod{n}$ is called the multiplicative inverse of $a \pmod{n}$ and it is denoted by a^{-1} and a is called *invertible*. An element $a \in \mathbb{Z}_n$ is invertible if and only if $\gcd(a, n) = 1$. For example, In \mathbb{Z}_9 , invertible elements are 1, 2, 4, 5, 7 and $8 \times 4^{-1} = 7$ because $4 \times 7 = 28 \equiv 1 \pmod{9}$.

Define $\mathbb{Z}_n^* = \{[a] \in \mathbb{Z}_n : \gcd(a, n) = 1\}$, as a set of residue modulo n . Then the structure $(\mathbb{Z}_n^*, \times_n)$ is an abelian group under the operation multiplication modulo n and it is denoted by \times_n . The order of this group (number of elements in \mathbb{Z}_n^*) is $\phi(n)$, where ϕ is Euler's phi function.

Properties of \mathbb{Z}_n^ [1][2]:*

(i) \mathbb{Z}_n^* has a generator $\Leftrightarrow n = 2, 4, p^k$ or $2p^k$, p is an odd prime and $k \geq 1$. In particular, if p is prime, then \mathbb{Z}_p^* has a generator.

(ii) If $\mathbb{Z}_p^* = \langle \alpha \rangle$, then $\mathbb{Z}_p^* = \{\alpha^i \pmod{p} : 0 \leq i \leq \phi(p) - 1\}$.

(iii) If $\mathbb{Z}_p^* = \langle \alpha \rangle$, then $\mathbb{Z}_p^* = \langle \alpha^i \rangle \Leftrightarrow \gcd(i, \phi(p)) = 1$. Thus if \mathbb{Z}_p^* is cyclic, then the number of generators are $\phi(\phi(p))$.

(iv) $\mathbb{Z}_n^* = \langle \alpha \rangle \Leftrightarrow \alpha^{\frac{\phi(n)}{p}} \neq 1$ for each prime divisor p of $\phi(n)$. Thus

For a prime number p , Z_p^* is always cyclic group. A generator of this cyclic group is called a primitive root modulo p . It is easy to see that for a generator g of cyclic group Z_p^* , $o(g) = o(Z_p^*) = p - 1$ and $Z_p^* = \{1, 2, 3, \dots, p - 1\}$.

FERMAT'S THEOREM AND ITS PROOF

For any integer a and a prime number p , $gcd(a, p) = 1$, then $a^{p-1} \equiv 1 \pmod{p}$.

Proof 1: We have a prime number p and an arbitrary element $a \not\equiv 0 \pmod{p}$. Consider the set of all non-zero integers modulo p , $A = \{1, 2, 3, \dots, p - 1\}$ and $aA = \{a, 2a, 3a, \dots, (p - 1)a\}$. We claim that all the elements of aA are distinct. For if $a_i = a_j \Rightarrow a^{-1}(a_i) = a^{-1}(a_j) \Rightarrow i = j \pmod{p} \Rightarrow i = j$ which contradicts the formation of the set A because all the elements of A are distinct. Therefore, both the set contains the same elements when reduced modulo $\Rightarrow 1.2.3... (p - 1) \equiv a(2a)(3a) \dots ((p - 1)a) \pmod{p} \Rightarrow 1.2.3 \dots (p - 1) \equiv a^{p-1}(1.2.3 \dots ((p - 1) \pmod{p}))$. It means $1 \equiv a^{p-1} \pmod{p}$ and we cancel each of $1, 2, 3, \dots, p - 1$ on both sides because they are all invertible modulo p . It gives us $a^{p-1} \equiv 1 \pmod{p}$ which is required.

Or

Proof 2: We know that $Z_p^* = \{1, 2, 3, \dots, p - 1\}$ is a group under \times_p (multiplication modulo p). Consider an element a such that $1 \leq a \leq p - 1$; i.e $a \in Z_p^*$ and $o(a) = m$, then m is the least positive integer such that $a^m \equiv 1 \pmod{p}$. By Lagrange's theorem, $o(a) | o(Z_p^*)$ i.e. $m | (p - 1) \Rightarrow p - 1 = mk$ for some positive integer k . Now $a^{p-1} = a^{mk} = (a^m)^k = (1)^k \equiv 1 \pmod{p}$. It proves the needful.

Proposed scheme: Here we want to propose a very interesting scheme for the readers of this paper. Our target is undergraduate students preparing for higher studies in the field of cryptography and network security^{3,4}. We present a scheme that can be very helpful in making algorithms and software and it is a classic

example that how a simple mathematical idea can be implemented. You need to assign numbers to days as follows:

Sunday $\equiv 0$, Monday $\equiv 1$, Tuesday $\equiv 2$, Wednesday $\equiv 3$, Thursday $\equiv 4$, Friday $\equiv 5$, Saturday $\equiv 6$.

We assume that today is Friday and we illustrate the scheme with the help of some problems arranged in easy to difficult order.

Problem 1: What will be the day after 62 days?

Solution: As per our scheme, Friday $\equiv 5$, so $5 + 62 = 67 \equiv 4 \pmod{7}$ so the day will be Thursday.

Problem 2: What will be the day after 2346828 days?

Solution: We do $5 + 2346828 = 2346833$ and $2346833 \equiv 6 \pmod{7}$ so the day will be Saturday.

Problem 3: What will be the day after 2347¹²³⁹ days?

Solution: Since $2347 \equiv 2 \pmod{7}$ so we do 2^{1239} and $2^{1239} = (2^6)^{206} \cdot (2)^3 = (1)^{206} \cdot (2)^3$ because $2^6 \equiv 1 \pmod{7}$ by Fermat's theorem. So now we have $2^3 = 8$ and $8 \equiv 1 \pmod{7}$. Since today is Friday $\equiv 5$ so we do $1 + 5 = 6$. That means the day will be Saturday.

Problem 4: What will be the day after 9862943285639³⁶⁸⁹²⁵⁸²⁶⁹⁸²¹⁵³³ days?

Solution: $9862943285641^{3689258269821533}$
 $\equiv (5)^{3689258269821533}$
 $\equiv (5^6)^{614876378303588} \cdot (5)^5 \pmod{7}$
 $\equiv (1)^{614876378303588} \cdot (5)^5 \pmod{7}$
 $\quad | \because 5^6 \equiv 1 \pmod{7}, \text{ Fermat's theorem}$
 $\equiv (5)^5 \pmod{7}$
 $\equiv (-2)^5 \pmod{7}$
 $\quad | \because 5 \equiv -2 \pmod{7}$
 $\equiv -32 \pmod{7}$
 $\equiv 3 \pmod{7}$
 $\quad | \because -32 \equiv 3 \pmod{7}$
 $\equiv 3 + 5 \pmod{7}$
 $\equiv 8 \pmod{7}$
 $\quad | \because \text{Today is Friday} \equiv 5 \pmod{7}$

$$\begin{aligned} &\equiv 1 && \pmod{7} \\ &\equiv \text{Monday} && | \because \text{Monday} \equiv 1 \end{aligned}$$

That means the day will be Monday. WOW!
It's fun.

