ISSN 0531-495X

Vol. LIII No.- 3 (AUG-SEP, 2018)

एवरीमैन्स साइन्स

EVERYMAN'S SCIENCE

Dr. G. Madhavan Nair (2010)

Prof. K.C.Pandey (2011)

Prof. Geetha Bali (2012)

Dr. Manmohan Singh (2013)

Prof. Dr. Ranbir Chander Sobti (2014)

Dr. Ashok Kumar Saxena (2016)

भारतीय विज्ञान कांग्रेस संस्था, कोलकाता

THE INDIAN SCIENCE CONGRESS ASSOCIATION, KOLKATA

MEMBERS OF THE COUNCIL FOR 2018-2019

General President
Dr. Manoj Kumar Chakrabarti, Kolkata

Immediate Past General President
Dr. Achyuta Samanta, Bhubaneswar

General President-Elect
Prof. K.S.Rangappa, Mysore

General Secretary (Membership Affairs)
Prof. Gangadhar, Bengaluru

General Secretary (Scientific Activities)
Prof. Premendu P. Mathur, Pondicherry

Treasurer
Prof. Ranjit Kumar Verma, Munger

Elected Members of the Executive Committee
Dr. (Mrs.) Vijay Laxmi Saxena, Kanpur
Mrs. Kumkum Swarup, Kanpur
Dr. Anoop Kr. Jain, Mumbai
Dr. S.Ramakrishna, Bengaluru
Prof. M. Bhupathi Naidu, Tirupati
Prof. D. Narayana Rao, Guntur
Prof. Sasmita Rani Samanta, Bhubaneswar
Prof. Subodh Kumar Jain, Sagar
Prof. S.V. Kasmir Raja, Kattankulathur
Prof. Naresh Padha, Jammu

Representative of Department of Science & Technology, Government of India
Dr. Praveer Asthana, New Delhi

Local Secretaries
Mrs. Rashmi Mittal, Jalandhar
Dr. Monica Gulati, Jalandhar

Past General Presidents
Prof. M.S. Swaminathan, Chennai
Prof. R.P. Bambah, Chandigarh
Prof. C.N.R. Rao, Bengaluru
Prof. D.K. Sinha, Kolkata
Dr. S.C. Pakrashi, Kolkata
Prof. S.K. Joshi, New Delhi
Dr. P. Rama Rao, Hyderabad
Dr. (Mrs.) Manju Sharma, New Delhi
Dr. R.A. Mashelkar, Pune
Dr. R.S. Paroda, New Delhi
Prof. S.S. Katiyar, Kanpur
Dr. K. Kasturirangan, Bengaluru
Prof. Asis Datta, New Delhi
Prof. N.K. Ganguly, Faridabad
Prof. Harsh Gupta, Hyderabad
Prof. R. Ramamurthi, Tirupati
Dr. T. Ramasami, Chennai
Dr. G. Madhavan Nair, Trivandrum
Prof. K.C. Pandey, Lucknow
Prof. Geetha Bali, Bengaluru
Dr. Manmohan Singh, New Delhi

Past General Presidents (Contd.)
Prof. Dr. Ranbir Chander Sobti, Lucknow
Dr. Ashok Kumar Saxena, Kanpur

Past General Secretaries
Dr. (Miss) Shashi Prabha Arya, New Delhi
Prof. H.P. Tiwari, Allahabad
Prof. S.P. Mukherjee, Kolkata
Dr. (Mrs.) Yogini Pathak, Vadodara
Prof. Uma Kant, Jaipur
Prof. B. Satyanarayana, Hyderabad
Prof. B.P. Chatterjee, Kolkata
Prof. S.P. Singh, Kurukshetra
Prof. Avijit Banerji, Kolkata
Dr. Nilangshu Bhusan Basu, Kolkata
Prof. Arun Kumar, Imphal

Past Treasurers
Dr. S.B. Mahato, Kolkata
Prof. Dhyanendra Kumar, Arrah

Sectional Presidents
Dr. Sujay Rakshit, Ludhiana
Prof. Kuldeep K.Sharma, Jammu
Dr. Soibam Jibonkumar Singh, Imphal
Prof. Jagdamba Singh, Allahabad
Prof. J.P. Shrivastava, Delhi
Prof. Swami Vedajnananda, Kolkata
Dr. Indra Dutt Bhatt, Almora
Dr. Ratnadeep Raghunathrao Deshmukh, Aurangabad
Prof. K. Byrappa, Mangalagangotri
Prof. Nandadulal Bairagi, Kolkata
Prof. Prakash Chandra Dhara, Midnapore
Dr. Chinmay Kumar Panda, Kolkata
Prof. (Dr.) Vijay Janardhan Fulari, Kolhapur
Prof. (Mrs.) Seshu Lavania, Lucknow

Elected Members of the Council
Mr. Gauravendra Swarup, Kanpur
Dr. Nibedita Chakrabarti, Kolkata
Prof. Sunil Prakash Trivedi, Lucknow
Dr. M.G. Ragunathan, Chennai
Dr. C.A.Vasuki, Coimbatore
Prof. B. Reddya Naik, Hyderabad
Prof. C. Muthamizhchelvan, Kattankulathur

Representative of The Kolkata Municipal Corporation
Mr. Samiran Ghosh, Kolkata

Editor-in-Chief of Everyman's Science
Dr. Ashok Kumar Saxena, Kanpur

Representative of Indian National Science Academy (INSA) Council
Prof. N.R. Jagannathan, New Delhi

EVERYMAN'S SCIENCE

Vol. LIII No. 3 (August-September '18)

COVER PHOTOGRAPHS

Past General Presidents of ISCA

1. Dr. G. Madhavan Nair	**(2010)**
2. Prof. K.C. Pandey	**(2011)**
3. Prof. Geetha Bali	**(2012)**
4. Dr. Manmohan Singh	**(2013)**
5. Prof. Dr. Ranbir Chander Sobti	**(2014)**
6. Dr. Ashok Kumar Saxena	**(2016)**

Printed and published by Dr. Ashok Kumar Saxena on behalf of Indian Science Congress Association and printed at East India Photo Composing Centre, 69, Sisir Bhaduri Sarani, Kolkata, 700006 and published at Indian Science Congress Association, 14, Dr. Biresh Guha Street, Kolkata-700017, with Dr. Ashok Kumar Saxena as Editor.

Annual Subscription : (6 issues)

Institutional ₹ 500/-; Individual ₹ 300/-

Price : ₹ 20/- per issue

CONTENTS

EDITORIAL :

IMPACT OF OBESITY ON REPRODUCTIVE HEALTH OF WOMEN
Rashmi Sinha 139-140

ARTICLES :

THE EMERGENCE OF BIOSENSORS: POTENTIALITIES AND SCOPE IN FOOD SAFETY
Srinivas K, T. Srinivasa Rao and Ch. Bindu Kiranmayi 141-144

GENETIC POLLUTION: CAUSES AND EFFECTS
Monica Bhatt, Neeraj K Mishra, Amit Kumar, Neeta Azad, Pratibha Chaudhary and Rajeev Singh 145-148

GENETICS BASIS OF DISEASE RESISTANCE IN CHICKEN
M. Jeyakumar, R. Saravanan, M. Malarmathi and P. Ganapathi 149-154

ELECTROLYZED WATER : A GREEN CONCEPT FOR SANITATION OF FRUITS AND VEGETABLES
Archana T Janamatti and Rama Krishna K 155-159

BIOCONTROL : AN ECOFRIENDLY PEST MANAGEMENT TECHNIQUE
Moina Khan and Ahmad Pervez 160-164

THE JOURNEY OF OPIUM POPPY: FROM ANCIENT MESOPOTAMIA TO GOLDEN TRIANGLE
R. B. Mohanty and T. Panda 165-167

APPLICATION ASPECTS OF WAX DEGRADING BACTERIA FOR SUSTAINABLE CROP PRODUCTION
N. Arunkumar, J. Gulsar Banu, N. Gopalakrishnan and A. H. Prakash 168-172

PLANT-BASED TRADITIONAL FOOD FOR NUTRITIONAL SECURITY IN INDIA: NEED, ISSUES AND CHALLENGES
Ruparao T. Gahukar 173-181

WATER: CSIR-CSMCRI PREPARES THE ROAD-MAP FOR THE PEOPLE
N. Pathak and A. Bhattacharya 182-191

KNOW THY INSTITUTIONS 192-195

CONFERENCES/MEETINGS/SYMPOSIA/SEMINARS 196-197

S & T ACROSS THE WORLD 198-201

EDITORIAL

IMPACT OF OBESITY ON REPRODUCTIVE HEALTH OF WOMEN

Obesity is a worldwide public health concern having detrimental influences on multiple health systems. Owing to its potential health burden, obesity has been identified as a global epidemic by the World Health Organization (WHO). Majority of the research work relating obesity to health problems have paid particular attention to chronic diseases such as cardiovascular ailments, hypertension and diabetes, however, the impact of obesity on female reproductive health has received less attention. Due to globalization, our country has undergone rapid development and a modern infrastructure has been established. Women have undergone significant changes in lifestyle that parallel the rapid development of the country, including transition from deficiency diseases and undernutrition to degenerative diseases associated with overnutrition. These changes may lead to a rise in risk factors for chronic diseases and changes in reproductive factors in women.It is essential to understand the risks of obesity on reproductive functions as ultimately the burden of this impact will be borne by future generations.

Obesity has been found to play a very crucial role in negatively affecting the women of reproductive age. The risk of developing obesity associated reproductive consequences is correlated with increasing body mass index (BMI) - an index of obesity. Increased BMI may trigger many reproductive risks and outcomes including irregular menstrual cycle, miscarriage, infertility, caesarean section, birth defects, still birth and endometrial cancer. Various metabolic disorders induced by overweight and obesity conditions, like insulin resistance can also be considered as significant factors promoting the development of polycystic ovarian syndrome (PCOS), a condition characterized by the presence of oligomenorrhea (infrequent menestruation) and hyperandrogenism (excessive level of male sex hormone in female body). The association between one's weight and reproductive health has emerged as an important aspect with overweight and/or obese females having a greater incidence of reproductive-related disorders. Obesity, or too much body fat, has become a serious health threat for women at every stage of life.There is a direct association of obesity with menstrual irregularities and infertility conditions. Apart from BMI, obesity may also impair female reproductive health by affecting hormonal balance and ovarian and endometrium functions. The female reproductive system involves a complex interaction of hypothalamus, pituitary gland and the ovaries (HPO). In overweight and obese women, the neuro-regulation of HPO cycle deteriorates which leads to disturbances in ovarian functions.

Although previous researches have cited multiple components of obesity that influence

various stages of reproductive process, but the exact mechanism behind this process has not been documented yet. Understanding the complex association between obesity and reproductive function requires a systematic and trans-disciplinary approach as both of these systems are influenced by biological, environmental and socio-economic factors. Furthermore, public awareness is required to increase the knowledge on reproductive sequels of obesity. Weight loss in obese infertile women results in improvement in reproductive outcome for all forms of fertility treatment. Females should be educated and encouraged to maintain healthy lifestyle to reduce the risk of obstetrical problems caused by obesity.

Dr. Rashmi Sinha
Indira Gandhi National Open University, New Delhi

A healthy body is a guest-chamber for the soul; a sick body is a prison

— Sir Francis Bacon

THE EMERGENCE OF BIOSENSORS: POTENTIALITIES AND SCOPE IN FOOD SAFETY

Srinivas K, T. Srinivasa Rao and Ch. Bindu Kiranmayi

Increasing world population is a well known fact and increase in food production is one of its direct consequences but even in such situations, safety of food is not to be compromised. Several conventional methods are already in existence for upholding food safety; however they might not be able to cope up with the humongous pressure on food industry. Thus modern biotechnological intervention such as biosensor technology can be used to fill the void left in food safety in detecting food-borne pathogens, drug residues and heavy metals. It can provide rapid and reliable results, but the idea of its use in food safety is in its adolescence and needs suitable troubleshooting before they can set sail in commercial markets.

INTRODUCTION

Food borne pathogens pose a major threat to the welfare of people in terms of health and economy. Lapses in hygienic food habits may result in diseases ranging from mild nausea, vomiting and diarrhoea to fatal cancers. The WHO South East Asian Region, which consists of India, ranks second among WHO regions in terms of food borne disease per population[1]. Apart from food-borne diseases, a major area of concern in food safety is presence of veterinary drug residues. Commonly encountered drug residues belong to the class of antibiotics, followed by pesticides and hormones. Another major concern is the presence of heavy metals in food which causes adverse health effects of which Minamata and Itai-Itai diseases are good examples.

Conventional methods for detection of chemical and microbial hazards in food have their own drawbacks. Though they are highly sensitive and specific, they are time consuming and may not be able cope up with the increasing demands and market size of food industry[2].

Thus many technologies are being developed and tested to face the aforementioned shortcomings. Biosensor technology is one among them, with an aim to address various issues in food safety as one of its major objectives[3].

A biosensor is a fabricated receptor-transducer device, capable of providing analytical information (qualitative and quantitative) using a biological recognition element. Biosensor is an interdisciplinary research venture among the

Department of Veterinary Public Health and Epidemiology, NTR College of Veterinary Science, Gannavaram, Krishna District, Andhra Pradesh, India. Email: tumatisrinivas2001@gmail.com

fields of analytical biochemistry, biology and microelectronics[4].

BRIEF HISTORY

The development of biosensors set sail in the year 1962 with the use of enzyme based electrodes for glucose estimation by Dr. Leland C. Clark Jr., who is rightfully called as "father of biosensors". However, the term "biosensors" was coined by Karl Cammann in the year 1972 and has been scientifically defined by International Union of Pure and Applied Chemistry (IUPAC).

PRINCIPLE

The "biosensor" technology works on the principle of conversion of a biologically induced recognition event into a detectable signal (transduction) and readings are obtained on screen after a series of processing. The biologically induced recognition events may be in the form of enzyme substrate reaction, antigen-antibody binding, etc. Upon recognition, a physico-chemical change is generated on the transducer surface, resulting in a signal which is directly measured or converted into another signal which is suitably interpreted and visualized[2].

COMPONENTS

As the name suggests, the word "biosensors" is an amalgamation of two essential components namely, biological component and sensing (or) physical component[2]. The biological element consists of sensitive bio-element and the analyte under question, whereas the physical element consists of transducer and amplifier. Enzymes, living cells, antibodies, etc. can be used as biological elements. However, the physical elements especially transducer component is highly variable, as they include temperature, electromagnetic radiation, electric potential, electric current, mass, viscosity, etc.

SCOPE IN FOOD SAFETY

The scope of biosensors in food safety lies with the need to detect the hazards in food at a faster and cheaper rate. Since its inception, the biosensor technology has undergone fabrications and developments and they were gradually and systematically tested for its use in the field of food safety. The main advantage of biosensor technology is that it can be used to quantify non polar molecules[5]. Some of the developments and future prospects in food safety are:

Detection of food borne pathogens and toxins

The Surface Plasmon Resonance (SPR) based biosensors (optical biosensors) have been developed by various scientists for different organisms such as *E. coli* with a detection time of 20 minutes, *Salmonella* spp. and *Campylobacter*[2]. Other latest procedures under development are biosensor technology using immuno-magnetic separation technology, aptamer and Quantum Dots (QD). A less significant microbial hazard is the presence of toxins. Biosensors have also been already developed for detection of Staphylococcal Enterotoxin A (SEA)[6] and marine shellfish toxins[7] in food.

Detection of veterinary drug residues

Veterinary drug residues have emerged as a major public health concern over the last few years. Biosensor technology has been effectively applied in detection of antibiotics in poultry meat and pork[5]. The sensitivity and specificity in detection of antibiotic residues is comparable to that of immunological assays. Biosensors have also been successfully developed to screen milk for antibiotic residues[8]. Affinity type biosensors have been developed for monitoring of hormones[9]. Optical, electrochemical, acoustic biosensors have been developed based on

acetylcholinesterase enzyme inhibition to detect pesticides in food[2].

Detection of heavy metals

Biosensor technology also finds its application in detection of heavy metals owing to its sufficiently high sensitivity for the detection of heavy metal ions at a cheaper cost. It has been demonstrated that this technology can be used to detect cadmium[10], mercury and other metals such as aluminium[2].

DISADVANTAGES AND TROUBLE-SHOOTING

In spite of possessing potential to become a go-to technology in the future, it does have few disadvantages that need to be addressed to increase its chances of feasibility in the field as well as its marketability[11]. A majority of the literature reviewed suggested the following disadvantages:

- Heat sterilization
- Modification of biosensor by the analytes - resulting in single uses
- Physical and chemical changes may significantly influences the equilibrium of the components involved in the detection process
- Durability issues
- Portability issues
- Cost of development

The methodology of troubleshooting for the disadvantages have been emphasized by various authors belonging to various disciplines. It would be wise enough if they are discussed on a common platform to arrive at an augmented solution[9]. These efforts are to be aimed at:

- Reducing cost of development
- Multifunctional and versatile
- Easy to handle
- Multiple-array analysis
- Portability
- Integration

INTEGRATION WITH CONTEMPORARY METHODS

Integrating the Biosensor technology with other methods involved in assessing the food quality have been suggested a bit more frequently in the recent years as they endorse the chances of complementing and supplementing each other. Some technologies suggested for integration are PCR (Polymerase Chain Reaction) - based detection, Nucleic acid Sequence based Amplification (NASBA), Microfluidics, Quantum dots (QD) and Nanotechnology. Though efforts to integrate microfluidics and nanotechnology are already in action, they still require further refinement.

PCR based methods have long been in practice to ascertain microbiological safety of food. It has evolved over the years to very much suit the requirements in field. Some of the advancements are multiplex PCR, Real Time PCR (RT-PCR). Multiplex PCR allows for simultaneous detection of various pathogen in a single cycle. RT-PCR gives real time values and curtails the necessity for Post-PCR processing on agarose gels. Recently RT-PCR based kits are available commercially for detection of pathogens such as *Escherichia coli* and *Campylobacter*[12].

NASBA is a sensitive method which was conceived to the world as recent as 1991 by Compton. It uses an enzyme triplet to selectively amplify RNA[13]. The efforts to exploit the benefits of this technology have already been initiated and methods have been developed to use this technology in the detection of some food-borne pathogens such as *Campylobacter jejuni*, *Listeria monocytogenes*, etc[13]. Molecular based methods

have their own advantages and disadvantages[12] in terms of their applications in food safety which needs to be assessed before venturing for chances of integration.

Quantum Dot method is another interesting fast growing technology and it has its stronghold in terms of signal detection. Quantum dots are fluorescent nanocrystals which have the properties of a semiconductor[14]. This technology has not crossed the borders of research and development for a majority of time. However it is mooted to be a good solution for various technologies which have their drawback in terms of signal detection.

Microfluidics based method such as lab-on-chip devices has been suggested to overcome the limitations of molecular methods[15] and biosensors[16]. It allows for increased throughput with small amount of sample requirement and assurance of sensitivity.

CONCLUSION

Biosensor is an emerging technology with its own advantages and disadvantages over other methods used in food safety. The advantages are that its rapidity and reliability whereas its disadvantages are its cost of development. It is wise to conclude that biosensor technology still requires adequate amount of incubation period in laboratories before they set sail in commercial markets.

REFERENCES

1. NCDC, CD Alert: Food Borne Diseases and Food Safety in India 2017.
2. J. Yasmin, M. R. Ahmed, and B. Cho, *J. of Biosystems Eng.*, **41**, 3, 240-254, 2016.
3. H. Yang, H. Li, and X. Jiang, *Microfluidics and Nanofluidics*, **5**, 5, 571-583, 2008.
4. K. M. Naik, D. Srinivas, B. Sasi, and S. K. J. Basha, *Int. J. Pure App. Biosci.*, **5**, 4, 1219-1227, 2017.
5. N. A. Mungroo and S. Neethirajan, *Biosensors*, **4**, 472-493, 2014.
6. S. Wu, N. Duan, H. Gu, L. Hao, H. Ye, W. Gong and Z. Wang, *Toxins*, **8**, 176, 1-20, 2016.
7. D. A. McPartlin, M. J. Lochhead, L. B. Connell, G. J. Doucette and R. J. O'Kennedy, *Essays Biochem*, **60**, 49-58, 2016.
8. K. Jayalakshmi, M. Paramasivam, M. Sasikala, T. V. Tamilam and A. Sumithra, *J. Entomol. Zool. Stud*, **5**, 3, 1446-1451, 2017.
9. M. S. Thakur and K. V. Ragavan, *J. Food Sci. Technol*, **50**, 4, 625-641, 2013.
10. N. Verma, S. Kumar and H. Kaur, *J Biosens Bioelectron*, **1**, 102, 1-3, 2010.
11. P. Meena, Arvind and A. D. Tripathi, *Int.J.Curr.Microbiol.App.Sci*, **6**, 4, 576-585, 2017.
12. J. W. Law, N. A. Mutalib, K. Chan and L. Lee, *Front Microbiol*, **5**, 770, 1-19, 2015.
13. M. Fakruddin, R. M. Mazumdar, A. Chowdhury and K. S. B. Mannan, *Int. J. Life Sci. Pharma Res.*, **2**, 1, 106-121, 2012.
14. N. Hildebrandt, C. M. Spillmann, W. R. Algar, T. Pons, M. H. Stewart, E. Oh, K. Sususmu, S. A. Diaz, J. B. Delehanty and I. L. Medintz, *Chem. Rev.*, **117**, 536-711, 2017.
15. A. Lauri and P. O. Mariani, *Genes Nutr*, **4**, 1-12, 2009.
16. G. Luka, A. Ahmadi, H. Najjaran, E. Alocilija, M. DeRosa, K. Wolthers, A. Malki, H, Aziz, A, Althani and M. Hoorfar, *Sensors*, **15**, 12, 30011-30031, 2015.