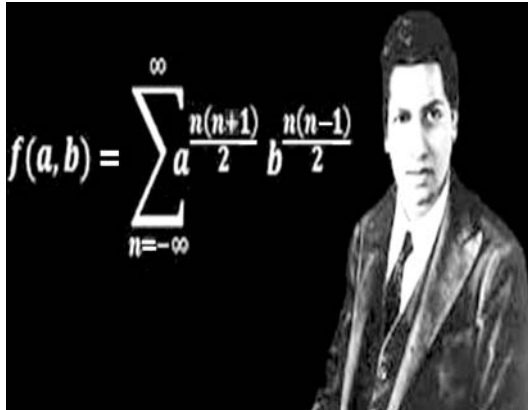


Figure 1. Srinivasa Ramanujan Iyengar, a legendary Indian, is always remembered as one of the great number theorists in the world. As a young student, Ramanujan was interested in magic squares. He has given many concepts like Ramanujan Congruence, highly composite numbers and Diophantine equations. He has given several formulas for π also.

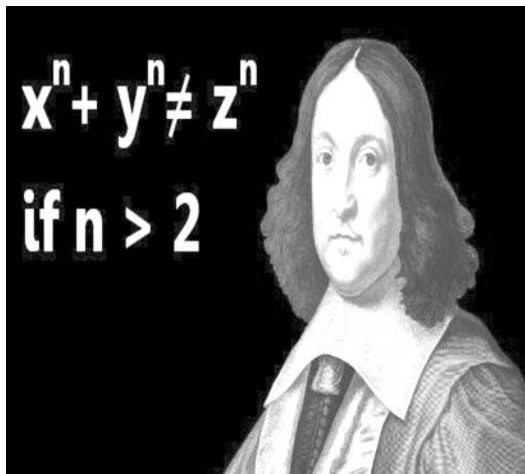


Figure 2. Pierre De Fermat was the French lawyer at the parliament of Toulouse, France and one of the finest French mathematicians. He has contributed significantly in calculus, analytic geometry, and probability and number theory. He had seen number theory as an independent stream of mathematics. He has deep interest in primness and divisibility.

CONCLUSION

We have shown that number theory and modulo system are powerful tools in our daily life calculations. We have shown that how real life problems can be solved using Fermat's theorem in number theory. The problem number 4 can't be solved using computers but we have solved it using Fermat's theorem. It is very important to mention here that number theory is deeply involved in cryptographic algorithms. So it is the motivation for undergraduate students wants to pursue cryptography and network security in their higher studies because it is meaningless to talk about cryptography without number theory and modulo system^{3,4}.

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AZOLLA : A POTENTIAL BIO-RESOURCE FOR AGRICULTURE AND ALLIED ACTIVITIES

B. Jeberlin Prabina¹, M. Hemalatha², S. Merina Premkumari³, S. Suresh⁴,
P. Subbulakshmi⁵ and Shri Hari Prasad⁶

Azolla is a floating aquatic fern and is commonly called as mosquito fern, duckweed fern, fairy moss and water fern. *Azolla* species are distributed throughout the world in temperate and tropical fresh waters. *Azolla* floats on the surface of water with the help of numerous small, closely overlapping scale-like leaves, with their roots hanging through the water and forms large mats. The habitats include ponds, ditches, canals and paddy fields. It is also commonly seen in places where agricultural runoff or urban effluent accumulation is seen³ (Raja, 2014). By nature, they form a symbiotic relationship with the cyanobacterium *Anabaena azollae*, which fixes atmospheric nitrogen, giving the plant access to the essential nutrient that helps to colonize areas of freshwater and grow at great speed. *Azolla* grow best at temperature range of 25-30°C. The favourable water temperature for multiplication of *Azolla* is between 18-26°C. The ideal characteristics that make *Azolla* significant to agriculture and allied activities are its rapid growth rate and possession of various nutrients particularly protein. The relative growth rate of *Azolla* is high as it generally doubles its weight in 2-4 days period resulting in very high biomass in a short period of time.

MORPHOLOGICAL CHARACTERISTICS AND LIFE CYCLE OF AZOLLA

Azolla fronds consist of leaf, rhizome (stem) and root. Leaves occur in two rows along the side of rhizome and each leaf has a thin ventral lobe and a thick dorsal lobe. The dorsal lobe contains chlorophyll and carotenoid pigments that carry out photosynthesis. Within the dorsal lobe the cyanobacterium, *Anabaena azollae* is present in a specialized ovoid cavity¹¹ (Lumpkin, 1993). The roots are adventitious and chlorophyllous in their early stage. *Azolla* fronds are triangular or

polygonal and float on water surface. The morphological characteristics as supported by Kumar and Nayak, 2019 that are helpful to differentiate the six major *Azolla* species are¹,

- *Azolla cristata* (*A. caroliniana*)-The fronds are very short and are about 5-10mm long, grow less than 1 inch tall, green to reddish in colour with tiny protuberances called trichomes that give them a velvety appearance. The trichomes are septate; star shaped branched floating stem with highly imbricated leaves. The dorsal leaf lobe is round, acute angled and the ventral lobe has pink tint. Thin root hair is present throughout the root.
- *Azolla filiculoides* grows up to 2.5 cm and is a large floating fern. Star shaped branched floating stem with highly imbricated leaves. Dorsal and ventral leaf lobes grow on upper side of the rhizome. The dorsal leaf lobe is slightly acuminate and acute angled. The ventral leaf lobe is pink tinted. The trichomes

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are unicellular thereby could be distinguished from *Azolla cristata*.