GENETIC POLLUTION: CAUSES AND EFFECTS

Monica Bhatt[1], Neeraj K Mishra[1], Amit Kumar[1,2], Neeta Azad[1], Pratibha Chaudhary[3] and Rajeev Singh[1*]

Genetic engineering is a very useful technique as per the agricultural or animal breeding aspects. We can modify the genes of an organism to improve or change its properties. This modification sometime undesirably spreads into the neighbouring species via pollination or cross breeding which might either improve or deteriorate the properties of the organism. This unwanted deterioration of natural organisms due to genetically tailored one's cause genetic pollution. Genetically modified species have been extensively synthesized over recent years increasing the risk of genetic pollution more than ever.

INTRODUCTION

Genetic pollution is the contamination of unaltered or natural organisms with modified genes from the genetically hybridised organisms. According to environmentalists[1] and various groups, genetic pollution is an undesirable phenomenon. Earlier it was described as the gene flow from domestic, non-native sub species to wild native population but lately it has been termed as the flow of genes from genetically engineered species to non-GE species. There are many terms given to this change like genetic deterioration, genetic aggression, genetic mixing, but none has been collectively agreed upon. Hence, the definition of genetic pollution remains a dispute as far as now.

The first genetically modified plant was an antibiotic tobacco plant which was introduced as the first GMO in 1983. The history of genetic pollution goes back to 1854 when an Austrian monk, Gregor Mendel discovered the Theory of Inheritance through experiments involving breeding of pea plant. Mendel was able to explain the very basic form of inheritance and assumed that some heritable material is present in the pea plant which is able to transmit its traits to the offspring plant. About a century later, in 1962, Francis Crick and James Watson[2] won the Nobel Prize in Medicine for deciphering the structure of DNA which is till date the basis of inheritance.

[1]Material/Organometallics Laboratory, Department of Chemistry, Atma Ram Sanatan Dharma College, University of Delhi, New Delhi-110021, India; [2]Japan Advanced Institute of Science and Technology (JAIST), 1-1 Asahidai, Ishikawa 923-1292, Japan; [3]Department of Chemistry, Maitreyi College, University of Delhi, New Delhi-110021 India E-mail: rajeev@arsd.du.ac.in

GENETIC MODIFICATION

The DNA molecule consists of two chains that twist around each other forming an anti-parallel double helix structure. The discovery of DNA was due to the idea of its sequence which carries all the genetic information of any organism. Some nitrogenous bases called pyrimidines and purines are arranged in a specific manner in the DNA molecule itself in order to create a code which is transferred into a protein in the cell as a part of the creed of central biology. DNA is the basic unit of inheritance among the other larger units. One of those large units is gene which has the code for some product protein.

The main idea behind Genetic Modification is to find such genes within an organism which can be modified and then transmitted into target organism to finally get the desired characteristic bearing species. It can be seen as an argument with the fundamental facts of nature which has its ill effects at very microscopic level summing up to genetically derived pollution.

Genetic engineering has made possible to modify plants and other organisms[3, 4]. In order to acquire desirable properties, new genes from any other species can be inserted into the subject species. These inserted genes are known as *Transgenes*[5]. In few cases, the gene of the subject specie is taken out in order to compare the nature and properties of the organism. Various changes are made genetically to study the changes in behaviour and characteristics. This change that takes place due to genetic modification has been termed as "undesirable" by organisations such as Greepeace[6] and TRAFFIC[7].

Table 1: Genetically engineered crops in this table include the crops that have insect-resistant traits or crops that have herbicide tolerance traits, or both[8].

Year	GE corn		GE soybeans		GE cotton	
	Million acres planted	Percent of corn acres	Million acres planted	Percent of soybean acres	Million acres planted	Percent of cotton acres
2000	19.89	25	40.1	54	9.47	61
2001	19.68	26	50.37	68	10.88	69
2002	26.82	34	55.47	75	9.91	71
2003	31.44	40	59.46	81	9.84	73
2004	38.04	47	63.93	85	10.38	76
2005	42.53	52	62.67	87	11.25	79
2006	47.78	61	67.21	89	12.68	83
2007	68.27	73	58.91	91	9.42	87
2008	68.79	80	69.66	92	8.15	86
2009	73.42	85	70.48	91	8.05	88
2010	75.85	86	71.99	93	10.21	93
2011	81.21	88	70.46	94	13.25	90
2012	85.5	88	71.79	93	11.58	94
2013	87.64	90	72.29	93	9.23	90

GENETIC POLLUTION IN PLANTS AND ANIMALS

Gene flow can take place undesirably from genetically tailored organism to non-genetically modified one. This flow of genes may occur via cross pollination, water pollination or animal pollination. Seeds of the genetically modified organism may reach the non-modified organisms through animals, water or cross-pollination. Genetic pollution can also occur through the mating of wild and modified organisms, producing hybrids. This undesired mixing might cause genetic pollution by interfering with the genetics of the other organisms.

The process of gene flow for animals is about same as plants although it is not very common as the genetic pollution in plants. The gene flow from one animal to other can cause genetic pollution by altering certain properties of the animal. Genetic pollution in animals is a very serious issue as it can pose harmful effect on that particular breed of organisms and sometimes can make them extinct.

HOW DOES GENETIC MODIFICATION CAUSE POLLUTION?

- GMOs or Genetically modified organisms can cross pollinate and it becomes extremely impossible to clean the whole genetic pool.
- A survey[9] in US from 1996 to 2008 showed that a larger amount of herbicides and pesticides were required to use on the GMOs as compared to the non-GM plants. This may reduce the value of nutrients and increase the risk of "superweeds" which are resistant of herbicides.
- Genetically Modified crops and the extensive use of herbicides can harm birds, marine ecosystems, insects, amphibians and soil organisms. They reduce pollute water resources, bio-diversity and are unsustainable. For example, GM crops are eliminating habitat for monarch butterflies, whose populations are down 50% in the US[10].
- Contrary to the claim, the yield of the GMOs is less as compared to the natural products.

HOW TO CHECK THE ILL EFFECTS OF GENETIC POLLUTION?

- While purchasing food products one should always look for genetically engineered free products in order to resist from consuming polluted food.
- New age modification should be developed which is not transferable or contaminable to other crops or animals.
- Extensive use of herbicides and pesticides will deteriorate the quality of both natural and modified crops which should be strictly avoided.
- There should be a limit or restriction over the percent of modification done in the genes. The modification must only be done to improve certain properties lacking in the organism and not to completely modify it.

FEW FACTS

- US, Brazil, Argentina, India and Canada are the countries producing 90% of genetically modified food products[11].
- 93% or more Soybean produced in US is bioengineered[12].
- Herbicide tolerant genetically engineered crops have created weed resistance causing the pesticide use to increase by 70 million pounds within the period of 1996 to 2003.
- Scientists from Taiwan have created a glow-in-the-dark pig in 2006 by inserting the genes of jellyfish in the pig's embryo.

CONCLUSION

Genetic modification of plants and animals has been a boon in many ways but since everything has its advantages and disadvantages; genetic pollution became the ill effect of GMOs. Many new species have been derived by gene altering to improve the weak characteristics of organisms. The undesired cross-pollination in plants and cross-breeding in animals has brought about some unwanted changes in field of genetic modification which is a challenge for the scientists. The contaminated species cannot be brought back to their natural self hence genetic pollution has become an irreversible process. There are very few steps taken collectively to stop this unfortunate situation where many of naturally occurring species are on the verge of extinction. We must proceed with caution to avoid causing unintended harm to the human health and use this technique for the betterment of the humankind.

REFERENCES

1. A. Zaid, H.G. Hughes, E. Porceddu, F. Nicholas, Glossary of Biotechnology for Food and Agriculture - A Revised and Augmented Edition of the Glossary of Biotechnology and Genetic Engineering. A FAO Research and Technology Paper ISSN 1020-0541. Food and Agriculture Organization of the United Nations. ISBN 92-5-104683-2, 2001.
2. R. Dahm, *Dev. Biol.*, **278,** 2, 274-288, 2005.
3. A. Barta, K. Sommergruber, D. Thompson, K. Hartmuth, M. Matzke, & A. Matzke, *Plant Mol. Biol.*, **6**, 347–357
4. P Beyer, S Al-Babili, X Ye, P Lucca, P Schaub, R Welsch & I Potrykus, *Journ. of Nutr.*, **132**, 506-510, 2002.
5. Bryan D. Ness, Encyclopedia of Genetics. Revised Edition. Salem Press Inc, Pasadena, California, 2004.
6. Greenpeace, "Say no to genetic pollution" (n.d.) http://www.greenpeace.org
7. When is wildlife trade a problem? hosted by TRAFFIC.org, the wildlife trade monitoring network, a joint programme of WWF and IUCN-The World Conservation Union.
8. http://2012.igem.org/wiki/index.php?title=Team:Tianjin/Modeling/Human&oldid=297757
9. E Andrianantoandro, S Basu, D K Kariga and R Weiss, *Mol. Syst. Biol*. **2,** 2006.
10. R G Wilson, S D Miller, P Westra, A R Kniss, P W Stahlman, G W Wicks, S D Kachman, *Weed Technol*. **21,** 4, 900–909, 2007.
11. Timo, Kaphengst, Nadja El Benni, E. Clive, F. Robert, H. Sophie, M. Stephen, S. Nataliya 2011, Assessment of the Economic Performance of GM Crops Worldwide ENV.B.3/ETU/2009/0010. Report to the European Commission, March. Ecologic Institute, Berlin, 2009.
12. Cornejo-Fernandez, Jorge, W. Seth, L. Mike, M. Lorraine Genetically Engineered Crops in the United States, ERR-162 U.S. Department of Agriculture, Economic Research Service, February 2014.

GENETICS BASIS OF DISEASE RESISTANCE IN CHICKEN

M. Jeyakumar, R. Saravanan, M. Malarmathi and P. Ganapathi

Natural resistance to disease has been recognised for a long time as an important factor in disease control. There are two types of resistance to infectious diseases: resistance to infectious and resistance to disease development. Resistant to infection or true resistance reduces or prevents infection and is rare. It is usually specific for a pathogen and inherited in Mendelian fashion. Resistance to disease development or disease tolerance is less specific with regard to type of pathogen.

INTRODUCTION

A basic tenet in all considerations of disease in poultry is that the genetics of a bird or a flock defines the maximum disease-resistance potential available. One gene family, the MHC, has long been the subject of intense investigation for its role in disease resistance. A response to a wide array of pathogens has been demonstrated to be associated, in part, with the major histocompatibility complex. Many other candidate genes with a proven or potential role in disease resistance can also be identified: cytokine genes, CD-encoding genes, T cell receptor genes, Nramp1, growth hormone, and the immunoglobulin genes. But resistance to most diseases is likely controlled by polygenes. Both physiological genetic and molecular genetic approaches can be used to investigate polygenic control of immune response and disease resistance. Divergent genetic selection for immune competence traits or disease resistance can produce genetic lines to study for correlated changes in their physiology and genetics. These divergent lines can also be crossed to generate populations suitable for mapping molecular markers for desirable performance. Genetic selection, aided by molecular markers, can be used to improve resistance to disease. But, ultimately, a detailed understanding of the genetic basis of immune response modulation will be needed to fully exploit the discoveries of modern molecular genetics in improving poultry health.

Department of Animal Genetics and Breeding, Veterinary college and Research Institute, Namakkal-637002, Tamil Nadu. Email: drjaikumar007@gmail.com

RESISTANCE AND SUSCEPTIBILITY STUDIES FOR CERTAIN DISEASES IN POULTRY

Among the different diseases, the three important diseases causing great havoc to the poultry industry are Marek's disease, Avian lymphoid leucosis and salmonella infection. Experiments by several authors reported line differences in resistance to Marek's disease,

lymphoid leucosis, infectious laryngotracheitis, IBD and *Escherichi coli* infection, Newcastle disease, pasturellosis and coccidiosis.

MAREK'S DISEASE

One of the major diseases affecting poultry industry and is a lymphoma caused by avian herpes virus. Resistant and susceptibility lines of chickens can be selected using natural exposure to the virus. Genetic selection based on pathogen challenge for improved resistance to MD could be observed within relatively few generations. A selection programme was conducted in Cornell Randombred control strain of chickens. Before selection programme commenced, mortality due to MD was 51 per cent. After only four generations of selection in one line for resistance and another line for susceptibility, the lines showed mortality of 7 and 94 per cent respectively.

An association of MD resistance with major histocompatibility complex (MHC) was first reported as a difference in susceptibility to MD in chicken's carrying two different blood groups[7]. Since this report numerous studies have shown that genes located in the chicken MHC play an important role in MD resistance. The most prominent example is the association of the B21 haplotype with resistance. The relative ranking of other alleles: moderate resistance B2, B6 and B14; susceptibility, B1, B3, B5, B13, B15, B19 and B27. However, selection based on pathogen challenge is time-consuming and cost-intensive. Therefore molecular polymorphism in candidate genes or in loci closely linked to genes involved in MD resistance and vaccine efficacy would be attractive markers for selection.

AVIAN LYMPHOID LEUCOSIS

A neoplastic disease caused by exogenous lymphoid leucosis viruses of subgroups A, B, C and D which causes huge mortality as well as reduces growth rate and productivity in birds with sub-clinical infection. There are two levels of genetic resistance to lymphoid leucosis

a. Cellular resistance to virus infection
b. Resistance to tumour development in infected birds

Resistance to development of neoplasm has been studied experimentally mainly with Rous sarcoma virus. Two types of mechanisms of this resistance are : One mechanism influences resistance of cells to neoplastic transformation, while the other causes the initial tumour to regress. The rate of Rous sarcoma regression could be increased by selection[6]. They carried out selection based on individual and family selection after viral inoculation at 6 weeks of age. In sixth generation the percentage of regression was 59.2 per cent vs 14.3 per cent in the first generation. The B2 haplotype has an association with tumour regression. Regression of primary tumour and more resistance to tumour metastasis was observed in line with B^2B^2 genotype when compared with B^5B^5 genotype[3].

Resistance or susceptibility to a leucosis virus infection can be determined by inoculating chick embryo fibroblasts in cell culture with Rous sarcoma virus of corresponding subgroup, that can cause neoplastic transformation observed as discrete pocks of tumour cells, if susceptible. Resistance can also be detected by inoculation of Rous sarcoma virus on to the chorioallantoic membrane of 11-day-old embryonated eggs. After eight days of inoculation there is formation of tumours visible as pocks on the chorioallantoic membrane in susceptible line. Lack of mortality or tumour incidence after subcutaneous, intramuscular or intracerebral inoculation with Rous sarcoma virus can be also used as indicators of resistance to infection.

RESISTANCE TO SALMONELLA INFECTION

Differences in the susceptibility of chicks to salmonellosis between strains were also reported.

The resistance mechanism may apply to all Salmonella spp. The resistance was autosomally inherited, fully dominant and not associated with the MHC[8]. The first successful selection for resistance to disease was made on *Salmonella gallinarum* in White Leghorns. Years later, the resistance to selected population was retested, and its resistance was found to be unchanged despite many generations without challenge or selection. This confirms persistence of genetic resistance.

It is clear from many studies that there are large differences in susceptibility to most (if not all) diseases in chickens and that these could, in principle, contribute to control of disease. It is also apparent that different diseases are influenced by different resistant genes and mechanism, rather than a single common mechanism such as increased immunological activity. An interesting but little studied area is that of potential differences in response to vaccines. This is an important aspect of variability, since more homozygous or enhanced responses could significantly affect the efficacy of vaccines at the level of both the individual and the flock. The development of genomic mapping technology in chickens has opened up exciting new possibility for locating the genes responsible for these differences in susceptibility.

MOLECULAR GENETIC STUDIES

Chicken genome has 39 pairs of chromosomes and is about one-third the size of the human genome. There are six macro chromosomes that make up 55 per cent of the genome, five mid-sized chromosomes that make up the next 20 per cent and the last 25 per cent of the genome is located in 28 micro chromosomes[4]. In chicken, the linkage map first published in 2000, it plays a central role in the alignment of different types of maps developed for chicken[5]. Since that time the map has seen a modest increase in number of markers from 1889 loci in 51 linkage groups spanning 3800 cM, to its current size of 4200 cM with 2,261 loci on 53 linkage groups. So far 31 of the linkage groups have been assigned to particular chromosomes. The linkage map remains the essential tool for the mapping of QTL. The chicken genome map has been derived mainly from three reference populations. They are a) East Lansing (United State of America), b) Compton (United Kingdom) and c) Wageningen (Netherlands). The complete sequence of chicken has been derived from Red Jungle Fowl x White Leghorn (East Lansing), White Leghorn x White Leghorn (Compton) and broiler dam x broiler dam (Wageningen) reference populations.

The first draft of the entire genome sequence was published by International Chicken Genome Sequencing Consortium in December 2004[9]. Recently much effort has been spent on obtaining knowledge about quantitative trait loci (QTL) in chicken. The QTL are segment(s) of chromosomes that affect trait(s). Such information on QTL would be useful for marker assisted breeding as well as for improving the understanding of the biological background (i.e., which genes are involved and their effects on traits). In the past ten years, QTL mapping studies in the chicken have identified chromosomal regions that contribute to variation in economically important traits. The ultimate goal of these studies is generally to identify genetic markers that are close to the QTL or the gene underlying the QTL and to use this information in marker assisted breeding programmes.

The experimental designs for identifying QTL for various production traits were typically an F_2 cross between two breeds with 250 to 700 birds. To detect QTL for disease resistance, selection lines and backcrosses rather than F_2 crosses have largely been used. In addition, several recent reports described half sib experiments.

QUANTITATIVE TRAIT LOCI AND CANDIDATE GENE STUDIES

a. Immune response

The QTL associated with antibody response to Keyhole Limpet Hemocyanin (KLH) and *Mycobacterium butyricum* [13]. In a half-sib analysis, QTL on GGA14, GGA18 and GGA27 were detected for KLH and three QTL on GGA 2, 3 and 14 for *Mycobacterium butyricum.*

Cytokines play as important role in regulating the intensity and duration of the immune response. The Interferon-ã (IFN-ã) genes play an important role in chicken primary and secondary antibody response to sheep RBC and *Brucella abortus* antigens[16]. This IFN-ã gene may be considered as a candidate gene for marker-assisted selection to improve immune response in poultry for genetic enhancement of chicken health and productivity. Stress resulting from exposure to hostile environment is partly genetically determined. Stress is known to influence the levels of some hormones that can also affect immune response and thus influence disease resistance.

b. Mareks's disease

One promising candidate region for MD resistance is the MHC. Despite the strong contribution of some MHC haplotypes, other genes also have a large effect on the overall level of résistance to MD[14]. Many studies have shown that MHC complex (B blood group) on chromosome 16 affects resistance to MD and identified QTL on chromosomes 1, 2, 4, 7 and 8 for MD resistance in White Leghorns[15].

The growth hormone gene (GH1) on chromosome 1 also has an allelic association with MD resistance. Stem lymphocyte antigen 6 complex locus E (Lr6E) on chromosome 2 has also been identified as an MD resistance gene through genetic, RNA and protein analysis. The QTL conferring resistance to Marek's disease in commercial layer chickens. Seventeen microsatellite markers were identified in chicken chromosome 2, 4, 5, 6, 8, 15 and Z at different positions[12].

c. Salmonellosis

A small number of potential candidate genes have been identified for salmonella resistance in the chicken. The natural resistance-associated macrophage protein 1 (NRAMP1) gene is linked to mortality induced by *Salmonella typhimurium* in the chicken[8]. They reported that one G to A substitution at nucleotide 696 resulted in the replacement of Arg223 to Gln223 in the NRAMP1 was specific to susceptible line and the same mutation was not observed in resistant line. NRAMP1 gene accounted for 33 per cent of the differential resistance in early infection. They further reported that resistance to salmonella infection is inherited as a complex trait and comparative mapping has proven to be useful to identify salmonella –resistance genes in the chicken.