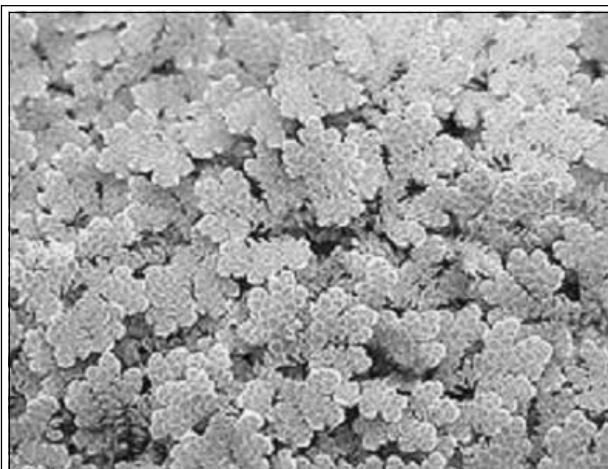
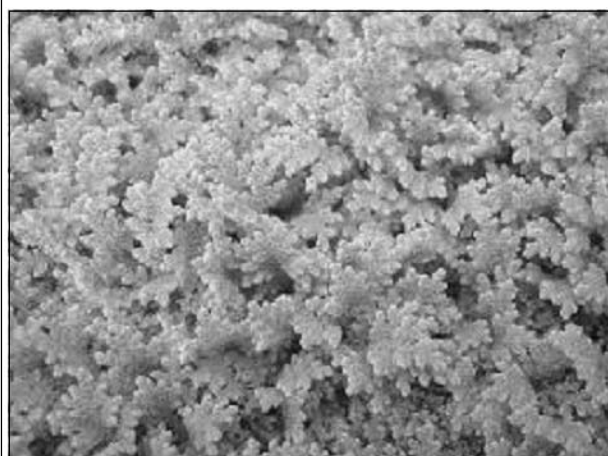
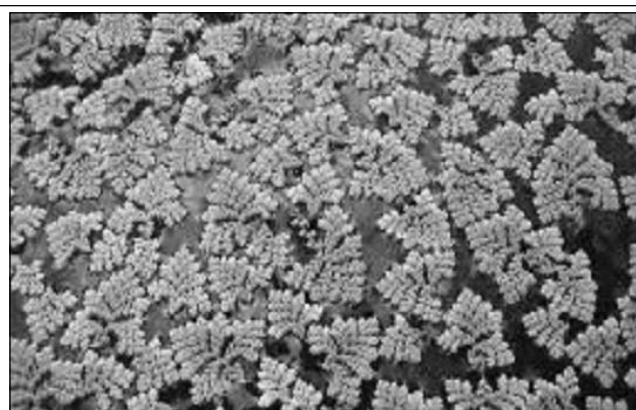
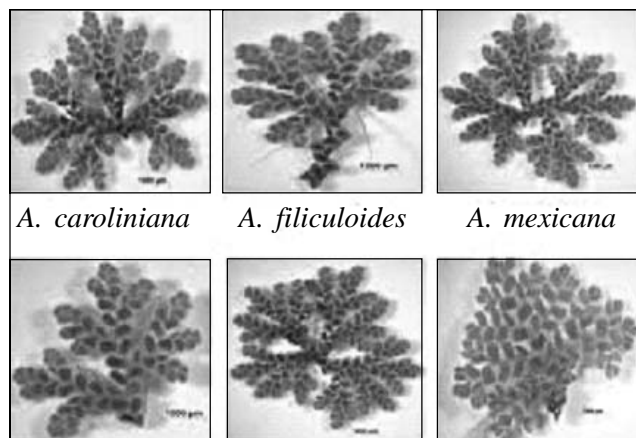
- *Azolla mexicana* differs from *Azolla cristata* and *Azolla filiculoides* by having multicellular trichomes. Dorsal and ventral leaf lobes grow on upper side of the rhizome. Star shaped branched floating stem with highly imbricated leaves. The dorsal leaf lobe is slightly acuminate and acute angled. The ventral leaf lobe is pink tinted.
- *Azolla microphylla*—Star shaped branched floating stem with highly imbricated leaves. The dorsal leaf lobe is highly acuminate, acute angled and the ventral lobe is with pink tint. Thin root hair is present throughout the root.
- *Azolla pinnata*—Triangular shaped branched floating stem with slightly imbricated leaves. The dorsal leaf lobe is highly acuminate, acute angled with translucent ventral leaf lobe. Thick root hair is present throughout the root.
- *Azolla rubra*—Dorsal and ventral leaf lobes grow upper side of the rhizome. Star shaped branched floating stem with highly imbricated leaves. The dorsal leaf lobe is highly acuminate and acute angled. The ventral leaf lobe is pink tinted.

Azolla has sporophytic and gametophytic phase of life cycle. In sporophytic phase when the fronds reach a certain size, depending upon the species (1-2cm) the older secondary stems detach themselves as a result of formation of abscission layer and give rise to new frond. This is the common mode of reproduction in *Azolla*. Gametophytic reproduction (sexual) is essential for survival under adverse condition. In gametophytic phase, micro (male) and mega (female) sporocarps are produced on the same plant. The sporocarps are formed at the lateral end of the ventral lobe. The micro and mega sporocarps after maturation get detached from the mother sporophyte and sink to the bottom of the water column. The mega sporocarp germinate

into a female gametophyte containing one or more archegonia containing one egg cell called the oocyte. The antherozoids move through the massulae and fertilize the oospores. The zygote is formed within the megaspore apparatus under the water body. The germination of sporocarp is triggered by light and temperature. As the embryo grows, the new *Azolla* plantlet is released.

AZOLLA FOR IMPROVEMENT OF SOIL FERTILITY

The nitrogen-fixing capability of *Azolla* due to the presence of the cyanobiont *Anabaena azollae* makes *Azolla* a popular bio-fertilizer, especially in parts of southeast Asia¹⁰. (Peters and Calvert, 2003). It fixes 1100 kg nitrogen per hectare per year and *Azolla* is considered as a bio source of nitrogen. It can be easily multiplied in wet lands, cement tanks or pits lined with silpaulin sheet. The multiplied biomass can be collected and applied to soil as green manure. For paddy, it can be used as bio-fertilizer by a technique called dual culturing. In dual culturing *Azolla* @500kg per hectare is broadcasted in the standing water after seven days of transplanting the paddy seedlings. *Azolla* grows and would cover the surface. This prevents the growth of weeds in paddy fields⁴ (Bhuvaneshwari and Kumar. 2013). With the help of the cyanobiont, it converts the atmospheric nitrogen to ammonia that is released to the standing water. The released ammonia is utilized as a source of nitrogen by paddy⁷ (Ray et al., 2008). When the entire paddy field gets covered with *Azolla*, decomposition takes place and *Azolla* is added as organic manure to soil that adds upto nine tonnes of protein per hectare per year⁵ (Raja et al, 2012). *Azolla* contains 2-5% nitrogen, 1-2% phosphorus, 0.5-6% potassium on dry weight basis. Also, contains calcium, magnesium, silica, zinc, copper, iron, sulphur, sodium and plant growth promoting substances like auxins and gibberellins. Upon decomposition these nutrients are released into

*AZOLLA CRISTATA**AZOLLA FILICULOIDES**AZOLLA PINNATA**A. caroliniana**A. filiculoides**A. mexicana**A. microphylla**A. rubra**A. pinnata*

(Source : ICAR NRRI, 2019)

soil and help to improve soil physio-chemical and biological properties particularly the organic carbon content of soil. Since, the carbon nitrogen (CN) ratio is ideal, decomposition of Azolla in soil occurs at faster rate. Because of the Biological Nitrogen Fixing (BNF) ability, the use of Azolla as bio-fertilizer in paddy cultivation is a promising approach for better nitrogen use efficiency. It has been scientifically proven that application of Azolla increases paddy yield by 20-30%. Rice varieties like DR-92, RCPL-1-87-8, Mendri, H-2850 and Manipuri have been reported to produce more than 30 q/ha rice yield when grown with Azolla as dual cropping under natural soil fertility. In recent days, Azolla is widely exploited as green leaf manure in coffee plantation as source of bio

nutrient. When Azolla is added to soil as bio-fertilizer the use of chemical nitrogenous fertilizer could be reduced by 25-50%. Azolla reduces water evaporation and increases the water use efficiency also.

AZOLLA AS FEED FOR LIVESTOCK AND POULTRY

Azolla, is a suitable feed to livestock and poultry as it harbors many nutrients⁸ (Pillai et al., 2005). *Azolla* is rich in protein (25-35%), minerals (10-15%), amino acids (7-10%), vitamins and growth promoting intermediates. It's nutrient composition makes it an efficient and ideal feed supplement for livestock, poultry, pigs and fish² (Katole et al., 2017). It can be fed as fresh or as dried one. *Azolla* has immune

modulatory effect and is found to give resistance against Ranikette disease in chicken⁶ (Jeberlin Prabina and Kumar 2010). In layers, it increases the egg production and nutrient content of the egg. In broilers, the body weight is improved on feeding of *Azolla*. Higher feed conversion ratio is added advantage while substituting concentrate feed with *Azolla*. Feeding of *Azolla* to cattle increases milk yield, digestibility and feed conversion ratio. *Azolla* is widely cultivated by dairy farmers where the land is insufficient for fodder production. *Azolla* can replace 7.5% of concentrate feed in broilers, 20% in ducks without any adverse effects on growth and health. Fish require diets with higher protein content. As protein represents the most expensive component in a formulated diet in fish farming, feeding *Azolla* saves cost of concentrate feed⁹ (Fiogbe et al., 2004). For improving the digestibility and feed quality, *Azolla* can be mixed with wheat bran and rice bran. Encouraging research reports in weight gain by feeding *Azolla* has been recorded in tilapia, grass carp and common carp. With acceptable results from extensive animal trials, combination of *Azolla* with other feed or fresh *Azolla* alone can be given to livestock and poultry that saves feed cost.

CONCLUSION

With multifarious advantages, *Azolla* is an ideal bio-input for sustenance of soil health and environment in agro ecosystem. Use of *Azolla* as source of bio-nitrogen, reduces the use of chemical nitrogenous fertilizers thus saving the cost of chemical fertilizers. With the shrinkage of area under cultivation for agricultural activities, *Azolla* would be an ideal choice as livestock and poultry feed, making it an indispensable component of Integrated Farming System.

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To encourage Scientists, The Indian Science Congress Association has instituted two Best Poster Awards in each Sections. These awards carry a sum of Rs. 5,000/- besides a Certificate of Merit.

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4. The number of authors of each poster submitted for the award shall be limited to two only. **The first author of the poster shall be the presenting author. Both the authors should be the members of the Association and have paid their Subscription on or before 15th July, 2021.**
5. The research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
6. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any of her Conference/Seminar/Symposium or submitted for consideration of any award.
7. A scientist shall submit only one poster in anyone Section (and not a second poster on the same or any other topic in any other Section) for consideration for poster presentation award.
8. A person who has already received ISCA Best Poster Award in any section once will not be eligible to apply for the above Award in the same or any other section.
9. Incomplete Applications will not be considered.
10. Full length papers will be evaluated by experts and maximum twenty posters in each section will be selected for presentation during 108th Indian Science Congress.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 108th Indian Science Congress session on **January 7, 2022**.
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HISTORICAL BACKGROUND

Defence Materials and Stores Research and Development Establishment (DMSRDE) originated in 1929 as Inspectorate of General

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VISION

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Development of Products & Technologies which are globally recognized and acceptable.

Design, development and evaluation of advanced engineering polymers, elastomers and multi-performance composites for defence applications.

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Development of Smart polymer, fibre & fabrics for wide range strategic applications like NBC, stealth, extreme cold, fire resistant & ballistic protection etc.

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TECHNOLOGIES

Although the technologies have been developed keeping in view the needs of Services by putting in extensive R&D efforts, many of them are equally useful for civil sector. Some of these technologies are:-

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- Rust Converter
- Life Jacket
- Moisture Resistant Corrugated Fibre Board Box
- Glycol Based Anti freeze Coolant
- Engine Starting Aid Capsules
- Corrosion Inhibitor Concentrate Packs
- Auto Rust & Scale Inhibitor(ARS-70)
- Splint Inflatable
- Survival Blanket
- Jacket Wind cheater
- Anti-Riot Helmet
- Trouser Wind cheater
- Anti-RiotShield
- Footwear for Leprosy Patients
- Polymer Heart Valve
- Alcolgel
- Gloves Glacier

PRODUCTS

Anti Riot Helmet with Visor, Bullet Proof Jacket, Anti Riot Polycarbonate Shield, CAP Glacier, Bag Carrying Rescue, V-Packing Ring and Collar, Ballistic Helmet, Ecofriendly Coolant, Ballistic

Shield, Face Mask, Food Container Plastic, Gun Cleaning Solution, Jacket ECW, Poncho Glacier, High Energy & High Density Fuel, NBC Casualty Bag, Radar Absorbing Structures, Silicon Carbide Fibre, Recoil Fluid Oil, Survival Blanket.

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Website : <https://www.drdo.gov.in/labs-and-establishments/defence-materials-and-stores-research-and-development-establishment-dmsrde>

CONFERENCES/MEETINGS/SYMPOSIA/SEMINARS**INTERNATIONAL CONFERENCE ON EDUCATIONAL TECHNOLOGY, LEARNING AND SOCIAL SCIENCE (ICETLSS), 28TH-29TH DECEMBER 2021, MUMBAI, MAHARASHTRA**

The ICETLSS conference is an international forum for the presentation of technological advances and research results in the fields of Educational technology, learning and Social Science. The conference will bring together leading researchers, engineers and scientists in the domain of interest from around the world. We warmly welcome previous and prospected authors submit your new research papers to ICETLSS, and share the valuable experiences with the scientist and scholars around the world.

Conference Website : <http://scienceplus.us/Conference/18467/ICETLSS/>

INTERNATIONAL CONFERENCE ON INTER DISCIPLINARY RESEARCH IN ENGINEERING AND TECHNOLOGY, 03 JAN 2022-04 JAN 2022, NEW DELHI

The purpose of ICIDRET 2020, the International Conference on Inter Disciplinary Research in Engineering and Technology, is to bring together researchers, mathematicians, engineers and practitioners interested on security aspects related to Inter Disciplinary Research in Engineering and Technology. ICIDRET 2020 will be the most comprehensive conference focused on the various aspects of advances in Inter Disciplinary Research in Engineering and Technology. This Conference provides a chance for academic and industry professionals to discuss recent progress in the area of Inter Disciplinary Research in Engineering and Technology.

Categories : Industrial Engineering, IT & Technology

Conference Website link page : <https://www.eventalways.com/international-conference-on-inter-disciplinary-research-in-engineering-and-technology>

ICAGC 2022 : 16. INTERNATIONAL CONFERENCE ON APPLIED GREEN CHEMISTRY JANUARY 07-08, 2022, TOKYO, JAPAN

ICAGC 2022 : 16. International Conference on Applied Green Chemistry aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Applied Green Chemistry. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Applied Green Chemistry.