There are 37 SNP in 3.1 kb of genomic DNA of the NRAMP1 gene and the SNP (at ser379 position) of the NRAMP1 gene was associated with spleen bacterial load after exposure to pathogenic *Salmonella enteritidis* (SE) and also with antibody production to SE vaccination[11]. It may be used as a useful marker for marker assisted selection to improve resistance to SE in poultry population. The Slc11a1 region (Soluble carrier family 11, member 1) formerly called as NRAMP1, was significantly involved with control of probability of spleen contamination four weeks after inoculation. SNP in Slc11a1 was significantly associated with the risk of spleen contamination and appears to be involved in the control of resistance to salmonella carrier state[2].

d. Coccidiosis

A marker was located at 259 cM on chromosome 1, as being significantly associated with reduced oocyst faecal shedding of birds

experimentally infected with *Eimeria maxima*[17]. The QTL loci identified in chicken and classified phenotypic traits into 5 major trait categories: growth (body weight, body composition and feed intake), egg (egg production, egg quality and skeleton), disease resistance (traits associated with disease resistance), metabolic for traits related to metabolic parameters and behaviour for traits related to behaviour[1]. About 697 QTL were reported and there were more on growth than the other traits. The number of QTL reported for growth, disease resistance, egg, behaviour and metabolic trait categories were 383, 83, 143, 50 and 38 respectively. They reported that the population designs used by different authors were F_1, F_2, F_3 and backcross. Among this F_2 design is most frequently used; however resolution of QTL obtained using this design is generally low. High resolution mapping of QTL location can be obtained using a backcross strategy.

BREEDING FOR DISEASE RESISTANCE

The simple and widely used method / approach are the observation of breeding stocks and its use in selection. In this method, there is no negative effect on the expression of genetic potential for production, but it does not guarantee adequate expression of genetic resistance. Any breeder will try to minimise the exposure of his breeding stock to disease. Hence resistance to important diseases may not be expressed. Breeders tend to select against total mortality, a trait ie. Poorly defined and has low heritability.

The second approach is to challenge the breeding stock with infectious agents. This method will have a negative effect on the expression of genetic potential for production traits and also there is a danger of losing due to disease. The method is occasionally used for selection of coccidiosis resistance by brooding young chicken on litter to get them exposed. If the dosage of the pathogen is standardised, this method could result in good expression of disease resistance.

Another excellent way to measure disease resistance is to expose sibs/progeny of the breeding stock to disease agent. This approach was used to improve MD resistance prior to development of vaccines. It's obvious disadvantage is high cost of challenged population. In commercial breeding programmes selection based on exposure testing of full sibs would have higher expected response and would allow reduced intervals between generations.

The first successful selection for resistance to diseases was reported by Lambert [10] who selected white leghorn for resistance to fowl typhoid by standardised challenge of chicks with *Salmonella gallinarum*. The experiment confirmed the persistence of genetic resistance after many generations. Similar selection studies have carried out for avian lymphamatosus, MD and Lymphoid leucosis. The selection for egg production and viability resulted in improved MD resistance as well as production.

Indirect selection based on suitable genetic markers represents an ideal approach to the improvement of disease resistance. The effectiveness of indirect selection depends on the heritability of the marker and resistance traits and their genetic correlation. Numerous studies reported that selection for increased resistance is feasible. Hence resistance should therefore be taken into account in selection schemes to prevent any decrease in resistance. Improving poultry health by increasing genetic resistance to disease is essential to meet the increasing emphasis of the industry on animal welfare, food safety, environment concerns and efficiency of production.

CONCLUSION

Improving the genetics of disease resistance is the most eligible approach for sustainable

control of infectious diseases in poultry. A difference in disease resistance between individuals is the result of genetic heterogeneity of the immune response. The diversity of the MHC, TCR, immunoglobulins and cytokines, constitutes the major immunological bases in resistance variations. The diversity of these molecules is attributed mainly to the intrinsic polymorphism of their genes. The MHC has been shown as a major immune factor associated with resistance differences to many infectious pathogens. Its broad effect on the various immune response features such as antibody responses, cytokine production, and TCR expression would elaborate its significance in disease resistance differences. A marker assisted selection by introgression of the resistance QTL is the most attractive approach to develop the genetic resistance. The immune system counteracts each pathogen with a distinct way. Therefore, an optimal improvisation of the immune competence by simultaneously considering different markers is essential to upgrade the general resistance to a range of pathogens. The immune mediators are also the best targets for vaccine and therapeutic interventions to enhance disease resistance. Finally, the eminent effect of genetic interactions of the immune physiology with certain non-immune related (production) traits and the environment on disease resistance needs to be taken into account in a global strategy.

REFERENCES

1. B., Abasht, J.C.M. Dekkers, and S.J, Lamont, *Poult. Sci*, **85**, 2079-2096, 2006.
2. C., Beaumont, J., Protais, F., Pitel, G., Leveque, D., Malo, and F., Lantier, *Poult. Sci*, **82**, 721–726, 2003.
3. W.M., Colllins, W.E., Briles, R.M., Zsigray, W.R., Dunlop, A.C. Corbett, and K.K, Clark, *Immunogenet*, **5**, 333-343, 1990.
4. R.J, Etches, *Poult. Sci*, **80**, 1657-1661, 2001.
5. M.A.M., Groenen, H.H., Cheng, N., Bumstead, B.F., Benkel, W., Elwood Briles, and T., Burke, *Genome Res*, **10**, 137-147, 2000.
6. N.R., Gyles, B.R., Stewart, and C.J, Brown, *Poult. Sci*, **47**, 430-450, 1968.
7. M. P., Hanson, G. R. J., Law, and J. N, Van Zandt, *Poult. Sci*, **46**, 1268, 1967.
8. F.B., Hutt and J.C., Scholes, *Poult. Sci*, **20**, 342-352, 1941..
9. J., Hu, N., Bumstead, P., Barrow, G., Sebastiani, L., Olien, K., Morgan, and D., Malo. *Genome Res*, **7**, 693–704, 1997.
10. International Chicken Genome Sequencing Consortium. *Nature*, **432**, 695-716.
11. W.V., Lambert, *J. Immunol*, **23**, 229-239, 1932.
12. W., Liu, M.G., Kaiser, and S.J., Lamont, *Poult. Sci*, **82**, 259-266, 2003.
13. J.P., McElory, J.C.M., Dekkers, J.E., Fulton, N.P., O'Sullivan, M., Soller, and E., Lipkin, *Poult. Sci*, **84**, 1678-1688, 2005.
14. M., Siwek, A.J., Buitenhuis, S.J.B., Cornelissen, M.G.B., Nieuwland, H., Bovenhuis, and R.P.M.A., Crooijmans, *Poult. Sci*, **82**, 1845-1852, 2003.
15. R.L., Vallejo, L.D., Bacon, H.C., Liu, R.L., Witter, M.A.M., Groenen, and J., Hillel, *Genet*, **148**, 349-360, 1998.
16. N., Yonash, L.D., Bacon, R.L. Witter, and H.H., Cheng, *Anim. Genet*, **30**, 126-135.
17. H., Zhou, A.J., Buitenhuis, S., Weigend, and S.J., Lamont, *Poult. Sci*, **80**, 1679-1689, 2001.
18. J.J., Zhu, H.S., Lillehoj, P.C., Allen, C.P., van Tassell, T.S., Sonstegard, H.H., Cheng, Pollock, D., Sadjadi, M., W., Min, and M.G., Emara, *Poult. Sci.*, **82**, 9-16, 2003.

ELECTROLYZED WATER : A GREEN CONCEPT FOR SANITATION OF FRUITS AND VEGETABLES

Archana T Janamatti* and Rama Krishna K

Electrolyzed water a new sanitizer also called as miracle water in Japan has gained immense popularity in recent years due to its simplicity of production and application. It is a simple solution produced using a table salt and tap water upon electrolysis process. It has found many applications in agriculture field including irrigation, food processing, poultry and livestock management etc. In the food industry, it is mainly used as a novel broad-spectrum sanitizer. Electrolyzed water has several advantages over traditional sanitizers due to its sustainable nature, a green concept including cost-effectiveness, ease of application, on-site production, no adverse effect on health and environment and effective disinfection. Considerable progress has been done to attain a food safety in many countries. However, unacceptable rates of foodborne illness are still prevalent and also associated with consumption of fruits and vegetables. So, electrolyzed water could be a potential sanitizer for fruits and vegetables.

INTRODUCTION

Over the past few years, food safety has become and continues to be the number one public concern as the reports of foodborne outbreaks are increasing over year. The centre of disease control and prevention, USA has reported that there are 31 pathogens and unknown agents which cause illness in humans. Contamination in food and agriculture products may occur at any stage of the food supply chain from field to the table. The increase in consumption of minimally processed, fresh-cut, fruits and vegetables in recent years has been parallel to an increase in the number of foodborne illness attributed these produce. *Escherichia coli, Salmonella, Listeria monocytogenes, Staphylococcus aureus* and *Clostridium botulinum* and other emerging foodborne pathogens associated with the fresh produce, which poses a high health risk and requires an effective control/decontamination techniques to ensure food safety to the consumer method. So to achieve this, the food industry has employed a number of decontamination techniques including both physical and chemical methods. However, the existing decontamination technique poses many disadvantages like the highcost, low efficiency, adverse effects on the quality of the food products and remaining of chemical residues. The chlorine-based sanitizers, liquid chlorine and sodium hypochlorite are widely used sanitizer for fruits and vegetables. But these chemicals have drawbacks for its

*Division of Food Science and Postharvest Technology, ICAR-Indian Agricultural Research Institute, New Delhi–110012, E-mail: archanajanamatti@gmail.com

application in the food industry as they produce chlorinated organic compounds like chloramines and triatomines, which are carcinogenic in nature and cause respiratory tract and skin irritation on prolonged exposure. So to overcome the drawbacks of these traditional decontamination techniques the recent discovery sought to be the promising alternative is the possibility of using the electrolyzed water, as a result of concept developed in Japan.

Electrolyzed water (EW) is a solution developed from regular water without the addition of any harmful chemical except NaCl or dil. HCl. It has been regarded as the non-thermal technology and widely used as sanitizer and cleaner. The popularity of the EW is mainly due to its simplicity of application and production. It has a wide range of antimicrobial activity against vast microbes and eliminates all pathogens in few seconds (5 to 20sec). According to World Health Organization (WHO), electrolyzed water is the most efficient non-toxic disinfectant known today[8].

Electrolyzed water has found its various applications in agriculture, food sanitation, medical sterilization, antimicrobial techniques and livestock management. It is widely used in Japan since 1980 for various purposes including medical institutions. Overtime its use has broadened to various purposes. In postharvest management of fruits and vegetables, its utility is found as follows

- It is used as disinfectant for equipment in processing industry
- It doesn't have adverse effect on the environment as it does not contain any toxic chemical residues, hence it can be used to wash fresh fruits and vegetables
- It inactivates pathogen on fresh produce
- It extends shelf life of fresh, pre-cut fruits and vegetables
- Eliminates pesticide residues, mycotoxins and reduce rate of germination of certain fungal spores

HOW DOES ELECTROLYZED WATER PRODUCED?

Electrolyzed water is produced in an electrolysis chamber containing a dilute NaCl solution. Upon onset of electrolysis process, NaCl dissolves in water into positive and negative ions. The chamber includes a diaphragm (used to separate anode and cathode). Current is passed through EW generator, whereas voltage is generated between electrodes with voltage and current values set at 9-10 V and 8-10A, respectively. NaCl dissolves into sodium chlorine, meanwhile, hydroxide and hydrogen ions are also formed. The negatively charged ions move towards the anode (OH^- and Cl^-), where electrons are released and hypochlorous acid, hypochlorite ion, HCl, O_2, chlorine are generated. The positively charged ions Na^+ and H^+ move towards cathode where they gain electrons, resulting in the generation of NaOH and H_2 gas. So at the anode, AEW (Acid ElectrolyzedWater) or electrolyzed oxidizing water (available chlorine is 20-60 mg/L) is formed whose pH is 2 to 3 with oxidation reduction potential of more than 1000 mV, which gives a property to the water to kill the microorganisms which comes in contact with it. At the cathode, the basic electrolyzed water(alkaline) is formed with pH of 10-13. Recently neutral electrolyzed water (7 to 8 pH) and slightly acidic electrolyzed water (available chlorine-10 to 30 mg/L) with pH 5-6 are also developed. NEW and SAEW are produced in a single cell unit without a diaphragm. Slightly acid electrolyzed water contains un-dissociated HoCl that SAEW and show excellent sanitization efficiency against several types of food pathogens. Electrolyzed water can also be stored for future

use by conserving in the dark or converting it into ice cubes. Many systems for producing EW are available in the world markets such as in U.S, Russia, South Korea, Japan and Taiwan. Japan is the leading manufacturer of EW machines with over 20 companies manufacturing them.

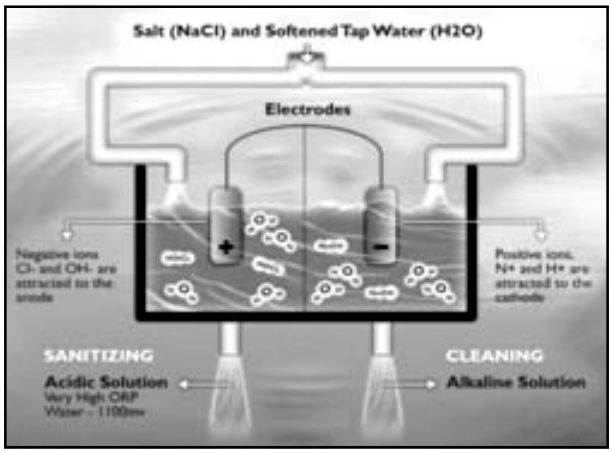

Fig.1. Electrolyzed water generation in chamber (Source: ewatersystems.com.au)

The sanitation of produce is a very important step in ensuring its quality and safety. A variety of disinfectants like liquid chlorine, sodium hypochlorite, sodium bisulphite and organic acids are commonly used to reduce the microbial population on fresh-cut vegetables but these pose some potential toxicity and incapable to completely eliminate the pathogens. Neutral electrolyzed water is the promising disinfection method to wash fresh cut lettuce, carrot, endive and corn salad containing about 50 ppm of chlorine and equally effective as chlorinated water at 120 ppm[3]. Thus electrolyzed water would allow reducing the amount of free chlorine used and could be safer to wash fresh-cut produce. The food spoilage causing organism like *Salmonella, L. innocu* and *E. caratovora* on minimally processed vegetables can be effectively reduced by electrolyzed water.

Broccoli (*Brassica oleraceae*) is sought for its nutritive value and antioxidant activities. Low electrolyzed water when combined with mild heat reduces the aerobic bacteria, yeasts and moulds in addition with increasing firmness of organic broccoli[1].

The mango varieties like 'Tommy Atkins' gets infected with *Escherichia coli, Salmonella* and other illness-causing pathogens at the field. Hot water treatment is commonly used in mangos and heat treatment may contribute to internalization of the pathogen in water, hence the quality of water is very important. When electrolyzed water was used to rinse sliced 'Tommy Atkins' mangoes, the 2.2 Log cfu/g reduction in the population of *E. coli* was observed [6]. Similar effects of electrolyzed water were also observed in minimally processed apples. The electrolyzed water as an effective disinfectant to control *E. coli, Listeria innocua* and *Salmonella choleraesuis* population on apple slices and found positive results. Electrolyzed water was more effective even when compared with other sanitizers like chlorine and sodium hypochlorite[2].

Hurdle technology is the best measure than any single postharvest treatment because no individual treatment can satisfy all the purpose. When electrolyzed water was combined with an organic acid (calcium oxide and fumaric acid) and ultra-sonication, the sanitization effect on fresh apple and tomato was more prominent than individual treatments[5]. The combined treatment ensured a high microbial quality and safety and also preserved the quality of fresh apple and tomato fruits.

Pesticide residue in food is the main concern of food safety as pesticides are biologically active and highly toxic even at very low concentration. Fresh fruits and vegetables are the major food

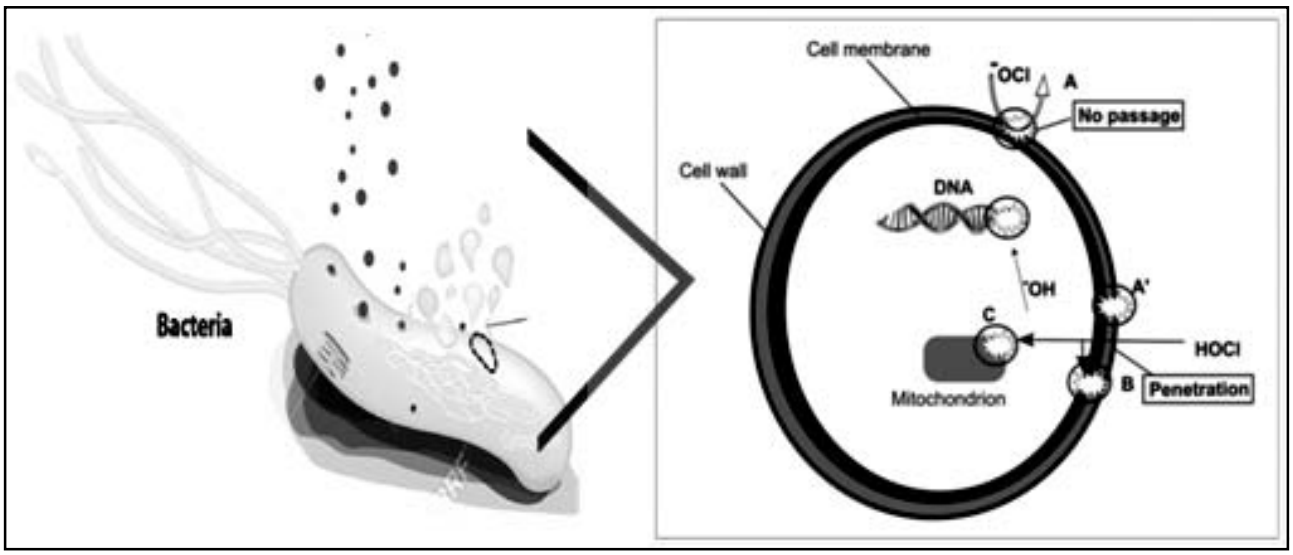

Fig. 2. Mechanism of germicidal action[4]

source for pesticide exposure. Washing solution added with strong oxidizing agents like ozone and chlorine dioxide effectively remove the pesticide residues from produce samples. Therefore, electrolyzed water with dissolved chlorine could be used to degrade pesticides residues from fresh produce. The electrolyzed water with available chlorine concentration (ACC) of 120 mg/L after washing fresh snap bean, spinach and grapes for 15 min removed 30 to 85 % of diazonin, cryrodinil and phosmet residues[7].

PROS AND CONS OF THE TECHNOLOGY

- Electrolyzed water when comes in contact with organic acids or tap water becomes normal water again, hence there is no residual effect and safer to use
- It has broad-spectrum antimicrobial activity
- It is less expensive and have more power at 50 mg/L than available chlorine at 120 mg/L
- It is more economical as it is produced on demand on-site reducing the cost of bottling and transportation
- It not only sanitizes fruit and vegetables, it also prolongs its shelf life thereby electrolyzed water is more ecological approach by food industries
- The initial cost of the equipment is very high
- Losses its antimicrobial activity very soon if not supplied continuously with hypochlorous acid/chlorine or due to improper storage condition.
- It causes discomfort to the operator due to presence of chlorine gas when operated below pH 5.

SCENARIO IN INDIA

There is scarce research information available on the utilization of electrolyzed water in India. Hence, there is scope for ample research work in India, in the use of this technology mainly in the fields of water sanitation, food science, industrial equipment sanitation, agriculture food supply chain etc. There are some industries national and international wide, which are involved in scaling up this technology by supply and creating knowledge centers in India. They are

- De Nora India Ltd.-India
- Sana Water Solutions-India
- SSICA-International
- TecnograndaSpA-International
- EAU Technologies-International
- MVS Engineering PVT. Ltd.-India
- Mikuni corporation-India.

The efficiency of this technology can be promoted in India with the support of Indian Govt. and research institutes.

CONCLUSION

Owing to the concern on food safety and prevailing food-borne illness ecological and cost-effective disinfectant method is required. Electrolyzed water exhibits strong bactericidal, fungicidal effect on fruits and vegetables. Therefore, it seems to be an alternative to available disinfectants for microbial control, removal of pesticide residue, although, its potential need to be explored. Now the expensive chemical for sanitization of fresh fruits and vegetables can be replaced at the price of table salt.