Conference Website link page: <https://waset.org/applied-green-chemistry-conference-in-january-2022-in-tokyo>

ICAA 2022 : 16. INTERNATIONAL CONFERENCE ON ADSORPTION ANALYSIS, JANUARY 28-29, 2022, NEW YORK, UNITED STATES

ICAA 2022 : 16. International Conference on Adsorption Analysis aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Adsorption Analysis. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Adsorption Analysis.

Conference Website link page : <https://waset.org/adsorption-analysis-conference-in-january-2022-in-new-york>

ICCSHE 2022 : 16. INTERNATIONAL CONFERENCE ON COGNITIVE SCIENCE AND HUMAN EXPERIENCE, FEBRUARY 04-05, 2022, BANGKOK, THAILAND

ICCSHE 2022 : 16. International Conference on Cognitive Science and Human Experience aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Cognitive Science and Human Experience. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Cognitive Science and Human Experience

Conference Website link page : <https://waset.org/cognitive-science-and-human-experience-conference-in-february-2022-in-bangkok>

1241ST INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN MEDICAL AND HEALTH SCIENCES (ICRAMHS), 1ST-2ND MARCH, 2022, DHAKA, BANGLADESH

The Academics World International Conference on Recent Advances in Medical and Health Sciences ICRAMHS aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Medical and Health Sciences. It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the fields of Medical and Health Sciences.

Conference Inquiry Email ID : info@academicsworld.org

Conference Website : <http://academicsworld.org/Conference2022/Bangladesh/1/ICRAMHS/>

S&T ACROSS THE WORLD

IIT-K SCIENTISTS DESIGN MOBILE PESTICIDE SPRAYER THAT RUNS ON SOLAR ENERGY

The device will save labour and time for small and marginal farmers. Scientists from IIT Kharagpur have developed a mobile pest-control device that runs on solar power. The semi-automated device will reduce the labour of farmers who have to manually spray pesticides or use fossil-fuel based machines for the same. The innovation, meant mostly for small and marginal farmers, will also ensure pesticides are not wasted and the distribution is uniform.

Prevention of pests during different growth stages of crops is important to increase yield. But the process is labour and time-intensive. In smaller tracts of lands, the farmers usually use knapsack sprayers in which the cultivator has to carry the entire volume of pesticide on their back while moving around the field to spray.

“This impacts the efficiency of spraying as it depends on the skill of the operator leading to non-uniformity in spraying,” the scientists said in a statement to the press.

The device resembles a vegetable cart with three wheels and a roof of solar panels. The main system consists of a propelling unit fitted with a liquid storage tank and a DC motor-operated pump to pressure the liquid to be sprayed, the press note described.

Multiple numbers of spray nozzles are mounted on a boom fitted to the front of the machine. An

operator is required to control the movement of the spraying unit.

“It can be easily operated in the field using solar energy with a maximum speed of two kilometres per hour, and can cover a width of 1.5 metres at a time with a field efficiency of 81 per cent, thus saving time, human involvement and chemicals,” remarked Hifjur Raheman, a professor in the department of agriculture, food engineering at the university and a member of the team that created the device.

Raheman conceptualised and designed the product with Anup Behera Rahul K and PBS Bhadoria from the department. They have filed a patent for the sprayer and it is ready for commercialisation.

About 82 per cent of the country's farming community is categorised as small or marginal, according to Food and Agriculture Organization. These farmers have less than two hectares of land, according to the Union Ministry of Agriculture & Farmers Welfare.

With the view to improve the condition of such farmers and to double their income by 2022, the government is focusing on technological innovations, read the institute's press statement. “This is an open call to the technical institutions in India to deliver in the field of precision agricultural technologies. In the IIT system, IIT Kharagpur has the sole distinction of having an agricultural and food engineering department. Hence it is our foremost responsibility to answer this call,” remarked Virendra K Tewari, director, IIT Kharagpur.

Source: <https://www.downtoearth.org.in/news/agriculture/iit-k-scientists-design-mobile-pesticide-sprayer-that-runs-on-solar-energy-75457>

DOG BRAINS DO NOT PREFER FACES

Even though dogs gaze into man's eyes, dog brains may not process faces as human brains do. A new study from *JNeurosci* suggests that the canine visual system is organized differently: the face network found in primates may not extend to all mammals.

Faces constitute a critical part of communication for humans and other primates, so much so that faces have a special status in their visual system. Areas in the face network, like the fusiform face area, activate specifically to faces. Dogs care about faces, too, but they may not have face areas. Bunford, Hernández-Pérez et al. used fMRI to compare the brain activity of humans and pet dogs as they watched brief videos of other humans and dogs. Human brains showed a preference for faces, meaning that some visual areas had greater activity in response to a face compared to the back of the head. A subset of these regions also displayed species preference, with increased activity in response to viewing a human over a dog. In contrast, dog brains only showed species preference. Visual areas had greater activity in response to seeing a dog over a human, and no activity difference between seeing a face vs. the back of the head.

Source: <https://www.sciencedaily.com/releases/2020/10/201005140825.htm>

CHILDHOOD DIET HAS LIFELONG IMPACT

Eating too much fat and sugar as a child can alter your microbiome for life, even if you later learn to eat healthier, a new study in mice suggests.

The study by UC Riverside researchers is one of the first to show a significant decrease

in the total number and diversity of gut bacteria in mature mice fed an unhealthy diet as juveniles.

“We studied mice, but the effect we observed is equivalent to kids having a Western diet, high in fat and sugar and their gut microbiome still being affected up to six years after puberty,” explained UCR evolutionary physiologist Theodore Garland.

A paper describing the study has recently been published in the *Journal of Experimental Biology*. The microbiome refers to all the bacteria as well as fungi, parasites, and viruses that live on and inside a human or animal. Most of these microorganisms are found in the intestines, and most of them are helpful, stimulating the immune system, breaking down food and helping synthesize key vitamins.

In a healthy body, there is a balance of pathogenic and beneficial organisms. However, if the balance is disturbed, either through the use of antibiotics, illness, or unhealthy diet, the body could become susceptible to disease.

In this study, Garland's team looked for impacts on the microbiome after dividing their mice into four groups: half fed the standard, 'healthy' diet, half fed the less healthy 'Western' diet, half with access to a running wheel for exercise, and half without.

After three weeks spent on these diets, all mice were returned to a standard diet and no exercise, which is normally how mice are kept in a laboratory. At the 14-week mark, the team examined the diversity and abundance of bacteria in the animals.

They found that the quantity of bacteria such as *Muribaculum intestinale* was significantly

reduced in the Western diet group. This type of bacteria is involved in carbohydrate metabolism.

Analysis also showed that the gut bacteria are sensitive to the amount of exercise the mice got. Muribaculum bacteria increased in mice fed a standard diet who had access to a running wheel and decreased in mice on a high-fat diet whether they had exercise or not.

Researchers believe this species of bacteria, and the family of bacteria that it belongs to, might influence the amount of energy available to its host. Research continues into other functions that this type of bacteria may have.

One other effect of note was the increase in a highly similar bacteria species that were enriched after five weeks of treadmill training in a study by other researchers, suggesting that exercise alone may increase its presence.

Overall, the UCR researchers found that early-life Western diet had more long-lasting effects on the microbiome than did early-life exercise.

Garland's team would like to repeat this experiment and take samples at additional points in time, to better understand when the changes in mouse microbiomes first appear, and whether they extend into even later phases of life.

Regardless of when the effects first appear, however, the researchers say it's significant that they were observed so long after changing the diet, and then changing it back.

The takeaway, Garland said, is essentially, "You are not only what you eat, but what you ate as a child!"

Source : ScienceDaily. ScienceDaily, 3 February 2021. <www.sciencedaily.com/releases/2021/02/210203090458.htm>.

ANCIENT PROTEINS PROVIDE EVIDENCE OF DAIRY CONSUMPTION IN EASTERN AFRICA

Consuming the milk of other species is a unique adaptation of *Homo sapiens*, with implications for health, birth spacing and evolution. Key questions nonetheless remain regarding the origins of dairying and its relationship to the genetically-determined ability to drink milk into adulthood through lactase persistence (LP). As a major centre of LP diversity, Africa is of significant interest to the evolution of dairying. Here we report proteomic evidence for milk consumption in ancient Africa. Using liquid chromatography tandem mass spectrometry (LC-MS/MS) we identify dairy proteins in human dental calculus from northeastern Africa, directly demonstrating milk consumption at least six millennia ago. Our findings indicate that pastoralist groups were drinking milk as soon as herding spread into eastern Africa, at a time when the genetic adaptation for milk digestion was absent or rare. Our study links LP status in specific ancient individuals with direct evidence for their consumption of dairy products.

Source: <https://www.nature.com/articles/s41467-020-20682-3>

BIOCHEMISTS SWITCH DNA FUNCTIONS ON AND OFF USING LIGHT

Biochemists use protein engineering to transfer photocaging groups to DNA. DNA (deoxyribonucleic acid) is the basis of life on earth. The function of DNA is to store all the genetic information, which an organism needs to develop, function and reproduce. It is essentially

a biological instruction manual found in every cell.

Biochemists at the University of Münster have now developed a strategy for controlling the biological functions of DNA with the aid of light. This enables researchers to better understand and control the different processes which take place in the cell – for example epigenetics, the key chemical change and regulatory lever in DNA.

The results have been published in the journal *Angewandte Chemie*.

Background and methodology

The cell's functions depend on special molecules, the enzymes. Enzymes are proteins, which carry out chemical reactions in the cell. They help to synthesize metabolic products, make copies of the DNA molecules, convert energy for the cell's activities, change DNA epigenetically and break down certain molecules.

A team of researchers headed by Prof. Andrea Rentmeister from the Institute of Biochemistry at the University of Münster used a so-called enzymatic cascade reaction in order to understand and track these functions better. This sequence of successive reaction steps involving different enzymes makes it possible to transfer so-called photocaging groups – chemical groups, which can be removed by means of irradiation with light – to DNA. Previously, studies had shown that only small residues (small modifications such as methyl groups) could be transferred very selectively to DNA, RNA (ribonucleic acid) or proteins.

“As a result of our work, it is now possible to transfer larger residues or modifications such as the photocaging groups just mentioned,” explains Nils Klöcker, one of the lead authors of the study and a PhD student at the Institute of Biochemistry.

Working together with structural biologist Prof. Daniel Kümmel, who also works at the Institute of Biochemistry, it was also possible to explain the basis for the changed activity at a molecular level.

Using so-called protein engineering – a method for which a Nobel prize was awarded in 2018 – the Münster researchers engineered one enzyme in the cascade, making it possible to switch DNA functions on and off by means of light. With the aid of protein design, it was possible to expand the substrate spectrum of enzymes – in this case, methionine adenosyltransferases (MATs). In their work, the researchers examined two MATs. The modifications carried out offer a starting point for developing other MATs with an expanded substrate spectrum.

“Combining these MATs with other enzymes has potential for future cellular applications. This is an important step for implementing in-situ generated, non-natural substances for other enzymes in epigenetic studies,” says Andrea Rentmeister.

Source: Angewandte Chemie. DOI: 10.1002/anie.202012623 <https://scitechdaily.com/biochemists-switch-dna-functions-on-and-off-using-light/>

THE SONGS OF FIN WHALES OFFER NEW AVENUE FOR SEISMIC STUDIES OF THE OCEANIC CRUST

The songs of fin whales can be used for seismic imaging of the oceanic crust, providing scientists a novel alternative to conventional surveying, a new study published this week in *Science* shows.

Fin whale songs contain signals that are reflected and refracted within the crust, including the

sediment and the solid rock layers beneath. These signals, recorded on seismometers on the ocean bottom, can be used to determine the thickness of the layers as well as other information relevant to seismic research, said John Nabelek, a professor in Oregon State University's College of Earth, Ocean, and Atmospheric Sciences and a co-author of the paper.

"People in the past have used whale calls to track whales and study whale behavior. We thought maybe we can study the Earth using those calls," Nabelek said. "What we discovered is that whale calls may serve as a complement to traditional passive seismic research methods."

The paper serves as a proof of concept that could provide new avenues for using data from whale calls in research, Nabelek said.

"This expands the use of data that is already being collected," he said. "It shows these animal vocalizations are useful not just for understanding the animals, but also understanding their environment."

The study's lead author is Vaclav M. Kuna, who worked on the project as a doctoral student at Oregon State and has since completed his Ph.D.

Kuna and Nabelek were studying earthquakes from a network of 54 ocean-bottom seismometers placed along the Blanco transform fault, which at its closest is about 100 miles off Cape Blanco on the Oregon Coast.

They noted strong signals on the seismometers that correlated with whales' presence in the area.

"After each whale call, if you look closely at the seismometer data, there is a response from the Earth," Nabelek said.

Whale calls bounce between the ocean surface and the ocean bottom. Part of the energy from

the calls transmits through the ground as a seismic wave. The wave travels through the oceanic crust, where it is reflected and refracted by the ocean sediment, the basalt layer underneath it and the gabbroic lower crust below that.

When the waves are recorded at the seismometer, they can provide information that allows researchers to estimate and map the structure of the crust.

Using a series of whale songs that were recorded by three seismometers, the researchers were able to pinpoint the whale's location and use the vibrations from the songs to create images of the Earth's crust layers.

Researchers use information from these layers to learn more about the physics of earthquakes in the region, including how sediment behaves and the relationship between its thickness and velocity. Earthquakes shake up the sediment, expelling water and speeding up the settlement of the sediment.

The current traditional method for imaging of the crust can be expensive and permits can be difficult to obtain because the work involves deploying air guns, Nabelek said. The imaging created using the whale songs is less invasive, though overall it is of lower resolution.

Future research could include using machine learning to automate the process of identifying whale songs and developing images of their surroundings, Nabelek said.

"The data from the whale songs is useful but it doesn't completely replace the standard methods," he said. "This method is useful for investigating the Earth's oceanic crust where standard science survey methods are not available."