REFERENCES

1. L. Qin, S. Chih, Y. Hongshun and W. Shifei, *LWT- Food Sci. Technol.*, **79**, 594-600, 2017.
2. G. Ana, A. Maribel, S. Miguel and N. Carla, *Postharvest Biol. Technol.*, **61**, 172-177, 2011.
3. A. Maribel, U. Josep, O. Marcia, A. Isabel and V. Inmaculada, *Int. J. food microbiol.*, **123**,151-158, 2008.
4. S. Rahman, I. Khan and D. Oh, *Compr. Rev. Food Sci. Food Saf.*, **15**, 471-490, 2016.
5. N. Charles, K. Imran and N. Paul, *Food Microbiol.*, **67**, 97-105, 2017.
6. S. David, G. Ana, N. Carla and Q. Celia, *Food Microbiol.*, **70**, 49-53, 2018.
7. Q. Hang, H. Qingguo and H. Yen, *Food chem.*, **239**, 561-568, 1998.
8. Times of India. https://timesofindia.indiatimes.com/city/agra/Electrolysed-water-is-most-efficient-water-treatment-method-Expert/articleshow/53214910.cms

BIOCONTROL : AN ECOFRIENDLY PEST MANAGEMENT TECHNIQUE

Moina Khan and Ahmad Pervez*

Biological control or Biocontrol seems to be the best ecofriendly, cost-effective and self-sustaining option to bring the pest populations below the level of economic threshold. Despite this technique was instrumental in the nature since time immemorial, the first successful biocontrol program dated only 130 years back in 1888-89 using ladybird beetles as biocontrol agents. In this communication, the broadening of the scope of biocontrol is attempted in different forms with special reference to its advantages and disadvantages.

INTRODUCTION

Biological pest control is currently the most exciting area of agricultural and entomological research. A century ago, Harry Scott Smith coined the term *'biological control'* in 1919, which may be defined as "the manipulation of natural enemies, such as predators, parasites/parasitoids and pathogens, to bring the pest populations below the level of economic threshold and to a tolerable level". Albeit, this technique has been employed in agriculture for centuries, it is still naive as an industry. Biological control or "*Biocontrol*" depends on the knowledge of biological interactions at the ecosystem, organism, cellular, and molecular levels and often is more complicated to manage compared with physical and chemical methods. It is also likely to be less celebrated than most physical or chemical control methods, however, it is more eco-friendly, cost-effective, self-sustaining and long-lasting. Now biocontrol has been given priority for various types of crops and ecosystems as the primary method of pest control. One reason for its growing preference is its record of safety during the past 100 years. Also, microorganisms or beneficial insects which have been applied as a biocontrol agents had not been reported as itself a pest, and there is no evidence so far of measurable or even negligible adverse effects ofbiocontrol agents on the environment.

* Biocontrol Laboratory, Department of Zoology, Radhey Hari Government Post Graduate College, Kashipur, Udham Singh Nagar-244713, Uttarakhand, India. Email: ahmadpervez@yahoo.com

HISTORY OF BIOCONTROL

Biocontrol was in action much before the term itself came into existence. Old practice of not

growing the same crop species in the same field every year is supposedly one of the oldest methods of biocontrol. Such crop rotation buys time for the pest or pathogen populations in the soil to decrease below some economic threshold because of the predatory, competitive, and other antagonistic effects imposed by the associated microflora and fauna. In other words, crop rotation allows time for the natural soil biota to cauterize the soil, especially plant-specific parasites and insect pests which are highly dependent on their host crop to maintain their populations above the threshold. Similarly, Erasmus Darwin in early eighteenth century that an ichneumon fly (a parasitoid) killing the eggs of cabbage butterfly (*Pieris brassicae*) caterpillar, which was a serious pest of cabbage. The first celebrated example of biocontrol came in 1888, when ladybird beetle, *Rodolia cardinalis* was imported from Australia to be employed against the heavy outbreak of cottony-cushion scale, *lcerya purchasi* infesting citrus orchards of California. This phenomenal success encouraged the export and import of several natural enemies, especially ladybird beetles. More than 6000 species of predaceous ladybird beetles are on record and majority of them are known for their seasonal synchrony with a numerous insect and acarine pests, and thereby could be used as their biocontrol agents[1]. The middle history of the development of biological control thus begins with 1888-89 and lasts in 1962. Rachel Carson's famous book, *Silent Spring* in 1962 brought immense general awareness against the usage of synthetic chemical pesticides that induce both resistance in insect-pests and eco-degradation. This was followed by the modem era of biocontrol, which begins new avenues, as more than a thousand biocontrol agents have been introduced against almost 200 insect-pests, the world over.

DIFFERENT FORMS OF BIOCONTROL

Biocontrol may be employed through several approaches including the mass introduction of antagonists, plant breeding, and specific cultural practices aimed at modifying the microbial balance. The mechanisms on which biocontrol agents work are as follows:

Antibiosis

Vuil1emin coined the term "antibiosis" in 1889-90 to describe antagonistic effects between microorganisms. It has been as defined as the interactions that involve a low-molecular-weight compound or an antibiotic produced by a microorganism that has a direct influence on another microorganism. This plays an essential role in plant disease suppression by certain bacteria like *Pseudomonas fluorescence* and fungi like *Gliocladium* and *Trichoderma*.

Competition

This process is supposed to be an indirect interaction whereby pathogens are excluded by depletion of a food base or by physical occupation of the site. Biocontrol by nutrient competition can occur when the biocontrol agent decreases the availability of a particular substance thereby restricting the growth of the pathogen. Notably, the biocontrol agents have a more efficient uptake or utilizing the system for the substance than do the pathogens. A biocontrol agent can provide plant protection by efficient interception of these stimulating factors before pathogens can use them.

Mycoparasitism

Mycoparasitism is a process in which one fungus as biocontrol agent may attack another pathogenic fungus. These fungi parasitizing other fungi are referred to as mycoparasites. Several mycoparasites occur on a wide range of fungi,

Table 1. List of some biocontrol agents.

Biocontrol Agents		Target pathogen/pest/weed
Fungal	*Trichoderma* spp.	*Rhizoctonia, Pythium, Fusarium* and several soils and foliar nathozen
	Gliocladium catenulatum	*Pyhtium, Phytophthora, Rhizoctonia, Botrytis.*
	Coniothyrium minitans	*Sclerotinia* species
	Cryptococcus albidus	*Botrytis* spp., *Penicillium* spp.
	Beauveria bassiana	whitefly, aphids, thrips, grasshoppers, locusts
	Alternariacassia	Weedicide *(Cassia obtusifoliai*
	Cercospora rodmanii	Weedicide *(Eichhornia crassipes)*
	Colletotrichum coccodes	Weedicide, Velvetleaf *(Abutilon theophrasti)* in cornand soybeans
	Colletotrichum	Weedicide *(Cuscuta chinensis,* C. *australisi*
	Streptomyces griseoviridis	*Fusarium, Pythium, Phytophthora.*
	Streptomyces lydicus	powdery mildew
	Bacillus subtilis	powdery mildew, *Botrytis,* leafspots
	Bacillus thuringiensis	Caterpillars
Bacterial	*Cydiaspomonells* G*V*	Codling moth
	Autographia californica	Lepidopteron larva
	Anticarsia gemmantalis	Velvet bean caterpillar
	Heterorhabditismegidis	Soil insects primarily *Otiorhynchussulcatus*
Virus	*Steinernemafeltiae*	Sciarid flies and other soil insects
	Steinernema carpocapsae	Root weevils, cutworms, fleas, borers fungus
Insects (Ladybirds)	*Chilocorus nigritus*	Scale-insects, *Aspidiotus destructor, Coccus viridis*
	Cryptolaemus montrouzieri	Mealy-bugs, *Planococcus citri, Nipaecoccus viridis, Ferrisia virgata*
	Harmonia axyridis	Aphids, *Macrosiphum euphorbiae, Macrosiphum rosae, Phorodon humuli*

and some are very crucial in disease control. *Trichoderma harzianum,* a mycoparasitic fungus have been used for biocontrol of pathogens of crop plants; both soil-borne, (*e.g. Rhizoctonia solani* and *Sclerotium rolfsii*) and foliar pathogens including *Botrytis cinerea,* which infects cucumber[2].

Cell wall degrading enzymes

Extracellular hydrolytic enzymes produced by microbes can eliminate plant pathogenic fungi Chitin and β-l, 3-glucans are major constituents of many fungal cell walls, which could easily be broken by enzymes, *chitinase* or *β-l, 3-glucanase* alone or in a combination. Recently, genetic

evidence for the role of these enzymes in biocontrol was found. For instance, A *chitinase (ChiA)* deficient mutant of *Serratia marcescens* was shown to have decreased inhibition of fungal germ tube elongation and diminished biocontrol of *Fusarium* wilt of pea seedling in a greenhouse assay.

Induced resistance

The inducible resistance in plants to a variety of pathogens is known as systemic acquired resistance (SAR) which may be induced by treating plants either with a necrogenic pathogen or non-pathogen or with specific natural or synthetic chemical compounds. This defence system is also triggered when plants are colonised by plant growth- promoting rhizobacteria (PGPR) and a few binucleate *Rhizoctonia*. Several strains of PGPR have been shown to be effective in controlling plant diseases by inducing plant systemic resistance.

Plant growth promotion

Biocontrol agents also produce growth hormones like Auxins, Cytokinin, Gibberellins, *etc*. These hormones suppress the harmful pathogens and promote the plant growth and yield. PGPR promotes plant growth directly by the production of plant growth regulators or indirectly by stimulating nutrient uptake, by producing siderophores or antibiotics to protect the plant from soil-borne pathogens or harmful rhizosphere organisms. *Pseudomonas* spp. may increase plant growth by producing gibberellin-like substances, mineralising phosphates.

Hydrogen cyanide

Many rhizobacteria produce hydrogen cyanide, and this has been shown to play directly as well as the indirect role in biocontrol of plant diseases and increasing the yields. The fluorescent *Pseudomonas* themselves produce HCN and can suppress the pathogens.

Lytic enzymes

Lysis is the entire or partial destruction of a cell by enzymes and may be 'classified into endolysis and exolysis. Endolysis is the breakdown of the cytoplasm of a cell by the cell's own enzymes following death, which may be caused by nutrient starvation or by antibiosis or other toxins. This does not usually involve the destruction of the cell wall. Exolysis is the destruction of the cell by the enzymes of another organism. Typically exolysis is the destruction of the walls of the organism by chitinases, cellulases which frequently results in the death of the attacked cell.

ADVANTAGES OF BIOCONTROL

Biocontrol presents a green alternative to chemical control methods. For example, whereas weed killing chemicals can also destroy fruit-bearing plants, the biocontrol allows the fruit to be left uninterrupted while the weeds are destroyed. Biocontrol agents are capable of self-sustaining and thereby there is no need of re-fill. This indicates that after the initial introduction, a very limited effort is required to keep the system running fluidly. It also means that biocontrol can be kept in place for a much longer time than other methods of pest control. Biocontrol is highly cost-effective in long-term. Although it may cost a bit to introduce a new species to an environment, it's a tactic that only requires to be applied once due to its self-perpetuating nature. Most significant of all, it is effective in pest management programmes because the predator introduced will be naturally inclined to target the pests, very often you'll see the pest population dwindle.

DISADVANTAGES OF BIOCONTROL

Biocontrol could be fickle and a wrongly introduced biocontrol agent can't be retrieved back. It is likely that the introduced biocontrol

agent may attack the non-target organisms. It is likely that it may decide to feed crops rather than insect-pests. Furthermore, it may upset the natural food chain. Biocontrol could be a slow method at times, as it may take enough time and patience compared to other methods, like chemical control. The upside to this is the long-term impact of biocontrol provides. If you're looking to wipe out a pest completely, biocontrol is not the best option. Predators can only survive if there is something to eat, so destroying their food population would imperil their safety. Therefore, they can simply reduce the number of harmful pests. While it is cheap in the long run, the process of actually setting up a biocontrol system is a costly venture.

CONCLUSION

It can be concluded that biocontrol seems to be the only solution to reduce the deleterious effects of synthetic chemical pesticides. If nature has posed tedious questions in the forms of pests, the answer to those questions are also provided by the nature itself. We just have to minimize the over-use of chemicals and maximize the manipulations of natural enemies. Doing so, we are not only providing an ecological balance but also we are reducing the effects of harmful chemicals in our environment and human health, which due to bioaccumulation and biomagnification have become components in the food-chains. Hence, biocontrol plays an assertive role for the better crop productivity, toxicant-free environment and improved human health.

ACKNOWLEDGEMENT

AP thanks Science and Engineering Research Board, Department of Science and Technology, Government of India for financial assistance in the form of Major Research Project (EMR/2016/006296).

REFERENCES

1. Omkar, A., Pervez, Ladybird Beetles. In: Omkar (ed) Ecofriendly Pest Management for Food Security. Chapter 9: 281-310. Academic Press, London EC2Y SAS, UK, 2016.
2. M., Mukherjee, P.K., Mukherjee, B.A., Hoewitz, C., Zachov, G., Berg, S., Zeilinger, *Indian J Microbial,* **54**, 522-529, 2012.

THE JOURNEY OF OPIUM POPPY: FROM ANCIENT MESOPOTAMIA TO GOLDEN TRIANGLE

R. B. Mohanty[1] and T. Panda[2]*

Poppy (*Papaver Somniferum* L.) is a wild *cum* cultivated plant belonging to family Papaveraceae. Opium is the dried latex obtained by incision of its seed pods. Opium contains two main groups of alkaloids i.e. Phenanthrenes and Isoquinolines. Morphine, Codeine and Thebaine belong to first category and Papaverine and Noscapine belong to Isoquinolines group. The Opiates act upon the central nervous system being analgesic, narcotic and potentially addicting compound. Their principal action is to relieve or suppress the body pain. They also alleviate anxiety, induce relaxation, drowsiness, sedation and may impart a state of hallucination, euphoria or other enhanced mood for few hours. The journey of Opium Poppy from the region of lower Mesopotamia to the present region of "Golden Triangle" or "Golden Crescent" took a long 5500 years and became instrumental in initiating wars, trade and prosperity, political changes and ultimately becoming a boon to the pharmaceutical world as well as a bane for the wayward youth of 21st century. This long migration of Opium poppy through millennia and from one continent to another shall continue as long as people need relief from pain and develop addiction.

INTRODUCTION

Poppy is a wild and latter cultivated plant while opium is the dried latex obtained by incision of its seed pods. The scientific name of poppy plant is *Papaver Somniferum* L. belonging to family Papaveraceae. It is an erect, rarely branched, glabrous, annual herb with bluish white or purple coloured flowers, ultimately bearing large capsular fruit and famous for production of powerful drug Opium. The plant is cultivated from ancient period as an agricultural crop for production of seeds that are edible and consumed as condiment and spices, to produce Opium for use in pharmaceutical industry while small number of plants are cultivated for ornamental purposes. But Opium is mostly used since antiquity for its medicinal properties i.e. by suppressing the functioning of central nervous system, it controls pain in the body of the patients. It is also used for its antitussive properties. Moreover, it is used to treat diarrhoea by reducing the number and frequency of bowel movement[1].

[1]Plot No. 1311/7628, Satya Bihar, Rasulgarh, Bhubaneswar, Odisha-751010. [2]Department of Botany, Chandbali College, Chandbali, Bhadrak-756133, Odisha.

CHEMICAL COMPOSITION AND PHYSIOLOGICAL ACTION OF OPIUM

Opium contains two main groups of alkaloids i.e. Phenanthrenes and Isoquinolines. Morphine, Codeine and Thebaine belong to first category who is the chief psychoactive constituents. Papaverine and Noscapine belong to Isoquinolines group having no remarkable effect on the body. The Opiates act upon the central nervous system being analgesic, narcotic and potentially addicting compound. Their principal action is to relieve or

suppress the body pain. They also alleviate anxiety, induce relaxation, drowsiness, sedation and may impart a state of hallucination, euphoria or other enhanced mood for few hours. They also have other physiological effects i.e. they slow respiration and heartbeat, suppress the cough reflex and relax the smooth muscles of gastrointestinal tract. But, Opiates are powerful addictive drugs producing a strong physical dependence and withdrawal symptoms that can be assuaged by continued use of the drug. The important life saving drugs are mostly derived from five major alkaloids viz., morphine, codeine, thebaine, noscapine and papaverine, which are present in opium latex in ample amounts[2].

CHRONOLOGICAL HISTORY OF MIGRATION OF OPIUM PLANT

The poppy plant is associated with the human history from Neolithic period (9000BC to 3000BC) [3]. Finds of *Papaver sommiferum* L. from Neolithic settlements have been reported throughout Switzerland, Germany and Spain[4]. Numerous similar findings from Bronze Age (3000BC to 2400BC) and Iron Age (1200BC to 1000BC) settlements have also been detected. The native range of Opium plant is probably the eastern Mediterranean region. In fact, this region has the earliest archaeological evidence of human use of Opium while the oldest known seed dates back more than 5000BC. for food, anaesthetics and religious rituals.

- The opium poppy was cultivated in the fertile valleys of Tigris-Euphrates river systems of Mesopotamia during 3400BC.The Sumerians (4500-1900BC) used it and pass along the plant and knowledge about euphoric effect to the Assyrians (2334BC-2154BC). They in turn handed over the knowledge to the Babylonians and ultimately it came to Egyptians.
- Egyptians (1300BC) began cultivation of Poppy and it was traded through the Phoenicians (1550BC-300BC) and Minoans,(2000BC-1400BC),who transported it across the Mediterranean sea into Greece Carthage and Europe.
- In 1100BC, the people of Cyprus cultivated, traded and smoked Opium before the fall of Troy.
- Opium is mentioned in the most medical text of the ancient world including "Ebers Papyrus" and the writings of Dioscorides, Galem and Avicenna. In 460BC, Hippocrates, the father of medicine acknowledges its usefulness as a narcotic, in treating internal diseases and epidemics.
- In 330 BC., Alexander the Great introduced Opium to the people of Persia and India.
- Opium produced from Egyptian field was introduced to China by Arab traders in 400 AD.
- In 1500 AD, the Portuguese traders, while trading along the East China Sea, initiate smoking of Opium.
- In 1600 AD residents of Persia and India began eating and drinking Opium mixture for recreation. In fact, Opium was cultivated in India and produced in huge quantity. Portuguese merchants carrying cargos of Indian Opium through Macao, direct its trade to China.
- In 1700 AD, the Dutch expert shipments of Indian Opium to China and other islands of south East Asia and introduced the practice of smoking Opium in pipe to the Chinese people.
- In 1729, when majority of people of China became addicted with Opium, the Chinese emperor Yung Cheng ordered prohibition of smoking of Opium and its domestic sale.
- In 1750, realizing the huge profit out of Opium trade, British East India company started shipping Opium from Calcutta port to China on trade.
- In 1753, Linnaeus, the father of plant Taxonomy, first described and classified

Papaver somniferum plant in his famous book "The Genera Plantarum".

- In 1799, the Chinese emperor banned opium completely making its cultivation and trade illegal.
- In 1803, Friedrich Sertuerner of Germany, discovered the active ingredient of Opium i.e. Morphine, which was lauded as god's own medicine due its wonder action.
- In 1839, Britain attacked China in response to its total ban on Opium trade called 1st Opium war. China was defeated, forced to play large indemity and Hong Kong was ceded to Britain.
- British arrived in Burma in 1852, imported large quantity of Opium produced in India and exported to China through gout controlled monopoly on Opium trade.
- In 1856, British and French jointly attacked China when new restriction on Opium trade was imposed by it, known as 2nd Opium war. China was again defeated, forced to pay another indemnity and Opium trade was allowed. As a consequence, Opium production increased along the highlands of south East Asia.
- In 1874, British scientist C.R Wright synthesized 'Heroin' by boiling 'Morphine'.
- In 1906, China and England finally enact a treaty restricting the Sino Indian Opium trade.
- In 1925, in the wake of the 1st federal ban on Opium, a thriving black market opens up in New York's China town.
- In early 1940s, during World War II, Opium trade routes were blocked, but France encouraged the farmers to accelerate Opium production.
- From 1945-1947, Burma gained independence from Britain and Opium cultivation and trade flourished in its Shau states.
- In 1950s, the infamous "Golden Triangle" region covering parts of Laos, Thailand and Burma was developed with tacit support of United States for illegal Opium production and heroin trade.

PRESENT SCENARIO

Fr**o**m 1990's the "Golden Triangle" region of south East Asia became the epicenter of Opium production and smuggling of around 2500 tons of Opium annually. Another center of illegal cultivation and trade has developed since 1984 in the "Golden Crescent" area covering parts of Iran, Afghanistan and Pakistan, producing approximately 4800 metric tones of Opium per year. Side by side international drug trafficking organizations from China, Nigeria, Colombia and Mexico are aggressively marketing heroin in Europe and Asia. It is continuing till date and the Europeans, who as colonial rulers, once had encouraged the cultivation and trade of Opium in south East Asia, are now facing this potent drug menace in their motherland. The journey of Opium Poppy from the region of lower Mesopotamia to the present region of "Golden Triangle" or "Golden Crescent" took a long 5500 years and became instrumental in initiating wars, trade and prosperity, political changes and ultimately becoming a boon to the pharmaceutical world as well as a bane for the wayward youth of 21st century. This long migration of Opium poppy through millennia and from one continent to another shall continue as long as people need relief from pain and develop addiction.