Source: ScienceDaily, 11 February 2021. www.sciencedaily.com/releases/2021/02/210211171111.htm



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सदस्यता की शर्तें और सदस्यों की विशेषाधिकार :

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

- 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 है।
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 कृपया ISCA वेबसाइट से फार्म डाउनलोड करें।
- 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 रूप 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 है। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं है। सत्र सदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।
- छात्र सदस्य :** जो व्यक्ति स्नातक स्तर से नीचे पढ़ाई कर रहा है, उसे वार्षिक सदस्यता शुल्क ₹ 100/- मात्र देने पड़ेंगे अपना नाम छात्र सदस्य के रूप 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 सके, 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 प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसाय बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।
- 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 है। 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।

5. **संस्थान सदस्य** : एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के रूप में दे वही संस्था के संस्थान सदस्य उस वित्तीय वर्ष के लिए बन सकता है, (विदेशियों के लिए U.S. \$ 2,500)। इसमें वह विज्ञान कांग्रेस के वार्षिक सत्र में अपने एक व्यक्ति का नाम नामांकित कर सकता है, 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। इससे साथ वे संस्था के रोज़नामचा “एवरीमैन्स साइंस” की प्रति भी बिना मूल्य प्राप्त कर सकते हैं।

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 हैं, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के रूप 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।

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

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

(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।

(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।

(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।

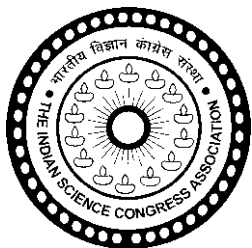
(ड) समय समय पर संस्था द्वारा तय की गई मूल्य दरों पर विश्रामगृह, सभागार आदि सुविधाओं की प्राप्ति भी सभी वर्गों के सदस्य कर सकते हैं।

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

ध्यान दें : (1) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, सदस्यता के विषय में बैंक ड्राफ्ट की प्राप्ति 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।



THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

Telephone : (033) 2287-4530, 2281-5323

Fax : 91-33-2287-2551

Website : <http://sciencecongress.nic.in>

E-mail : es.sciencecongress@nic.in

Terms of Membership and Privileges of Members :

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

- 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. 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. 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. 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. **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. **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.

* 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.

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

(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.

(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.

(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.

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

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

Note : (1) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association*, membership subject to realisation of the bank draft, 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 Form 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 envelop.



भारतीय विज्ञान कांग्रेस संस्था

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

दूरभाष : (033) 2287-4530, 2281-5323

फैक्स : 91-33-2287-2551

वेबसाइट : <http://sciencecongress.nic.in>

ई-मेल : es.sciencecongress@nic.in

सदस्यता के लिए नया आवेदन पत्र

सेवा में

महासचिव (सदस्यता कार्य)
भारतीय विज्ञान कांग्रेस संस्था
14, डॉ० बिरेश गुहा स्ट्रीट,
कोलकाता-700 017

महोदय,

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।

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

मैं निम्नलिखित विभाग में रुचि रखता/रखती हूँ (कृपया किसी एक में निशान लगाएँ)।

विभाग

1. कृषि और वानिकी विज्ञान
2. पशु, पशुचिकित्सा और मत्स्य विज्ञान
3. मानवशास्त्रीय और व्यवहारपरक विज्ञान (जिसमें सम्मिलित, हैं, पुरातत्व-विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)
4. रसायन विज्ञान
5. भू-पद्धति विज्ञान
6. अभियन्ता विज्ञान
7. पर्यावरण विज्ञान
8. सूचना और संचरण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)
9. भौतिक विज्ञान
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)
11. चिकित्सा शास्त्र (जिसमें शरीर विज्ञान भी सम्मिलित है)
12. नया जीवविज्ञान (जिसमें जीव रसायन, जीव भौतिकी और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी भी सम्मिलित है)

13. भौतिकीय विज्ञान

14. वनस्पति विज्ञान

(कृपया टंकित करें या ब्लॉक अक्षरों में भरें)

नाम (ब्लॉक अक्षरों में) :

श्री/सुश्री/श्री/श्रीमती/डॉ०/प्रो० (कृपया टिक करें)

कुलनाम

प्रथम नाम

मध्य नाम

शैक्षणिक योग्यता :

(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वतः सत्यापित जिराक्स प्रति संलग्न करना है)

पदनाम

सम्पर्क का पता :

(राज्य, शहर/नगर और पिन कोड सहित)

दूरभाष संख्या/मोबाईल संख्या और ई-मेल :

किसी भी सरकारी अनुमोदित पहचान पत्र (अनिवार्य) :

वर्तमान वर्ष विश्वविद्यालय प्रवेश-पत्र :

स्थायी पता :

दिनांक :

भवदीव

हस्ताक्षर

- ध्यान दें :**
- (i) सभी बैंक ड्राफ्ट The Indian Science Congress Association के नाम से ही लिखा जाएँ, सदस्यता के विषय में बैंक ड्राफ्ट प्राप्त और जो कोलकाता के किसी भी शाखा में देय हों।
 - (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।
 - (iii) भर्ती शुल्क ₹ 50/- सिर्फ एक नये वार्षिक सदस्य के लिए ज़रूरी है। वह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए ज़रूरी नहीं है।
 - (iv) सदस्यों से यह निवेदन किवा जा रहा है कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यालय के साथ पत्राचार के समय अवश्य करें।
 - (v) भारतीय विज्ञान कांग्रेस संस्था द्वारा मनीऑर्डर, आई. पी. ओ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जाएगा।
 - (vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता की नवीकरण के लिए) में विधिवत बिना भरने से नहीं लिया जाएगा।
 - (vii) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया डाक द्वारा लिफाफे के भीतर नकदी नहीं भेजें।



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Application Form For New Membership

To

The General Secretary (Membership Affairs)
The Indian Science Congress Association
14, Dr. Biresh Guha Street,
Kolkata-700 017

Stamp Size
Photograph

Dear Sir,

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)

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..... .

I am interested in the following section (Please tick any one).

Sections

1. Agriculture and Forestry Sciences
2. Animal, Veterinary and Fishery Sciences
3. Anthropological and Behavioural Sciences (including Archaeology, Psychology, Education and Military Sciences)
4. Chemical Sciences
5. Earth System Sciences
6. Engineering Sciences
7. Environmental Sciences
8. Information and Communication Science & Technology (including Computer Sciences)
9. Materials Science
10. Mathematical Sciences (including Statistics)
11. Medical Sciences (including Physiology)
12. New Biology (including Bio-Chemistry, Biophysics & Molecular Biology and Biotechnology)

13. Physical Sciences

14. Plant Sciences

(Please type or fill up in Block Letters)

Name (in Block Letters) :

Mr./Ms./Shri/Shrimati/Dr./Prof (Please tick)

Surname

First Name

Middle Name

Academic Qualifications :

Self attested xerox copy of last educational certificate/marksheet must be attached)

Designation

Address of communication :

(including state, city/town and pin code)

Phone No./Mobile Number & E-mail :

Any Govt. approved ID Card (Mandatory) :

Current Year University Admit Card :

Permanent Address :

Date :

Yours Faithfully

Signature

- Note :**
- (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association*, membership subject to realisation of the bank draft, Payable at any branch in Kolkata.
 - (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) Admission fess of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.
 - (iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.
 - (v) No Money Order, I.P.O., ECS or Cheque will be accepted by ISCA.
 - (vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership).
 - (vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.