REFERENCES

1. M., Heydari Mohammad Hashem Hashempur MH, A., Zargaran. *Acta Med-Hist Adriat*, **11,** (1), 101-112, 2013.
2. Frick Susanne, R, Kramell, J, Schmidt AJ, Fist and TM, Kutchan. *Journal of Natural Products*, **68**, 666-673, 2005.
3. M. D., Merlin. *Economic Botany*, **57,** 3, 295–323, 2003.
4. SP, Singh, KR, Khanna, S, Shukla, BS, Dixit and R, Banerjee. *Journal of Plant Breedin*g, **114,** 89-91, 1995.

APPLICATION ASPECTS OF WAX DEGRADING BACTERIA FOR SUSTAINABLE CROP PRODUCTION

N. Arunkumar, J. Gulsar Banu, N. Gopalakrishnan and A. H. Prakash

Wax degrading bacteria are a distinct group of microorganisms capable of degrading waxy substances through pseudosolubilization, adherence, biosurfactant production, enzyme secretion (lipase) and adsorption of waxes by direct contact. Various wax degrading eubacterial genera, *Pseudomonas, Alcaligenes, Acinetobacter, Micrococcus, Nocardia, Corynebacteria, Arthrobacter, Bacillus, Rhodococcus* and *Proteus* capable of decomposing complex waxes are prevalent in the environment.The application of wax degrading bacteria in agriculture is diverse such as decomposition of waxy rich agricultural residues, amelioration of water repellent soils and control of wax coated insect pests. Extensive use of chemical fertilizers and pesticides are regarded as ecologically unacceptable in all countries. Hence, the demand for the production and application of biological agents such as soil enhancers, nutrient recyclers and biocontrol agents' is rising steadily in all parts of the world. Hence, in various agriculture systems, wax degrading microorganisms with the above said efficacies and applications could enhance the production of agriculture produces in an ecofriendly approach than conventional chemical products.

INTRODUCTION

The wide spread application aspects of wax degrading bacteria in crop production ranges from decomposition of waxy rich agricultural residues (soil enrichment), followed by reclamation of water repellent soils (soil enhancement) and also biological control of wax coated insects (pest management). Initially, agricultural residue management with more emphasis on crop residue management is one of the important strategies in this direction. It is estimated that the need of food grain in India would increase to 280 million tonnes by 2020, which needs a lot of inputs including high yielding variety, inorganic and organic fertilizers, while newer approaches to enhance the agriculture production is need of the hour. Agricultural residues contain considerable amount of wax and rapid decomposition of wax rich crop residues by heterotrophic bacteria is hindered by chemical constituents of the residues. However, certain groups of bacteria are effective in wax degradation process resulting in addition of nutrients to the soil naturally. The emphasis is on

ICAR- Central Institute for Cotton Research, Regional Station, Coimbatore, Tamil Nadu-641003, India. Email-arunkumarpdf 2015@gmail.com

water repellency: water repellency is a widespread phenomenon that occurs naturally due to accumulation of hydrophobic waxes or humic substances on soil particles. Inoculation of wax degrading bacteria in repellent soils under laboratory condition resulted in decrease of water repellency due to the biosurfactants produced by the bacterial isolates to utilize the wax compounds[1]. The cuticular waxes of the insect species contain the following chemical classes: hydrocarbons, fatty acids, alcohols, triacylglycerols, and wax esters[2]. Hence, insect pest management is highly possible with effective hydrocarbon degrading bacteria[3]. Reduction in the wax content of certain insect pests like mealybugs through wax degrading microbial applications could be a potential biocontrol tool for mealybug control.

APPLICATIONS OF WAX DEGRADING BACTERIA

1. AGRICULTURAL RESIDUES DECOMPOSITION

Crop residues are good sources of plant nutrients and are important components for the stability of agricultural ecosystems. Large quantities of crop residues are left in the field, which can be recycled for nutrient supply. In India, agricultural residues are mostly used as fuel, but a large amount is burnt in the field itself. These crop residues are abundant with cellulose, hemicellulose, lignin, pectin and also contain a low amount of diverse group of substances like protein, waxes and fatty acids. Decomposition of wax rich crop residue like rice straw (2.18%), sunflower residues (3%), soybean

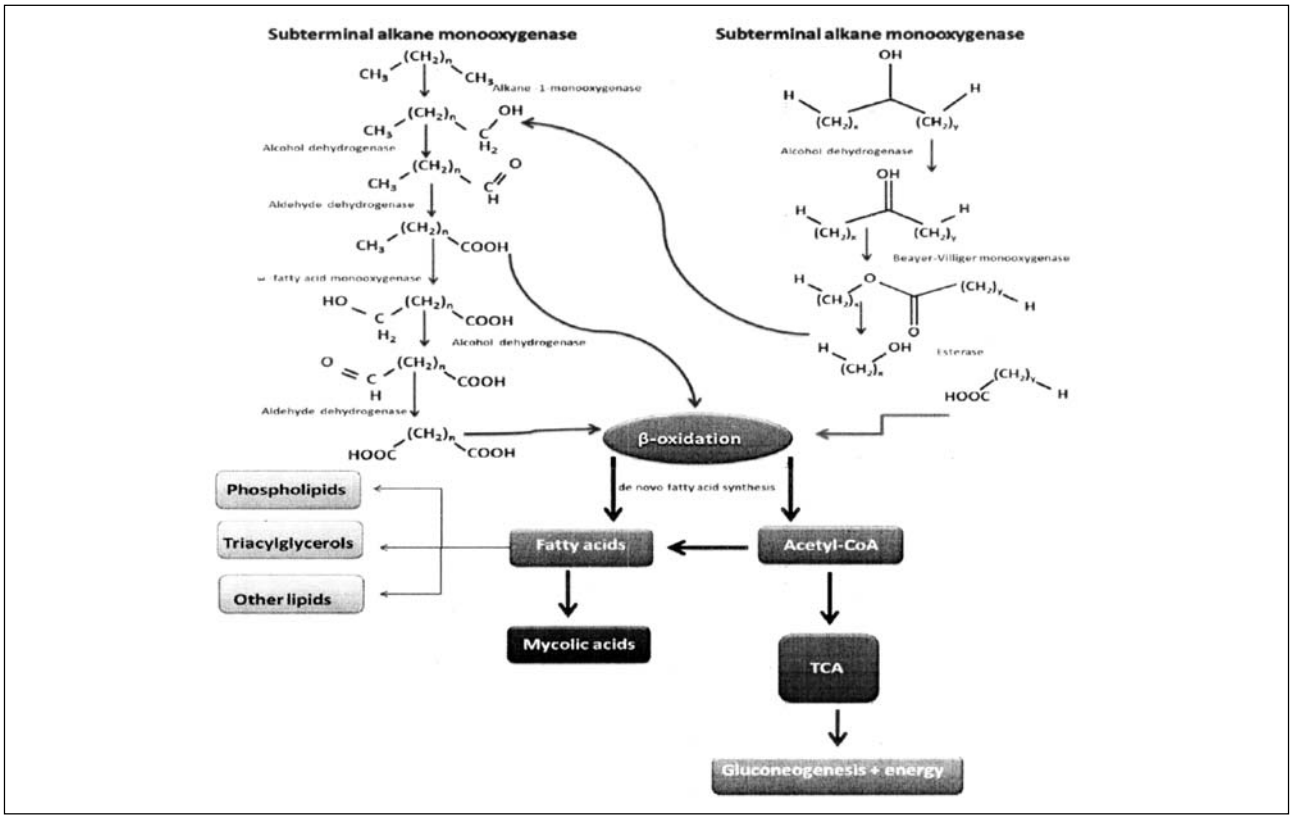

Figure 1. The main n-alkanes degradation pathways (Terminal and subterminal oxidation)[6]

(0.5%), sugarcane bagasse (1%) provides major and micro nutrients and also releases growth promoting substances[4]. Biodegradation of these ubiquitous crop residues with suitable microorganism facilitates nutrient release from crop residues and maintain sustainable soil fertility and health[5].

A wide variety of microbes are able to use long chain hydrocarbons as their sole source of carbon and energy, mostly by following two oxidation pathways. For example, in the case of aliphatic hydrocarbons (n-alkanes), microorganisms utilise soluble or integral-membrane non-haem iron monooxygenases; these enzymes, alkane hydroxylases (e.g. AlkB) hydroxylate the substrate. Essentially, the aerobic degradation of alkanes is usually initiated with an oxidization of the terminal methyl group producing a primary alcohol. This product is further oxidized by alcohol and aldehyde dehydrogenases to form the corresponding aldehyde. The resulting product is finally converted to fatty acid via β-oxidation. Fatty acid couples with CoA and is then channeled into the β-oxidation pathway in the form of acetyl-CoA (Figure 1)[6].

Wax degrading microorganisms also produce microbial lipases, cellulase, amylase and xylanase enzymes for effective decomposition of plant residues. Composting of wax rich sugarcane industry wastes like bagasse, pressmud and trash with wax degrading bacteria strains of *Pseudomonas striatum*, *Bacillus subtilis*, *Pseudomonas* sp. and *Serratia* sp. resulted in value added disposal of waste materials[7, 8]. Various studies have shown that composting of organic waste with microorganisms accelerates organic matter stabilization and gives a product rich in chelating and phytohormonal elements[5]. Triacontanol a phytohormone obtained from wax

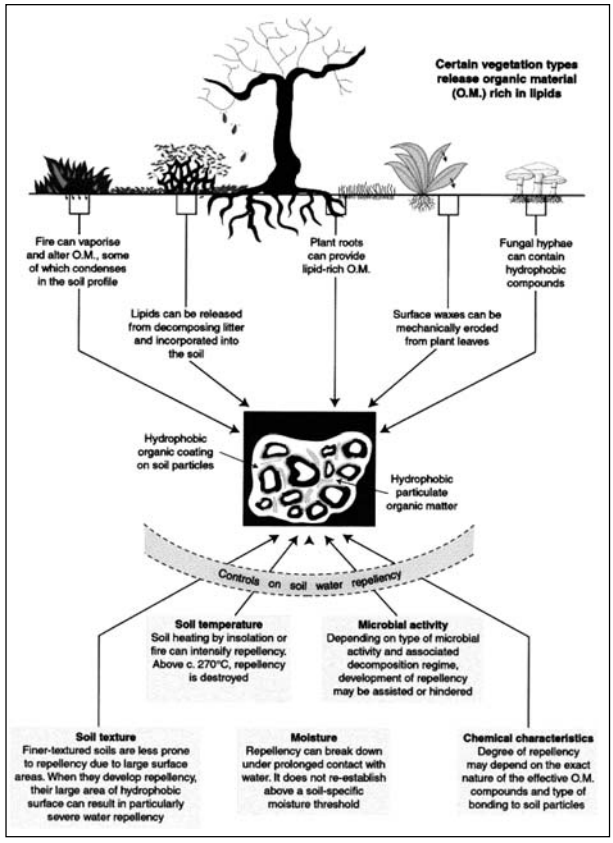

Figure 2. Origin of water repellency in soil[10]

breakdown is a natural growth promoting substance, enhanced the growth rate and yield of rice, maize, tomato, alfalfa, green gram and garden pea[9].

2. AMELIORATION OF WATER REPELLENT SOILS

Water repellency is the accumulation of hydrophobic waxy coatings around soil particles produced by roots, surface waxes from plant leaves, decomposed organic matter and soil biota, particularly fungi (Figure 2)[10]**.** These compounds are strongly hydrophilic when wet, but below a critical moisture threshold, the hydrophilic ends of this amphiphilic compounds bond strongly with each other and soil particles, leaving an exposed hydrophobic surface that induces water repellency. Severe soil water repellency is widespread and affects land used for agriculture.

Water repellency reduces crop and pasture yields through delayed germination, poor stand establishment and increased risk of erosion from wind and water. Different approaches exist to ameliorate soil water repellency; such as physical (tillage, addition of clay), chemical (application of wetting agents) and biological (increasing wax degrading bacterial population) but the first two approaches provide only short-term positive impacts, whereas the third approach shows long-term impacts by complete decomposition of repellency causing wax from soil particles with the help of lipase enzyme and microbial surfactant production[11].

The biological phenomenon was demonstrated to manage water repellency and isolated a number of bacteria (*Roseomonas* sp., *Mycobacterium* sp. *Nocardia* sp. *Rhodococcus* spp.) including *Actinomycetes* that are able to utilize waxes as sole carbon sources and inoculation of these wax-degrading bacteria in water repellent soils under controlled laboratory conditions improved soil wettability[1]. Reclamation process combining both chemical and microbial process is also successful. Laboratory and glasshouse experiments conducted in water repellent South Australian calcareous soils with slow-release sources of nitrogen and phosphorus fertilizers resulted in a significant drop in hydrophobicity due to stimulation of indigenous wax-degrading microorganisms already prevalent in the sandy loam soil[12].

3. CONTROL OF INSECT PESTS

The major components in the cuticular extracts of insects include hydrocarbons, wax esters, aldehydes, ketones, alcohols and acids. The homopteran insects produce large amounts of wax, which protects them from target chemicals resulting in higher insecticide consumption. Repeated use of chemical insecticides for a long time has disrupted biological control by natural enemies leading to frequent pest outbreaks and development of resistance in major insect pests. This indicates the need to develop new and selective insect control alternatives of biological origin, particularly for insects with waxy rich cuticle. Certain hydrolyzing microbes termed as the wax degrading microbes, are capable of degrading this waxy coating on mealy bugs and certain other insects. Since the chemical composition of plant wax and insect wax are mostly different (Figure 3)[13], insect wax specific wax degrading bacteria could be an effective solution to pest problems. For example, in case of cotton mealy bugs it is possible to develop wax degrading bacteria targeting the mealy wax without hindering the composition of the plant wax[14].

Wax degrading microbes produce cell wall degrading enzymes *viz*., chitinase, lipase, protease, β-1,3-glucanase, chitin deacetylase and chitosanase as a lethal component against insect pests. The bacterial isolates originating from *Maconellicoccus hirsutus* cadavers were screened

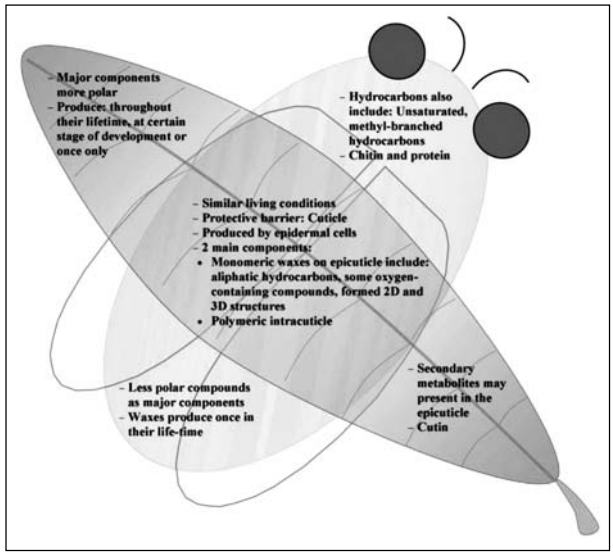

Figure 3. Summary of similarities and differences between the surface characteristics of insect and plant cuticles[13]

for their wax degrading effects and the three most potent wax degrading isolates were identified by 16S rRNA sequencing as *Serratia marcescens*, *Pseudomonas aeruginosa* and *Bacillus subtilis*. Application of these wax degrading bacterial isolates reduced female longevity, offspring production as well as reduction in weight and wax content of emerging mealybug adults[3]. Likewise eight strains of wax degrading bacteria identified as *Pseudoxanthomonas* sp. (PSAD1), *Acinetobacter* sp. (PSAD 2 and PSAD 7), *Klebsiella* sp. (PSAD3 and PSAD 8), *Providencia* sp. (PSAD5) and *Serratia* sp. (PSAD 9) capable of producing biosurfactants and lipase enzyme capable of degrading cuticle wax were isolated from the carcass of mealybug species *Phenacoccus solenopsis* (Tinsley) and *Ferrisia virgata* (Cockerell)[15].

CONCLUSION

Extensive use of chemical pest control agents are regarded as ecologically unacceptable in all countries. Now, it is time to replace them gradually with biopesticides with various biological activities that occur naturally from living organisms. Biopesticides based on microbes as whole, microbial toxins, biochemicals derived from micro-organisms are emerging faster but the potential of certain group of microbes still remains unexplored. This paper underscores the potential of wax degrading bacteria in plant residue decomposition, reclamation of problematic soils and importance in insect pest control.

ACKNOWLEDGMENT

The Financial assistance to Dr. Arunkumar Nagarathinam in the form of SERB National Post-Doctoral Fellowship (File Number: PDF/2015/000844) from Science & Engineering Research Board (SERB), Department of Science and Technology, Government of India and institutional support by ICAR- Central Institute for Cotton Research (CICR), Nagpur, Maharashtra, India are gratefully acknowledged.

REFERENCES

1. M. M. Roper, *Aust J Soil Res*, **42**, 427–434, 2004.
2. M. Golebiowski, M. I. Boguse, M. Paszkiewicz, P. Stepnowski, *Anal Bioanal Chem*, **399**, 3177-3191, 2011.
3. R. Salunkhe, C. D. Patil, B. K. Salunkhe, N. M. Rosas-Garcia, S. V. Patil, *BioControl*, **58**, 535–542, 2013.
4. G. Kumar, R. Kumar, A. Sharma, *J Environ Biol*, **36**, 1101-1104, 2015.
5. U. Tomati, E. Galli, L. Pasetti, E. Volterra. *Waste Manage Res*, **13**, 509-518, 1995.
6. E. Koshlaf, A. S Ball, *AIMS Microbiol*, **3,** 25-49, 2017.
7. V. Muthuvelu. M.Sc. Thesis, Tamil Nadu Agric. Univ. Coimbatore, Tamil Nadu, India, **115**, 2008.
8. R. Kumar, D. Verma, B. Singh, U. Kumar, N. Shweta. *Bioresource Technol*, **101**, 6707-6711, 2010.
9. M. Naeem, M. Masroor A. Khan, M. Moinuddin, *J Plant Interact*, **7**, 129 - 142, 2012.
10. S. H. Doerr, R. A. Shakesby, R. P. D. Walsh, *Earth-Sci Rev*, **51**, 33-65, 2000.
11. M. M. Roper, V. V. S. R. Gupta, *Aust J Soil Res*, **43**, 171-177, 2005.
12. C. M. M. Franco, P. P. Michelsen, J. M. Oades, *J Hydro*, 231/232, 342–351, 2000.
13. S. H. Nguyen, H. K. Webb, P. J. Mahon, R. J. Crawford, E. P. Ivanova, *Molecules*, **19**, 13614-13630, 2014.
14. N. Arunkumar, J. GulsarBanu, N. Gopalakrishnan, A. H. Prakash, *Phytoparasitica*, **46**,145-152, 2018.
15. N. Arunkumar, J. Gulsar Banu, N. Gopalakrishnan, A.H. Prakash, *Journal of Entomology and Zoology Studies*, **5,** 1191-1195, 2017.

PLANT-BASED TRADITIONAL FOOD FOR NUTRITIONAL SECURITY IN INDIA: NEED, ISSUES AND CHALLENGES

Ruparao T. Gahukar

The alarming pace of food biodiversity loss and ecosystem degradation and their impact on poverty and human health make us think of traditional foods connected with agricultural systems. Malnutrition and undernourishment remain a major problem in rural areas and incur economic costs to the government. Choosing traditional foods can be more affordable, tasty and nutritious than the packaged and processed foodstuff or "super foods". In this article, need, current issues, challenges and approaches to nutritional security related to traditional foods are discussed with a perspective towards better food habits and life style.

INTRODUCTION

In India, the current population is estimated at 1.26 billion and the trend towards any further increase will put the country in a difficult situation of rood security. For example, country produced 230 million tonnes of food grains to meet the needs of population of 1.15 billion. This production needs to be doubled by 2050 to meet the food needs of the expected population of 1.8 billion[1]. The compound growth rate of food grain production has constantly decreased from 3.22% during 1950-1959 to 1.22% in 2000-2007. Consequently, the per capita net availability of food grains decreased to 442.8 g/day in 2007 from 494.1g in 2002[2]. Thus, the challenge facing the country is to produce more and more from diminishing per capita arable land and irrigation resources and expanding abiotic and biotic stresses. There is stagnation in productivity improvement due to declining farm size and income, depleting natural resource base particularly ground water, increasing farm input costs, deficiency of micronutrients resulting in deterioration of soil health, inadequate harnessing of post-harvest technologies, high indebtness of farmers and uncertain market prospects[1]. Apart from socio-economic situation people suffer not only from lack of food availability and access to healthy food but also from undernourishment due to inadequate consumption and micronutrient deficiency[2]. For example, 230 million people in rural areas are undernourished, 40% of children below three years of age are underweight and 45% are stunted in growth[2]. In rural areas, people sustain their livelihood on farm activity by working as labourer or farm owner. The most

Formerly with UN Food and Agriculture Organization, Plot 220, Reshimbag, Nagpur 440009, Maharashtra, E-mail: rtgahukar@gmail.com

distress period for them is before rainy season when the food from the previous harvest are consumed and the next harvest is far away. Therefore, poor communities survive on any available food sources including wild food plants. Early grown/seasonal vegetables and legumes grown in vicinity of villages on the onset of early rains are used to tide over distress at the beginning of crop season[2].

Until the last two decades, food grain production by increasing crop productivity was emphasized by the policy makers. This is evident from Green revolution (GR) in the late 1960s with introduction of the high yielding crop genotypes without considering their nutritive values. These aspects affected human nutrition to a large extent. In fact, cost of treating malnutrition is 27 times more than the investment required for its prevention[3]. Malnutrition has also economic cost (low energy, deficiency in micronutrients, disease infection etc.). Plant-based foods can be one of the sustainable solutions to nutritional insecurity. In this article, traditional foods are discussed with a perspective of improving human nutrition for better living and healthy life.

NEED OF TRADITIONAL FOODS

Firstly certain local plants (minor food crops and wild species) are rich in protein, micronutrients and vitamins and can fill in the gap of nutritious food[4]. Therefore, there is need to revive them under Biological Diversity Act (2002) and distribute their seeds to farming communities. Exchange of seed of indigenous plants within communities can boost some of the traditional crops cultivated on small farms to contribute substantially towards mitigaling hunger and malnutrition. To make people aware of this fact, the UN celebrated the International family farming year in 2014 and stressed the importance of small farming and traditional foods from local plants to rejuvenate the basic principle of food availability.

Secondly globalization and liberalization in food trade made all foods available even in remote places and changed the consumers' food habits[5]. As a result, food recipes are prepared as per choice of consumers who appreciate the modem foods but who are not are aware of traditional dishes. This scenario is different in tribal communities who consume local vegetables and fruits. The freshness of local plants is assured when purchased in daily "haat" and weekly "bazar" that are held in small villages. These are the sole places for retail sale and purchase of fresh, often seasonal farm produce (depending upon local ecology). Unfortunately, not much attention has been given by concerned authorities to create infrastructure and market access for local producers except that laws are enacted to regulate them[5]. With new set up of Agricultural Produce Marketing Committee, it would be feasible and logical to include locally produced vegetables and fruits.

Thirdly, the dietary recommendations for humans are compatible with an environmentally sustainable food system[6]. For example, iron deficiency can be compensated by preparing dishes from local leafy vegetables (*Amaranthus* spp., *Chenopodium* spp. etc.) and minor millets (finger millet, foxtail millet, barnyard millet). Mehta *et al.*[7] identified several recipes based on local foods in Uttarakhand. The diversity of recipes in the region (amounting to nearly 125 containing cereals, pulses, vegetables and fruits) supports locals to sustain and enjoy the life in hilly areas of Himalaya where varieties of local crops, value-addition to local food and traditional knowledge are the pillars of food sustainability[7]. However, several plants that are easily available

in plenty round the year are still undocumented for their nutritional quality[4]. For example, about 100 species of domesticated plant species and 419 wild species are used as food in central India[8]. Most of them have medicinal/therapeutic uses and contain micronutrients, vitamins and minerals needed for human body and may have readily available antioxidants[8,9]. Cost of cultivation of local crops is not high but they have low yield potential. Therefore, fanners sell traditional food products at higher price than fast foods or conventional meals. Consequently, a small number of citizens purchase these items. There is urgent need to improve crop productivity and to initiate local marketing channels.

CURRENT ISSUES

(i) Marginal farners with small and fragmented land holdings are often unable to produce sufficient food and their livelihood is at stake in case of crop failure, lean seasons and periods of vulnerability or when food consumption exceeds production. In such cases, promoting traditional food through organic fanning on the principles of contract or cooperative farming can solve the problem of food accessibility and money earning, at least for a short period. In recent years, organic food has spread through and beyond food markets, taking a variety of forms and structures in the process of creating a new sustainable food network of traditional food systems[10]. Once the network is established, it would minimize malnutrition-related health complications in urban and rural populations. Schmid[11] explained reasons for chronic health problems due to consumption of modern diet and recommended traditional foods for improving our wellbeing. Poor persons having a significant deficiency in protein, micronutrients (calcium, iron, iodine) and vitamins (A, B-complex), do not take the Recommended Dietary Allowance (RDNday/ person) of 55-60 g of protein, 25-30 g of fat, 600 mg of calcium and 17-21 mg of iron[12]. This is probably a result of Iow level of utilization of cereals, pulses, oils, fruits and vegetables and which is reflected by a significant difference in RDA and actual consumption of the foods (Table 1).

Table 1. Recommended dietary allowance (RDA), food consumption and food availability per person per day[12].

Food Category	RDA	Current food consumption	Current food availability
Cereals	400 g	345 g	412 g
Pulses	80 g	24g	32.5 g
Milk	300 s	71 g	245 g
Vegetables	300 g	43 g	210 g
Oils	30 g	12 g	—

(ii) Research is focused on modernized cuisine and traditional recipes have been ignored by government departments, universities and food industry probably because new generation of tribal communities has lost the traditional knowledge and are no more interested in traditional food. Moreover, with modem life styles, urban consumers are looking only for celebrity food stuffs or so called "super foods" to fill kitchen racks[10]. To satisfy personal needs of young consumers towards processed food, certain food items are outsourced from different geographical locations. They are not aware of contents therein, and enjoyment being the sole motto, nutritional aspect is neglected. The junk/ processed food is often contaminated with pesticides, mycotoxins, trans-fat and artificial colours and is adulterated with non-permitted matters and have higher calories than traditional foods[5]. Persons (particularly employees) having increased family income have changed their food styles by preferring "outside" food rather than

Table 2. Content of major nutrients (per 100 g fresh weight) of popular local cultivated plants used in traditional recipes[14, 17 & 18].

Plant	Carbohydrates (g)	Protein (g)	Fat (g)	Fibre (g)	Calcium (mg)	Iron (mg)
Barnyard millet (1)	65.0	6.0	2.0	10.0	20	5.0
Bitter gourd (3)	4.2	1.6	0.2	0.8	20	1.8
Black gram (1)	60.0	24.0	1.0	1.0	154	4.0
Chick pea (1)	61.0	17.0	5.0	4.0	202	5.0
Finger millet (1)	72.0	7.0	1.0	4.0	344	3.9
Green gram (1)	57.0	24.0	1.1	4.0	124	4.0
Indian spinach (2)	8.9	5.0	0.8	—	410	20.5
Italian millet (1)	60.9	12.0	4.0	8.0	31	3.0
Kodo millet (1)	66.0	8.0	1.4	9.0	27	0.0
Little millet (1)	67.0	8.0	5.0	8.0	17	9.0
Pearl millet (1)	67.0	12.0	.0	1.0	42	8.0
Pigeon pea (1)	58.0	22.0	2.0	1.0	73	2.0
Rice grains (1)	77.0	7.0	1.0	1.0	10	3.0
Spine gourd (3)	4.2	3.1	1.0	3.0	33	4.6
Sweet gourd (3)	7.6	1.5	0.1	1.1	64	0

"home-made" food. Thus, one can enjoy easy-to-make delicious home food and reject "discernible palate" as described by Date[13].

Currently, demand for readily available foods is increasing day by day probably because the restaurants serve quick menus at affordable price. Nevertheless, contents of street food recipes/ foodstuffs are unhealthy. For example, wheat being glutenous is used for soft breads and puff pastries[12]. On the contrary, millets are gluten-free, rich in fibre, good source of protein and contain micronutrients. Finger millet is rich in calcium and being non-acidic, is ideal to maintain the natural pH of the body[14]. Millets are perhaps the most indigenous grains that exist in India but unfortunately, do not find place in supermarkets. Similarly, high quality protein intake largely provided by pulses is low. In future, food provision can be fulfilled by increasing pulse production in the country[15]. In fact, several recipes and traditional preparations of cultivated cereals and pulses are common in various states, examples of plants with content of major nutrients are given in Table 2. Recently, genetically modified (GM) food crops (cereals, pulses and vegetables) have been developed and may be available for human consumption in a course of time. They contain traits of resistance to abiotic and biotic stress, productivity increase etc. Whether traditional foods prepared from GM crops would be safe or not is a debatable subject[16].

(iii) Family farming or smallholder farming provides an opportunity to contribute significantly

to improve livelihood basically due to self-reliance, to manage natural resources on the farm and to provide jobs to the family members of poor farmers. Biodiversity is maintained through a variety of crop compositions, cropping patterns and crop rotations. For example, crop combinations consisting of cereals and pulses are practised by local communities in the central Himalayan region that help in safeguarding agrobiodiversity and in producing a rich and balanced nutritional diet. By this way, family farming contributes to 30-40% of the food requirement of small and marginal farmers[19]. The synergistic effect can thus avert total crop failure and thereby ensure food security to the family. Considering this success, cropping systems (intercropping, mix-cropping, relay-cropping, terrace farming) suitable to each agro- climatic zone needs to be promoted.

Livelihood to a large section of resource-poor farmers and landless labourers is equally assured whenever they get field work. For example, tribal women in central India collect mahua (*Madhuca indica*) flowers during peak flowering period that fetch good remuneration whenever there is market demand[20]. Otherwise, they prepare pan cake of sun-fried flowers and preserve to tide over period of drought and other natural disasters. Most of the farm activities and collection of wild food being handled by women, their empowerment becomes imperative to popularize local food plants for traditional foods. Food recipes readily available in cook books can be promoted during festivals because traditional foods often give a better indication of local cuisine. Along with seasonal plants, wild plants are traditionally used as food in the period of food scarcity by indigenous people. However, accelerated modernization is leading to erosion of traditional knowledge and cultural values of Iocal foods. The challenge is how to integrate traditional foods into contemporary diets. For this purpose, local groups should be encouraged through education, training, community outreach and networking. Creating and enhancing local marketing can therefore link farming, food, health and local economies. Foods from uncultivated plants would have a prominent role in future foods. To explain their importance in daily diet, 11 local wild plant species with their nutritional value and traditional preparations are described below. Plants are easily available in nature with no cost and support family livelihood. Some food recipes/preparations still exist in certain tribal communities in different states are given below :

Examples of specialized traditional foods based on local uncultivated plants with the content of major nutrients (compiled from various publications).

1. *Atrocarpus heterophyllus* Lam. (Jack fruit): Raw fruit contains carbohydrates (23%), protein (6-7%) and fat 92-3%). It is a good source of vitamins (A and C), minerals (K, 10%), (Mg, 8%), insoluble fibre with low sugar, and antioxidant (flavonoid). It can replace starchy staple food (wheat and rice). Raw buds having unique flavor are cut into slices to which grated coconut, honey and banana slices are mixed. Raw fruits are used in porridge or as raw meal. Curry prepared of raw fruits is very much appreciated by non-vegetarians due to meat-like texture. Fruit flesh is used with rice for steaming to prepare *Idli* and *Dosa.* Ripe fruits with sweet aroma are sliced and mixed with fruit salad. Jam, jelly and *Chutney* are other products prepared from ripe fruit.

2. *Fagopyrum esculentum* (Moench) (Ruck wheat): This pseudocereal is used in raw food recipes, porridge, breakfast food, and as thickening agent in soups, gravies and dressings. The whole grain and groats (grains after removing

hulls) contain protein (11.2%), fat (2.4%) and grains have more fibre (10.7%) than groats (0.6%).

3. *Moringa oleifera* Lam. (Drumstick, moringa): Fresh leaves, flowers, green pods and seeds are popularly used in various foods. Tea is prepared from leaves. A preparation of *Pakoda* from fried flowers is a delicacy. Young pods are routinely used in *Sambar* and curry preparations and are appreciated for their asparagus-like taste. Seeds are boiled and consumed with other foods. Content of nutrients in 100 g fresh leaves and pods are as follows: carbohydrates 12.5 and 3.7 g, protein 6.7 and 2.5 g, fat 1.7 and O.lg, fibre 0.9 and 4.8 g, Ca 440 and 30 mg, K 42 and 24 mg, Mg 259 and 260 mg and P 70 and 110 mg. Content of vitamin A is 4 times greater than in carrot and Vitamin C is 7 times higher than orange. Both leaves and pods contain all essential amino acids.

4. *Benincasa hispida* (Thunb.) (White pumpkin, fuzzy melon, wax gourd): Ripe fruits being sweet, are added to stir fries and soups. Sweet *Petha* and *Halwa* are common desserts in low-income communities. Fruits contain carbohydrates (3.05%), protein (1.06%), fat (0.74%), fibre (10.0%), vitamin C (19.11%), Vitamin B12 (11.15%) and amino acids (lysine, tryptophan). Among minerals, Na and Zn contents are 80% and 7.36% respectively.

5. *Manihot esculenta* Crantz (Tapioca): Although the plant is considered as poor man's crop, its tubers are high energy booster because they contain 78-90% starch and important minerals (Ca, Fe, P, Mg). Tuber starch is processed to edible starch, popularly known as *Sago* which also has high calorific value (350 Kcal), and content of protein (0.20%), fat (0.05%). Sago *Khichadi* is available even in restaurant on fasting days. In southern and central states, Sago *Kheer* as a sweet dish is served in religious rituals. In food industry, sago-based products like chips, wafers, vermicelli are manufactured and sago flour is used as thickening agent for soups, cakes and cookies. In rural areas, sago is mixed with rice in daily meals.

6. *Macrotyloma uniflorum* (Lam.) Verd. (Horse gram, kulthi): Grains are potential source of protein (22.0 g/100 g, fresh weight), carbohydrates (57.0 g), fibre (5 g), Ca (287 mg), Fe (7 mg) and P (311 mg/l00 g, fresh weight). Consumed as whole grains and sprouts and its dal (split grains) is quite popular in the form of curry, soup, *Vada, Ras* (cooked in frying pan) and *Chutney.* These preparations are consumed with boiled rice or bread *(Chapati),* tender leaves of radish and coriander or mustard grains.

7. *Sesbania grandiflora* (L.) Pers. (Agathi): The plant is available in plenty during early period of rainy season when the green tender leaves are plucked by folk for various traditional dishes. Also, flowers and young pods are consumed as vegetable. Pan cake is prepared from leaves after mixing with wheat flour. Leaves contain carbohydrates (11.8 g/100 g, fresh weight), protein (4.8 g), fat (1,4 g), Ca (1130 mg/l00 g), P (80 mg) and Fe (3.9 mg/l00 g, fresh weight). Lave also contain a reasonable quantity of vitamins A, B_1, B_2, B_3 and C.

8. *Vicia faba* L. (Broad bean, double bean, faba bean): Plant is largely Green pods and dry cotyledons are consumed as vegetable (fried or curry with potato) by local communities in hilly areas. Also, beans are boiled with salt, seasoned and consumed as snack. Beans are mixed with *Pulav* and vegetarian *Biryani.* Beans are a good source of calorific energy (341 Kcal/I00 g), carbohydrates (58.3%), protein (26.1%), fat (1.53%), Mn (77.0%), P (60.0%), Mg (54.0%), Fe (52.0%) and vitamin B_9.

9. *Madhuca longifolia* (Koenig) Macbr (Mahua): Flowers having sweet taste and flavour are consumed by tribal communities during flowering season and often as substitute to costly food grains. During off-season, sun-dried flowers are stored to use whenever needed. The flowers are fermented, jaggery is added and the resulting alcoholic drink forms a part of religious rituals and cultural heritage. Cake, syrup, jam and various kinds of bread are prepared from dried flowers. The pan cake is one of the dishes which are very much appreciated as seasonal delicacy in forest-dwelling populations. Flowers contain high amount of sugar (54.1 %), protein (6.4%), fat (0.5%), Ca (8.0%) and P (2.0%).

10. *Hibiscus sabdariffa* L. (Roselle): Fresh leaves and shoots are consumed as sour-flavoured green vegetable or condiment. *Chutney* prepared by mixing roselle leaves with green chillies, salt, and garlic is consumed with millet bread or pan cake. To prepare curry, leaves are steamed with lentil and cooked with *Dal* (split grains) or meat. Fleshy red calyxes/flowers are used in production of soft drink, tonic, soup or tea. Fried seeds are mixed in various diets. This plant is appreciated by villagers as a seasonal delicacy. The content of nutrients in leaf, calyx and seed/100g (fresh weight) are as follows: carbohydrates (3.5, 2.0, 28.9 g), protein (8.7,10.2,25.5 g), fat (0.3, 0.1, 21.4 g), Ca (240, 150, 350 mg). The high content of vitamin C in leaf (240 mg/100 g), calyx (150 mg) and seed (350 mg/100g), and vitamin A in leaves (1000 mg/100 g) made this vegetable popular among rural and urban consumers.

11. *Amaranthus* spp. (Amaranths): Fresh leaves are cooked with salt, chillies, tamarind, garlic and eaten with sorghum pan cake or finger millet balls. Soup, curry, kofta are popular dishes in northern India. Leaves being easily available in uncultivated land, is sold in local market during early period of rainy season. Although leaf contains low amount of carbohydrates (4.0 g/100 g) and protein (5.0%), it is accepted as a nutritious legume due to high content of Ca (330 mg/100 g) and Fe (19 mg/100 g).

CHALLENGES

(i) Intensification of agricultural systems has led to a substantial reduction in the genetic diversity of domesticated minor plants[2]. Therefore, tribal communities have lost access to numerous local plants which otherwise ensured food access and availability whenever urgent need was perceived. With implementation of National Food Security Act (2013), poor persons including small and marginal farmers get food grains at highly subsidized rate and subsidy on farm inputs[2]. These schemes prompted farmers to abandon traditional crops and discouraged procuring diverse foods from the wild. Indeed, farmers are always dependent on government rather than doing themselves innovative work on their farms (farm ponds, check dams, ridges and furrows, FYM composting, indigenous plant products for plant protection etc.). Farmers should become self-sufficient to procure preferred foods and cultivate minor food plants of their choice for supporting family livelihood.

(ii) Multi-grain food with magnitude of combinations is the recent addition to our food basket and is available in different market-innovated forms because it is healthy with high nutritional value. Indeed, these mixtures were already eaten by our ancestors and had been a part of Indian diet since ancient times as revealed by Acharya[21]. Even now, depending upon the austerity, locals mix the grains and enjoy a balanced diet. They often add condiments/ accompaniment or follow seasoning to make traditional food tasty. Generally, most of the traditional recipes based on local crops are

especially prepared for religious festivals and cultural events. The current challenge is how to popularize these foods.

(iii) In developed countries, school food is based on the content of energy, saturated fat and sodium. The Netherlands is perhaps one of the first countries to include ecological perspective in its dietary guidelines in 2011[22]. In India, The Food Safety and Standards Authority of India (FSSAI) had set up an expert committee to frame junk food guidelines for schools after the Delhi High Court order in 2014. Likewise, providing cooked food was made mandatory in mid-day meals by a Supreme Court order in response to a public interest litigation.

Gahukar[23] discussed at large the current situation of foods served in schools in India and prescribed certain logical steps to avert the trend of junk food easily available in the canteens and restaurants. Legally, the FSSAI has a mandate of developing and enforcing stringent laws, particularly labelling, to enable disclosing of relevant information on junk foods. This is being done only for energy foods and supplements.

(iv) Content of anti nutrients and toxic substances such as, phylates and tannins in millet, and trypsin, amylase inhibitors and saponins in pulses, can prevent the assimilation of essential nutrients by the body and may be hazardous to human health[4]. Simple processing methods such as, boiling, parboiling, drying, roasting etc. can effectively eliminate these elements to make food consumption safe 4. In future, research on natural detoxification may be helpful for "ready to use" foods.

(v) More and more people now rely on food that is not harvested locally but distributed by Public distribution system (PDS)[2]. The system has played an important role to augment supply and thereby to moderate market prices. With changing food habits, the urban and rural populations now prefer wheat and rice In pace of coarse grams an minor pulses[24]. Subsequently, demand for these two cereals has increased significantly. Certainly, this system assures food security but discourages traditional food and makes people vulnerable to malnutrition. Ultimately, those who cannot buy adequately diverse vegetables and food grains from the market, suffer from food insecurity, undernourishment and malnutrition[2]. Regional differences in food habits are evident from cultural diversity, economic growth and life style. To facilitate easy distribution to the poor people through fair price shops, government introduced subsidized rates to those Below Poverty Line (BPL). But the quality of food grains in these shops is often contested. There is a need to re-introduce system which would encourage selling minor food crops (pearl millet, finger millet, horse gram, green gram, black gram etc.) particularly in areas of their cultivation. The Food Corporation of India (FCI) should procure, store/maintain and distribute the grains of minor food plants. This would assure nutritional security of local communities. Unfortunately, PDS is concerned only with food from cultivated crops though foods prepared from indigenous uncultivated/wild fruits and vegetables are routinely consumed by tribal and other local communities. This aspect did not receive attention of government agencies and researchers as well.