----- (viii) -----



The Indian Science Congress Association

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

Telephone : (033) 2287-4530 / 2281-5323

Website : <http://sciencecongress.nic.in>

Fax : 091-33-2287-2551

E-mail : es.sciencecongress@nic.in

REMINDER

TO

ALL ANNUAL MEMBERS (2020-21)

RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2021-2022

Dear Sir/Madam,

1. Kindly fill up the renewal form given on the opposite page and remit ₹ 200/- by Bank Draft on a Kolkata Bank in favour of "The Indian Science Congress Association" to renew your membership for 2021-2022. No Cheque, Postal order or Money order will be accepted by ISCA.
2. For exercising **Voting Right** the enrolment of Annual Membership is required to be made by **July 15, 2021**. Subscription received after July 15, 2021 will be treated as Sessional Member.
3. Last date of receiving **full papers along with 3 copies of Abstracts** for presentation at the **108th Session of Indian Science Congress** to be held from 3-7 January, 2022 is **September 15, 2021**.
4. As per the resolution of the **Executive Committee** in its meeting held on **October 15, 2011**, 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'.
5. While sending your subscription, **Please quote your last year (i.e. 2020-2021 only) Annual membership number.**

If your subscription is already remitted, please ignore this letter.

Yours faithfully

Dr. S. Ramakrishna
General Secretary
(Membership Affairs)

N.B. : Sending of membership subscription without the duly filled in renewal form will not be accepted.



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APPLICATION FOR RENEWAL OF ANNUAL MEMBERSHIP SUBSCRIPTION FOR 2021-2022

Annual Membership Number :
(Last Year i.e. 2020-2021 only)

Name :

Middle Name :

Surname :

Affiliation :

Present Address (only for persons changing the address)

*If there is any change in the address as given earlier in your application, please state the original address mentioned previously.

Original Address :

+Enclosed Bank draft No. dt. of ₹ 200 (two hundred only)

Date : _____

Signature of the Applicant

Contact No : _____

+in favour of "*The Indian Science Congress Association*" payable at any branch of Bank in Kolkata.

GUIDELINES FOR SUBMISSION OF MANUSCRIPTS

1. Everyman's Science intends to Propagate the *latest message of science* in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. *Research articles* usually meant for publication in periodicals devoted to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman's Science. Instead, popular or easily intellegible expositions of new or recent developments in different branches of Science & Technology are welcome.
2. Manuscripts should be typewritten on one side of the paper with double spacing. Articles should be written generally in non-technical language and should not ordinarily *exceed 2000 words*. Articles must be understandable by the average enthusiastic readers with some modest scientific background but outside the field. It should not be a review article in a specialised area. Without being too technical, it must also reflect state of the art situation in the field. *A summary* in 50 words should be submitted along with the paper highlighting the importance of the work. *Two copies* of the manuscript complete in all respects should be submitted. The title should be written in capital letters and name(s) of the author(s) should be given along with the Department, Institution, City and Country of each author.
3. Illustration & Tables : the size of illustrations should be such as to permit reduction to about one-third. Legends and captions should be typed on a separate sheet of paper. Photographs should be on glossy paper with strong contrast in black and white. Typed tables should be separate pages and provided with titles and their serial numbers. The exact position for the placement of the tables should be marked in the script. Authors are specially requested to reduce the number of tables, illustrations and diagrams to a minimum (maximum of 3).
4. References : References to be given on a selective basis, (maximum of 10) and the order of placement should be numerically with (a) name(s) of the author(s) (surname last), (b) name of the journal in abbreviated form according to the 'World list of Scientific Periodicals' and in italics, (c) volume number (in bold) (d) page number and (e) year of publication.

For citations of books the author's name should be followed by the (a) title of the book, (b) year of publication or edition or both, (c) page number, (d) name of publishers, and (e) place of publication.

5. The Indian Science Congress Association and the Editors of Everyman's Science assume no responsibility for statements and opinions advanced by the contributors to the journal.

Reprints : The communicating author will receive 1 copy of the journal and 10 reprints free of cost.

All manuscripts and correspondences should be addressed to the *Hony, Editor, Everyman's Science, The Indian Science Congress Association 14, Dr. Biresw Guha Street, Kolkata-700 017.*
Email : iscacal@vsnl.net, iscacal_2004@yahoo.com, Fax : 91-33-2287-2551



THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, Dr. Biresh Guha Street, Kolkata - 700017

ISCA YOUNG SCIENTIST'S AWARD PROGRAMME : 2021-2022

To encourage Young Scientists, The Indian Science Congress Association has instituted a number of awards in different disciplines. These awards carry a sum of Rs.25,000/- besides a Certificate of Merit.

1. Applications are invited from members (Life & Annual) of the Association who have paid their subscription on or before **July 15, 2021**. The upper age limit of the candidates for the award is 32 years as reckoned on **December 31, 2021 (born on and after January 01, 1990)**.
2. Four copies of the abstract (not exceeding 100 words) along with four copies of full length paper must reach the office of the General Secretary (Membership Affairs) not later than **August 16, 2021**. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see <http://www.sciencecongress.nic.in/html/paper/presentations.php>
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website (http://www.sciencecongress.nic.in/html/young_sc_programme.php) with brief bio-data of the candidate (not exceeding 2 pages), list of publications, with copies of reprints of already published papers if any and a soft copy of the duly filled application form with scanned copies of enclosures (excluding reprints), full length paper and abstract in **MSWord (not PDF)** along with bio data in the form of a CD must also be sent simultaneously along with the hard copies.
4. The Paper submitted must be a **single author paper** and the research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
5. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference / Seminar / Symposium or submitted for consideration of any award.
6. A Young Scientist can present only one paper in any one Section (and not a second paper on the same or any other topic in any other Section).
7. A person who has already received Young Scientist Award in any section once will not be eligible to apply for the above Award in the same or any other section.
8. Incomplete Applications will not be considered.
9. The papers submitted will be subjected to verification for authenticity.
10. Full length paper will be evaluated by experts and the selected Young Scientists (**maximum of six**) in each section will be invited to make oral presentation of their paper during 108th Indian Science Congress. The selected candidates will be provided admissible travelling allowances by ISCA.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 108th Indian Science Congress session to be held on January 7, 2022.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving papers at ISCA Headquarters is **August 16, 2021**.

All correspondences should be made to: The General Secretary (Membership Affairs), The Indian Science Congress Association, 14, Dr. Biresh Guha Street., Kolkata-700017. Tel. Nos. (033) 2287-4530/2281-5323, Fax No. 91-33-2287-2551, Email: es.sciencecongress@nic.in, aes.sciencecongress@nic.in, Website: <http://www.sciencecongress.nic.in>