CONCLUSIONS

Eating fresh, home-cooked food is the best for health. For this goal, farmers and consumers should come together on a common platform for right to save traditional recipes of local food plants and have healthy and safe food produced through ecologically sound and sustainable fanning. This would be a welcome step towards

food sovereignty. Concurrently, there is increasing interest in second GR based on sustainable agriculture. Combining nutritional security would be a welcome step for traditional foods. New information technology (websites, blogs, apps etc.) can therefore be used to explore possibility of promoting traditional foods. Nowadays, events/ fairs on food recipes (often combined with cultural programmes) are organized by group of restaurants where holiday meals containing diverse traditional recipes can be made available. The current trend being for a fusion cuisine of traditional and modem recipes, cooking lessons and demonstrations are possible in metro cities with TV channels and teleconferences.

REFERENCES

1. M.S. Swaminathan and R.V. Bhavani, *Indian J Med Res,* **138**, 383-39, 2013.
2. R.T. *Gahukar, J Agric Food Inf,* **12,** 3-4, 270-286, 2011.
3. S. Burza *et al., American J Clin Nutr,* **101,** 4, 847-859, 2015.
4. R.T. Gahukar, *J Agric Food Inf,* **5**, 4, 342-352, 2014.
5. R.T. Gahukar, *Int J Basic Appl Sci,* **3**, 1, 47-54, 2014.
6. M. Nesheim, P.J. Stover, and M. Oria, *Nature,* **522**, 7556, 287, 2015.
7. P.S. Mehta, K.S. Negi and S.N. Ojha, *Indian J Nat Prod Resour,* **1**, 1, 89-96, 2010.
8. V. S. Kamble and V.D. Jadhav, *lnt J Agric Food Sci,* **3**, 2, 56-58, 2013.
9. B. Goudappanavar, K. Naik and S. Mahesh, *Kisan World,* **42**, 5, 52-53, 2015.
10. J.E. Ikerd, *J Agric Food Inf,* **12**, 1, 49-57, 2011.
11. R. Schmid, *Traditional foods are your best medicine.* Healing Arts Press, Randolph, VT, USA, 2015.
12. NIN (National Institute of Nutrition), *Dietary guidelines for Indians: a manual*. NlN, Hyderabad, Telangana State, 2011.
13. R. Date, *What's for lunch,* Sakal Publications Pvt. Ltd., Pune, India, 264 pp, 2014.
14. C. Gopalan, B.V. Rama Sastri and s.c. Balasubramanian, *Nutritive value of Indian foods*. National Institute of Nutrition, Hyderabad, Telangana State, 2004.
15. A. Das and P.K. Ghosh, *Outlook Agric,* **41**, 4, 279-284, 2012.
16. R.T. Gahukar, *J Food Agric Environ,* **2**, 2, 11-13, 2004.
17. D. Balasankar, P. Selva Preetha, and P. Jansirani, *Kisan World,* **40**, 5, 33-35,
18. I.S. Mathi, *Down Earth,* **21**, 9, 46, 2012.
19. R.K. Maikhuri *et al., Curr Sci,* **108**, 9, 1581-1583, 2015.
20. M. Pate! and S.N. Naik, *Indian J Nat Prod Resour,* **1**, 4, 438-443, 2010.
21. K.T. Acharya, *The story of our food,* Orient Blackswan Pvt. Ltd., Hyderabad, Telangana State, 104 pp., 2000.
22. CSE (Centre for Science and Environment), *Junkfood targeted at children,* CSE, New Delhi, 2014.
23. R.T. Gahukar, *Everyman's Sci*, **52**, 1, 26-29, 2017.
24. J.V. Meenakshi, *The public distribution system in the context of changing food consumption trends: a review of the evidence.* Planning Commission, Govt. of India, Delhi, 2001.

WATER: CSIR-CSMCRI PREPARES THE ROAD-MAP FOR THE PEOPLE

N. Pathak and A. Bhattacharya*

Scientific research is the foundation of modern advancement of techniques in water purification. In this regard 'Reverse osmosis (RO)' technique is one of the milestones. Banking on RO technology, CSIR-CSMCRI, Bhavnagar is serving people in a great extent. The present article covers activities regarding the RO Plant installation to various locations inside the country and abroad for providing safe and clean drinking water and also for providing water during the disaster like Cyclone, Aila.

INTRODUCTION

Fresh Water is treated as national security. It creates the history of the place. It controls the major part of the economy battle. It affects energy and food production as well as health issue. In other words water is for our survival and delivers the quality of environment. Ironically, sometimes natural or added contaminations rob us of the gift making us to confront a lot more challenging world. The fresh water is an important necessity for our health. The world is facing turbulent situation regarding water. United Nation has marked 22nd March as 'world water day' to spread the importance of water. With the advancement of technology and industrial growth fresh water resources all over the world are threatened. It is the technology to have the ability to counter the issue. The direction is to search effective, lower cost as well as robust technique to decontaminate as well as disinfect water from source to point of use. In this regard 'Reverse Osmosis' is the technique we can faith on it [1-3].

We owe the term 'Osmosis' to French Physiologist Henri Dutrochet, who coined the word 80 years after the discovery of the phenomenon by Abbe Nolet in 1748 [4,5]. The concept of 'reverse osmosis' arose in mid-1950's and considered a need based invention. Osmosis is the process where life sustains where as Reverse Osmosis is the regulator of life[6]. As we are progressing to the modern civilization, RO is the priority in our life. The ongoing revolutionary world of RO technology never stops. What it does is that it always innovates. It does not stay static. Its dynamism can be felt by the constant deliberation on making and upgrading technological advancements which are and in future will be impacting individuals and their setting.

* Membrane Science and Separation Technology Division, Council of Scientific & Industrial Research-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI), Bhavnagar-364002 Gujarat, India
E-mail : bhattacharyaamit1@rediffmail.com, amit@csmri.res.in

Though India has blessed regarding many reservoirs, long coastal line and average annual rainfall (120cm) is above the global average of 100cm many of its parts are water distressed. According to Central Ground Water Board report nearly half of India's groundwater is heavily polluted with geological as well as anthropogenic sources like fluoride, nitrates and even arsenic, which disturbs the general health of the people. The added concern is that agrochemicals and discharge of untreated industrial effluents and urban wastes in to water bodies make the surface and ground water sources unfit for drinking. Moreover, the population is another growing concern in our country. It is said that by 2022 the country will be most populous one overtaking China. In order to cater the population in terms of food, energy as well as to maintain the economic growth, availability of water is very much important. Thus technology can only protect us.

CSIR-CSMCRI has the pride in terms of development of technology. Being situated in remote part of the country, the institute has never minded to cross the obstacles in terms of developing different technologies as well as service to the nation. The Membrane Division has carrying the torch of the development of RO technology. It already becomes a trademark to CSIR-CSIR-CSMCRI with its splendid track record of performance over the past 50 years and having serviced the nation. Initially it was named as Reverse Osmosis Division. The research program in the area of membranes was initiated in 1969 with the main aim to develop membrane technologies to meet the demand for clean water through water purification and desalination. In the initial period, RO membranes for brackish water desalination were developed from cellulose acetate (CA) in the form of tubular membranes. Later, CA based flat sheet RO membrane technology was developed for brackish water desalination during the period 1970-1985. With the view to develop more robust membranes for desalination and other applications, research work was initiated on the development of state-of-art thin film composite (TFC) RO membranes in early 1990s[7]. The Division has been growing steadily since inception. The institute has not only recognized the true meaning of technology upgradation and transcended it into bigger frames but also the lives of people good enough[8].

The institute has spread its wings in terms of plant installation in various parts of the country. The state wise activities are described below.

RAJASTHAN

Rajasthan, the state of palaces and forts is proud for its history. But, Rajasthan is suffering from its geological contaminants in water. It is mainly because of the presence of fluoride, Nitrate as well as common salinity.

The attempt of CSIR-CSMCRI to tackle the problem started in the year 2003. It was in Barmer air force station, Utarlai. The capacity was 1500LPH. It was funded by DST, New Delhi. The performance for the plant for TDS 4288 is having rejection > 90%. The plant for Kasnau Mines (Rajasthan State Mines and Minerals Limited), Nagaur (Rajasthan) was installed in 2005. It was the capacity of 2400LPH. The performance for this plant for brackish water having TDS 7000-10000 ppm is extraordinary. It has the performance of 75-80% recovery of the water in the form of either drinking water or irrigation water.

It was the initiative of DST, India who has the understanding that CSIR-CSMCRI has the ability to do plant installation. In that mission three plants viz. Bhojadesar (Sikar), Theekaria Kala (Nagaour) and Kisar (Jhunjhunu) were installed. After studying the successful performance of these

Table 1

District	Village	District	Village
JhunJhunu	**Khidarsar** (Feed: 4000 ppm, Permeate: 70 ppm) **Tomkor** (Feed: 3600 ppm, Permeate: 46 ppm) **Kabirsar** (Feed: 3230 ppm, Permeate : 65 ppm) **Chimanpura** (Feed: 4420 ppm, Permeate: 86 ppm) **Mukha ka bas** (Feed: 3750 ppm, Permeate: 65 ppm) **Dhanicharan** (Feed:4230 ppm, Permeate: 70 ppm) **Gokhari** (Feed: 3500 ppm, Permeate: 50 ppm) **Kakra** (Feed: 1300 ppm, Permeate: 18 ppm) **Deblavas** (Feed: 2080 ppm, Permeate : 18 ppm) **Manjari ashram** (Feed: 2180 ppm, Permeate: 23 ppm) **Navta** (Feed: 1120 ppm, Permeate: 21 ppm) **Ramsar** (Feed: 1400 ppm, Permeate: 11 ppm) **Majri** (Feed: 1340 ppm, Permeate: 09 ppm) Ramsinghpura Kamalsar Kalva Dhakamandi **Dhanibhalod** (Feed: 1130 ppm, Permeate: 10 ppm)	Rajsamand	**Dhaneria** (Feed: 1810 ppm, Permeate: 28 ppm) **Pasund** (Feed: 1180 ppm, Permeate: 10 ppm) **Mohi** (Feed: 1480 ppm, Permeate: 11 ppm)
Sikar	**Chachiwad bada** (Feed: 3150 ppm, Permeate:134 ppm) **Shekhisar** (Feed: 1900 ppm, Permeate:150 ppm) **Mardatu Badi** (Feed: 1500 ppm, Permeate: 50 ppm) **Narsara** (Feed: 1450 ppm, Permeate: 50 ppm) **Rinau** (Feed: 1350 ppm, Permeate: 20 ppm) **Dinarpura** (Feed: 1730 ppm, Permeate: 25 ppm) **Rolsahabsar** (Feed: 2030 ppm, Permeate: 67 ppm) Bibipur chota Shekhivas	Churu	**Dandoo** (Feed : 3200 ppm, Permeate:80 ppm) **Payli** (Feed : 2150 ppm, Permeate: 56 ppm) **Lakhau** (Feed: 3120 ppm, Permeate: 50 ppm) **Shyopura** (Feed : 3470 ppm, Permeate: 50 ppm) **Aslu astesan** (Feed : 2220 ppm, Permeate: 56 ppm) **Raboori** (Feed :3830 ppm, Permeate: 250 ppmautomated plant operational at CEERI, PILANI for more than six month before installation)

District	Village	District	Village
Nagaur	Jhabdi Nagar		Central Jail, Bharatpur (Feed:1820 ppm, Permeate: 27 ppm)
Ajmer	**Chachiyawas (Rajasthan mahila Kalyan Mandal)** Feed: 2800 ppm, Permeate: 150 ppm		

plants Department of Science and Technology, Rajasthan has initiated the programme regarding 60 plant installations (initially it was 10 after those 50 plants were added). DST, Rajasthan under its societal activities engaged in dissemination of appropriate technologies in the state. The assignment was "Installation of Community Managed Reverse Osmosis Pilot demonstration plants in different geographical regions of the state". It was close coordination with Public Health Engineering Department (PHED), Rajasthan. In this direction the DST, Rajasthan had divided Rajasthan in three clusters- North Western, Western, and Eastern.

It is mostly 1000LPH capacity. The names of the villages are listed in **Table 1**. The feed water TDS is basically 1500- 8000 ppm. In this context CSIR-CSMCRI had taken initiative by installing plant in one Ashram for mentally challenged children (village: Chachiyawas, Ajmer) students. It is run by Rajasthan Mahila Kalyan Mandal. CSIR-CSMCRI had overwhelmed of their responses.

It was another chapter when CSIR-CSMCRI had installed plant in the army campus to deliver them safe water. CSIR-CSMCRI also had the feeling to them where no electricity is there. In those cases Solar Power driven plant was installed with the help of Barefoot College.

ANDHRA PRADESH

Andhra Pradesh is suffering geogenic contaminants especially fluoride. Earlier CSMCRI-CSIR has demonstrated through small mobile RO plants. After successful demonstration in various villages ranging fluoride level 3 to 6.5ppm, DST, India has sanctioned fund through Andhra Pradesh State council of Science and Technology (APCST), Hyderabad for installation of plants. In the year 2008 the first plant was installed at Kosuru village having capacity of 4000LPH. The plant locations are in ensemble (**Table 2**).

Table 2

District	Village
Krishna	**Kosuru** Capacity : 4000LPH Feed : 1500ppm, Permeate : 100ppm
Nalgonda	**Siripuram** Capacity : 4000LPH Feed : 2000ppm, Permeate : 230ppm
Chittor	**Bandlapalli** Capacity : 4000LPH Feed : 854ppm, Permeate : 75 ppm

WEST BENGAL

The state is based on river basin. Many of the districts are suffering from Arsenic as well as iron contamination problem. CSIR-CSMCRI activity was mainly in 24Parganas (North) as well as Kolkata.

The initiation started from the approach of Public Health Engineering Department. They have approached CSIR-CSMCRI for the setting up RO plant. CSIR-CSMCRI has first installed bullock driven RO plant in Machranga island, where there was no power at that time. It was CSIR-CSMCRI attempt to check the sustainability of indigenous bullock driven RO technology in reality. After successful installation, PHE department, West Bengal has approached CSIR-CSMCRI to install brackish water plant in 2004. CSIR-CSMCRI has installed plant having capacity of 5000LPH in AbadKulia Danga, Hasnabad area.

The remarkable achievement came when CSIR-CSMCRI in 2007 has set up boat mounted plant (having capacity of 150LPH) to cater the fresh water to different islands in Sunderbans. It is basically sea-water RO plant. In the same year another plant was installed having capacity of 500LPH at Central Glass Ceramic Research Institute (CGCRI) campus, Kolkata.

CSIR-CGCRI and CSIR- CSMCRI jointly installed one plant at Taki (24 Pgs(N)) in September, 2012 through DST, New Delhi funding. The capacity of the plant is 1250LPH. In the same year Indian Institute of Chemical Biology (IICB), Kolkata approached CSIR-CSMCRI to install four plants in their Kolkata premises for removal of iron. All the four plants were of 500LPH capacity. All the plants are in ensemble (**Table 3**).

Table 3

District	Village
24 Parganas (North)	Machranga island Animal powered plant Capacity:500-700LPH Feed:3200 ppm, Permeate: 400ppm
24 Parganas (North)	Abadkulia danga Capacity: 5000LPH Feed: 15000 ppm, Permeate: 450 ppm
24 Parganas (North)	Boat mounted plant Capacity: 150LPH
24 Parganas (North)	Taki Capacity: 1250LPH Feed: 6662ppm, Permeate: 147ppm
Kolkata	CGCRI campus Capacity: 500LPH
Kolkata	IICB campus Capacity: 500LPH (four)

TAMILNADU

Though the state has long coastal belt, it suffers drinking water problem. CSIR-CSMCRI has shown the gesture long back. The first Brackish water plant was installed in Melakudumular, (District: Ramnathpuram) in 1985. The successful and sustainable plant operation has driven CSIR-CSMCRI for accepting challenges with the initiative of CHT and CPCL, Chennai to install 1MLD capacity plant with 70% recovery in 2003. The notable achievement made CSIR-CSMCRI proud as it was based on indigenous RO membrane. Earlier CPCL was imported module to serve the purpose.

To solve the drinking water problem CSIR-CSMCRI installed sea-water desalination plant in Nelmudur (District: Ramnathpuram) with the financial support of DST, India. It was having the capacity of 1000LPH. Based on sustainable

performance DST, India funded for high capacity (6000 LPH) RO desalination plant at Ervadi in the year 2012. The plant details are in ensemble (**Table 4**).

The successful as well as sustainable operational activities regarding sea and brackish water with CSIR-CSMCRI based indigenous technology is continuing.

PUNJAB

It is recognized as the state of 'green revolution'. The state suffers from excess agricultural chemicals in water as well as salinity. The Central University of Punjab approached CSIR-CSMCRI for their needs in the campus. Actually the campus was suffering from good quality drinking ground water as well as insufficient supply from the Municipal

Table 4

District	Village	District	Village
Ramnathpuram	Melakudumulur Capacity: 1250LPH, Feed : 2400 ppm Permeate: 670 ppm	Ramnathpuram	Mullimunai Sea water desalination plant Capacity: 1000 LPH Feed : 32555 ppm Permeate: 355 ppm
CPCL (Chennai petroleum Corporation Limited)	Sewage water Treatment Plant Capacity: 1MLD Feed : 1500 ppm Permeate: 177 ppm	Ramnathpuram	Thirupalaikudi Sea water desalination plant Capacity: 1000LPH Feed : 29890 ppm Permeate: 140 ppm
Ramnathpuram	Nelmudur Sea water desalination plant Capacity: 1000LPH Feed : 36540 ppm Permeate: 860 ppm	CMFRI	Brackish water desalination plant Capacity: 2000LPH Feed : 3500 ppm Permeate: 250 ppm
Ramnathpuram	Karankadu Sea water desalination plant Capacity: 1000LPH Feed : 32060 ppm Permeate: 500 ppm	Ramnathpuram	Ervadi Sea water desalination plant Capacity: 6000LPH Feed : 42760 ppm Permeate: 282 ppm
Nagapattinam	Akkaraipettai Capacity: 2000LPH Feed : 6800 ppm Permeate: 420 ppm	Ramnathpuram	Mullimunai Sea water desalination plant Capacity: 6000LPH Feed : 32000 ppm Permeate: 287 ppm
Chennai	CLRI-CSMCRI Capacity: 2500LPH Feed : 1500 ppm Permeate: 100 ppm		

Corporation. The brackish water desalination plant having 4000LPH capacity was installed in 2014. It was of 99% salt recovery. After the successful implementation of the plant CSIR-CSMCRI installed a large capacity plant of 10KLPH in their new campus in the year 2016. The specific feature of the two plants is that CSIR-CSMCRI was added 'water reclamation' strategy. The reject water of the plant was used in the toilets of the universities through the connection. The locations of the plants are listed in **Table 5**.

Table 5

Location	Detail
Bathinda	Central University of Punjab (Campus-I) Capacity : 4000LPH Feed : 2100ppm, Permeate: 10ppm
Bathinda	Central University of Punjab (Campus–II) Capacity : 10KLPH Feed: 1570ppm, Permeate: 227ppm

GUJARAT

The state has its geography with long coastal belt. That's why the salinity in water is its inherent problem. CSIR-CSMCRI is being in Gujarat has its responsibility to solve the problem with its capacity. The plant installation started in Mocha village (Porbandar District) in the year 2000. The unique feature of the plant was to utilization reject water (10000 ppm) for growing Atriplex halophytes used as fodder. In this way CSIR-CSMCRI was successfully managed RO reject water in the coastal area. It was the initiative of DST, India. CSIR- CSMCRI installed in 2006 to counter the post effect of Surat Flood victims. The high recovery plants were installed in Air force station, Bhuj. The success story was repetitive regarding the animal power driven plant at Shram Mandir Trust, Vadodara. Apart from the brackish water plant sea water plant was installed at Narayan Sarovar, Bhuj in 2011. CSIR- CSMCRI was also made its mark by installing plant at Bhavnagar for hospital of dialysis patients administered by Sai Trust, Bhavnagar. The locations of the plants are in ensemble (**Table 6**).

Table 6

Location	Some feature(s)
Mocha, Porbandar	Capacity :1000-1500LPH
Surat	Capacity :20000LPH Feed water: 5000ppm, Product water: 200ppm
Air force station, Bhj, Kutch	I. Capacity :2000 LPH Feed : 1500ppm, Permeate: 250ppm and II. 600LPH Feed: 2500ppm, Permeate: 250ppm
Shram Mandir Trust, Vadodara	Capacity :400-600LPH Feed: 2700ppm, Permeate: 200ppm
Narayan Sarovar, Bhuj , Kachh	Sea water Capacity :6000LPH Feed: 35000ppm, Permeate: 220ppm
Sai Trust, Bhavnagar	Capacity :1000LPH Feed: 380ppm, Permeate: 10ppm

KARNATAKA

The initiative started from M. S. Ramiah Medical College and Hospital. The appeal was necessary steps regarding the Fluoride toxicity problem to the Government. The Government took initiative through CSIR-CSMCRI regarding the problem. In this connection CSIR-CSMCRI installed a plant having capacity of 6000LPH at Kiwara District in the year 2008. The fluoride toxicity problem was 2.26ppm. After filtration it was 0.539 ppm. It was funded by CSIR. The plant was named as 'Sujala'. The water transport vehicle was also arranged to supply water door to door.

ANDAMAN AND NICOBAR ISLANDS

It is one of the seven union territories. Actually it is group of islands (~300) positioned in Bay of Bengal and Andaman Sea. That's why the drinking water is mostly saline of different range. Desalination is the choice by which one can solve the drinking water problem. The activities of CSIR-CSMCRI was recommissioning of plants. These plants were dumped for nearly 3-4 years and all these plants were nonfunctional at that time. Central ground water board, Ministry of water resources had approached CSIR-CSMCRI to make them functional. CSIR-CSMCRI generated its capability to recommission for the development suiting to the site requirement for the plants. This was really challenging one in terms of logistics. The army as well as Andaman Public Works Department (APWD) helped a lot. CSIR-CSMCRI commissioned plants in the year 2007 within 2 months' time period. The names of the locations are in ensemble (**Table 7**).

AFGHANISTAN AND KENYA

CSIR-CSMCRI had spread their wings in Afghanistan outside India. The initiation is through Norweigh Church Aid (NCA). It is one of the NGO's active in various social activities in Afghanistan. They came to know CSMCRI capability for installation of RO plants and thus they have approached CSIR-CSMCRI for the said installation.

Actually in the north province of Afghanistan (Faryab), there is serious concern regarding drinking water. The water is saline as well as fluoride contamination problems. CSIR-CSMCRI supplied and installed customized RO plants suitable for reducing the salinity and fluoride

Table 7

Island (RO plant site)	Product water output (liters/hour)	Product water ppm	Raw water ppm
Bamboo Flat	1400	210	17000
Hut Bay	2100	50	2000
Kamorta	1500	200	14000
Chapin	1800	50	3000
Campbell bay-1	1200	208	13000
Campbell bay-2	1100	120	13000
Katchal	2000	50	1000
Teressa	2000	50	1000
Car Nicobar	1400	50	1500

content of ground water and brought it to drinking water level. These activities were done during 2007-2012. CSIR-CSMCRI installed 25 brackish water RO Plants having capacity of 1000LPH supplied and installed and 25 people were trained to operate and maintain the RO plants. The logistics were supported by Government of Afghanistan. The main obstacle was security for the CSIR-CSMCRI persons who went there for installing the plants. The success story is really encouraging amidst the turmoil situation and lot of terrorist activities. Later on it was sorted out the problem by sending the videography of all maintenance and installation activities. After that they requested us to bid for 50 plants in international bidding, but as CSIR-CSMCRI is Research and Development Institution did not take part in that bidding.

CSIR-CSMCRI also installed sea water desalination plant having capacity 200LPH at Kenya in 2008. It was stationed at Gongoni Saltworks, Kensalt Limited, Kenya. The permeate was in the range of 325-520ppm.

MOBILE RO BUS

CSIR – CSMCRI, Bhavnagar has its unique design in developing a mobile unit consisting RO & UF Plants for water desalination and purification. The key motivations include: (i) being in a state of readiness to respond swiftly to emergency situations (like drought, cyclone) (ii) providing on the spot demonstration of the capabilities of the various water purification units, (iii) creating awareness among the public on indigenous water purification technologies, and (iv) creating a model to serve a cluster of villages. The mobile RO units are operated by utilizing the power from the engine of the van and/or solar panels fitted on the roof to carry out solar powered water purification as well.

CSMCRI has continued to play a laudable role in providing water to the needy in the aftermath of natural calamities like cyclone in Orissa (1999), Earthquake in Gujarat (2001), Tsunami in Tamilnadu and Andaman (2004) post Tsunami at Campbell bay (2005), Flood Surat (2006), Flood in Bihar (2008), Cyclone 'Aila' in W. Bengal (2009), Himalyan Tsunami in Uttarakhand (2013), Cyclone 'Phailin' in Orissa (2013), drought in Maharastra (2016). Among these one of the challenging missions is 'Aila'. In that mission the bus had to go Hingalganj, away from main land by vessel service. The bus was stationed in the BSF camp and provided more than 30,000 LPD of potable water through desalination of saline (5000 ppm TDS) pond water. The filtered water was filled in to jerry cans. These were then distributed to the distressed to the affected people in several islands of Sunderban, W. Bengal.

CONCLUSION

As it is safer and cleaner technique people accepted the technology with great enthusiasm. The plant installation based on several factors viz. funding, support of local administrators, logistics, availability of semi-skilled/skilled operators. The infrastructure is basically required is covered space (preference concrete structure), electrification. It should not be far away from the vicinity of feed water source. The success story of the plants is not only installing them, it should also monitor the time -frame operation. It means the plant should be sustainable. CSIR-CSMCRI in that cases very successful by including recurring expenditure it in to it, of course it depends on site.

ACKNOWLEDGEMENT

The authors are thankful to Director, CSIR-CSMCRI who has guided throughout the

activities. The authors are especially thankful to all the colleagues (Division as well as administration) who have helped the activities directly or indirectly. The manuscript is having the CSIR-CSMCRI communication number 119/ 2018.

REFERENCES

1. A. Bhattacharya and P. Ghosh, *Rev. Chem. Eng*. **20,** 1-2, 111-180, 2004.
2. S. Sharma and A. Bhattacharya, *Applied Water Science,* **7**, 3, 1043-1067, 2017.
3. Mark A. Shannon, Paul W. Bohn, Menachem Elimelech, John G. Georgiadis, Benito J. Marinas and Anne M. Mayes, *Nature* **452**, 2008
4. J.A. Nollet, Lecons de physique experimentale, Hippolyte-Louis Guerin and Louis-Francios Delatour, Paris, 1748.
5. C. Reid, "Principles of Reverse Osmosis", in *Desalination by Reverse Osmosis,* U. Merten, ed., pp.1-14, M.I.T. Press, Cambridge, Mass. 1966.
6. A. Bhattacharya, *Science and Culture,* 47-48, 2001.
7. V.J. Shah, S.V. Joshi, A.V. R. Reddy, J.J. Trivedi, C.V. Devmurari, A. Prakash Rao, N. Pathak, P. Singh, S.L. Daga, S.T. Rajan, P.K. Ghosh, Sustainable Management of Water Resources: Emerging S&T Issues in South Asia, Eds. M.G. K. Menon and V. P. Sharma, XII General assembly of scope, New Delhi Indian National Science Academy Publication 123. 2005.
8. P.K. Ghosh, V. J. Shah, S. V. Joshi, N. Pathak, J.J. Trivedi, C.V. Devmurari, A. Prakash Rao, A. A. Patel, K. Eswaran and S. L. Daga, *UNDP* **11**, 61-74, 2006.

KNOW THY INSTITUTIONS

NATIONAL INSTITUTE OF TECHNOLOGY, DELHI

National Institute of Technology Delhi (NITD) is one of the thirty NIT (s) established in the year 2010 by an act of parliament and has been declared as an Institute of National importance.

NIT Delhi is an autonomous Institute which functions under the aegis of Ministry of Human Resource Development, Government of India. It aims to provide instructions and research facilities in various disciplines of Engineering, Science and Technology, Management, Social Sciences and Humanities for advance learning and dissemination of knowledge.

The mission of NIT Delhi is to produce human resource those who are creative, competitive and innovative with high intellect and ethical values. The Institute is imparting holistic education, along with inculcating high moral values in its students.

NIT Delhi has started its academic session in 2010 with three undergraduate B.Tech degree programmes in Computer Science and Engineering, Electronics and Communication Engineering and Electrical and Electronics Engineering. The academic activities of NIT Delhi were initiated at NIT Warangal in year 2010

which later moved to a temporary campus at Dwarka, New Delhi in June 2012 and now currently running at IAMR Campus, Narela (February 2014).

Possession of fifty one acre land has been allotted for permanent campus of NIT Delhi on NH-1, Narela sub city, New Delhi. The process of developing the permanent campus has begun.

Vision

Committed to holistic development of Lives and Society by imparting Knowledge of Science and Technology and Crystallizing the future.

Mission

Application of Knowledge through learning and inculcating Research Oriented mindset towards Design and Innovative Development for Realistic Societal Solutions.

Academic Programmes underway at NIT Delhi

From academic year 2013-14 the intake in each B. Tech programme has been increased to strength of 60 students. Admission for B.Tech programmes are made on the basis of the performance in the Joint Entrance Examination (JEE) for the Indian Nationals. Admissions to 50% of the seats are made amongst the students of Delhi & Chandigarh and the remaining 50% seats are made on the basis of All India ranking of the aspiring applicants. The intake in each M. Tech programme is 15 students. Admissions to the M.Tech Programmes are made on the basis of performance in GATE (Graduate Aptitude Test in Engineering).

Quality Policy

- To create an environment for holistic learning and development.
- To provide academic excellence, good governance, team work, spirit towards the development of responsible citizen.
- To provide opportunities for Research, Innovation, Creativity initiatives to reflect high level of Intellectual Professionalism towards achieving Excellence.
- To provide infrastructure and facilities benchmarked to reflect the High Standard and Latest Technology.
- To provide state-of-the-art laboratories with latest Equipment and Instruments.
- To provide the highest level of cleanliness, hygiene, safety, discipline environmental consciousness in the institute.

Departments

Department of Applied Sciences

The Department of Applied Sciences provides an inclusive environment for everyone by integrating a range of educational, research and consultancy opportunities to enhance knowledge and skills. The department acts as a bridge in between the basic science like physics, chemistry and mathematics with engineering procedure. Faculty in applied sciences offers high quality basic courses to first year undergraduate students to make them strong in fundamentals before handing them over to their concerned engineering disciplines for completing their required credits. Also our faculty equipped the graduate students with knowledge and skills by offering specialized courses across a broad range of study options to M. Tech. in Smart Materials and Doctoral degree in applied physics, chemistry, and pure and applied mathematics to drive the student carrier as a professional scientist/engineer. The department aspires to develop the full potential of our students whilst offering an enriched educational experience that equips them with the qualifications and skills to achieve their scientific and technical ambition

The Computer Science and Engineering Department

The Computer Science and Engineering Department was started in 2010 along with the

foundation of NIT Delhi. Initially, only Bachelor of Technology Programme was offered with the intake 30 which presently has been increased to 60. Now, apart from B. Tech., the department also offers Master of Technology and Ph.D. programmes which cover a number of important areas of Computer Science and Engineering, e.g., Algorithms, Computer Networks, Data Warehousing and Data Mining, Software Engineering, Machine Learning, Image Processing, Web Technologies, Data Analytics, Complex Networks, Wireless Sensor Networks etc. Students are provided with a broad undergraduate and graduate curriculum based on the application and theoretical foundations of computer science. Faculty and students participate in interdisciplinary research. The combination of these elements makes the department an especially exciting environment in which to study and work; an environment that serves us well in our goal of providing excellence in education, research, and discovery. The department envisions producing quality graduates, capable of leading the world in technical realm. The department is equipped with latest configuration and high computing system with hi-speed Internet facility, both wired as well as wi-fi. The Computer Science programs at this institute are dedicated to educate students and to advance research in computer and information technology. The department has all the facilities to carry out the related teaching and research work.

Department of Electronic and Communication Engineering (ECE),

The Department of Electronic and Communication Engineering (ECE), was established in 2010, immediate with the beginning of the Institute under the ages of Ministry of Human Resource and Development (MHRD), Govt. of India. Currently it is offering one Undergraduate (B. Tech) course and two Post Graduate (M. Tech) courses in ECE and in VLSI Design. The Department also offers PhD programme in relevant areas. It has excellent laboratories and research facilities in following areas:

- Electronic Devices and Circuits.
- Electronic Measurement and Instrumentation.
- Microprocessor and Microcontroller.
- Microwave and Antenna Design.
- Optical Fibre Communication and Optical Device.
- Multimedia and Advanced Communication.
- Design, Automation and Simulation Laboratory

The Department has received grants from, Ministry of Electronics and Information Technology (MeitY), Department of Science and Technology (DST)-SERB for various projects. The Department has active collaborations with Institutes & research institutes in India and abroad. The Department of ECE has a blend of young as well as experienced, dynamic faculty members and is committed to providing quality education and research in the field.

Electrical & Electronics Engineering (EEE) Department

The Electrical & Electronics Engineering (EEE) Department is a blend of teaching and research activities pertaining to advanced fields of engineering. The department is currently offering courses at both the UG and PG level with an intake of 60 and 15 respectively. The specialization of PG course is Power Electronics & Drives. The department also offers Ph.D. program in various specialization of Electrical Engineering and allied areas. The department is equipped with state-of-the-art facilities to carry

out research work at all levels. The research focus of the department is in the area of power electronics, renewable energy systems, control/ time delay systems, pattern recognition, image processing etc. The department also actively involved in multi-disciplinary research activities. The UG program is embraced by rigor and span to prepare a practicing engineer for a lifetime of creative work and ongoing technical learning. The department provides healthy & competitive environment for all round development of students leading to several remarkable achievements in GATE, CAT, GRE, TOEFEL, PSUs etc. The department currently has following laboratories, equipped with latest equipment and software platforms, to impart state-of-the art technical knowledge. The department aims to setup new laboratories such as Green Energy Technologies, Digital Control & FPGA Design, Biometric etc.

- Electrical Machines,
- Power Electronics and Drives,
- Power System,
- Control System,
- Electrical Measurement,
- Network Analysis,
- Signals and Systems,
- Microprocessor & Microcontroller,
- Analogue Electronics & IC applications,
- Modelling and Simulation etc.

Mechanical Engineering

The Department of Mechanical Engineering is a diverse subject, which involves design, analysis and manufacturing from small machine parts and devices to large systems. It is aspired to have a distinguished tradition of excellence in the theme areas ranging from thermal, mechanics, design and manufacturing to CAD/CAM/CAE. Currently Department offers M. Tech. programme in Computer Aided Design & Manufacturing (CAD/CAM) and Ph.D. programme in Mechanical Engineering. Apart from these, Department also offers first year courses in B. Tech. (common for all branches). The Department has two Laboratories: CAD Lab. & CAM Lab. Intake for M.Tech. CAD/CAM Programme: 15 seats (through CCMT) + 2 seats (through DASA). The programme has been started from academic session 2016-17.

CONTACT :

Director

National Institute of Technology Delhi

National Institute of Technology Delhi Sector A-7, Institutional Area, Near Satyawadi Raja Harish Chandra Hospital, Narela, Delhi – 110040, Phone : 011 –33861005, 33861006, 33861010, 33861012

CONFERENCES/MEETINGS/SYMPOSIA/SEMINARS

XIV AGRICULTURAL SCIENCE CONGRESS (ASC), 20-23 FEBRUARY, 2019, NASC, PUSA, NEW DELHI

Topics:

- Plant sciences (Field Crops)
- Plant sciences (Horti Crops)
- Natural Resource Management
- Plant Protection
- Food Science & Value Addition
- Animal Sciences-Livestock, Dairy & Poultry
- Fisheries
- Engineering & IT
- Social Sciences
- Agricultural Education

Contact:

Dr. Anil K. Bawa, Executive Director, National Academy of Agricultural Sciences, NASC Complex, DPS Marg, Pusa, New Delhi - 110 012 Post Box No. 11325, Email: naas@vsnl.com

2ND INTERNATIONAL CONFERENCE ON INNOVATIONS IN CHEMICAL, BIOLOGICAL & ENVIRONMENTAL SCIENCES, FEBRUARY 27-28, 2019, PANIPAT

Topics:

Physical Chemistry: Solution Thermodynamics, Thermodynamics of Biological Systems, Colloid and Interface, Physicochemical properties of Ionic Liquids, Polymer Chemistry, Catalysis, Quantum Chemistry,Electrochemistry, Vapour Liquid Equilibria, Nano-Surface Chemistry, Crystallography, Nano-Chemistry, Nano & Green Composite, Smart Polymers and Materials, Corrosion, Non-Equilibrium Thermodynamics etc.

Organic Chemistry: Synthetic and Structural Organic Chemistry, Natural Products, Applications of Spectroscopic Techniques, Bio-organic Chemistry, Drug Design and development and Therapies, Medicinal Chemistry, Green Chemistry, Nucleic Acid Based Therapeutics and Diagnostics etc.

Inorganic Chemistry: Coordination Chemistry, Industrial Pollution, Bio-inorganic Chemistry,

Organometallics, Nano-Environmental Chemistry, Metallurgy, Nuclear Chemistry etc.

Role of Chemical Sciences in drug design, biosciences & environmental sciences.

Petrochemicals, Analytical chemistry, Soil Chemistry, Industrial Chemistry, Nano-Technology, Pharmaceutical Chemistry, Cheminformatics, Pharmaceutical Nanotechnology, Biotechnology, Biochemistry & Chemistry of Life, Chemistry of Food & Nutrition, Water Chemistry, Dairy Chemistry, Chemical Engineering, Nuclear Radiations Safety and any other topic related to the theme of the conference.

Contact:

Dr. Anil Kumar, HOD Chemistry & Organizing Secretary, ICICBES-2019, ARYA P.G. COLLEGE, PANIPAT, HARYANA, INDIA. E-MAIL: icicbes2019@gmail.com, kumar_anilab@rediffmail.com Mob. No.: +919416937764, www.aryapgcollege.com

FIFTH INTERNATIONAL CONFERENCE ON BIOSIGNALS, IMAGES AND INSTRUMENTATION (ICBSII 2019), MARCH 14-15, 2019, CHENNAI, TAMILNADU, INDIA

Topics:

- **Bio - signals Track**
  - o Biomedical Signal Processing.
  - o Cardiovascular & Respiratory Systems Engineering.
  - o Cognitive Neuroscience.
  - o Brain Computer Interface.
  - o Speech Signal Processing.
- **Images Track**
  - o Biomedical Imaging and Data Visualization.
  - o Computer Aided and Automated Diagnosis.
  - o Medical Image Mining & Retrieval system.
  - o Optimization techniques.
  - o Virtual Reality.
- **Instrumentation Track**
  - o 3D Bio-printing.
  - o Device Technologies & Biomedical Robotics.
  - o Drug Delivery & Diagnostic Systems.
  - o IOT & Healthcare Information System.
  - o Mobile Health and Wearable Sensor Networks.
  - o Advances in Biomedical Instrumentation.

Contact : SSN College of Engineering, Old Mahabalipuram Rd, Kalavakkam-603110, Tamil Nadu, India, Phone: 044 2746 9700, Intercom number: 493/414/485 Mobile: +91-98947 74811 / +91-97894 44988, Email: icbsii@bme.ssn.edu.in

INTERNATIONAL CONFERENCE ON ADVANCES IN MATERIAL SCIENCE AND NANOTECHNOLOGY, 29TH-30TH APRIL, 2019 , STELLA MARY'S COLLEGE OF ENGINEERING, ARUTHENGANVILAI, TAMIL NADU, INDIA

Topics:

1. Advanced materials in Engineering 2. Bio Medical, Electronics and Green Architecture 3. Building Energy Conservation and Green Architecture 4. Computer Vision and Robotics 5. Computational Fluid Dynamics 6. Civil Engineering Materials 7. Chemical and Process Engineering 8. Design of Embedded system with VLSI 9. Data mining 10. Electrical Materials Electro magnetics 11. Electrical, Electronic and Systems Engineering 12. Green Manufacturing 13. Internal combustion Engines Internet and Mobile Computing 14. Instrumentation and Control Engineering 15. Mechatronics 16. MEMS and NEMS 17. Materials preparation and processing Nanotechnology 18. Nano Devices 19. New Technology, methods and Techniques in Civil Engineering 20. Networking, Communication and Multimedia 21. Photonics and Opto-electronics 22. Power engineering 23. Pervasive, Grid, Cloud computing 24. Renewable and Non-Renewable Energies 25. RADAR and satellite communication 26. Semiconductor devices 27. Structural Engineering, Signal and Image Processing 28. Theory and Advanced Technology of Engineering Structure

Contact : Conference Organizing Chair, ICMN-2K19 ,Dr. M Freeda , Professor & Head,Department of Science and Humanities, Stella Mary's College of Engineering, Aruthenganvilai, Azhikal post, Kanyakumari Dist-629202, Tamil Nadu, South India. +91 9486881397, +91 9442075946, email : drmfreeda@gmail.com

S&T ACROSS THE WORLD

NOBEL PRIZE IN PHYSICS 2018

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics 2018 *"for groundbreaking inventions in the field of laser physics"*with one half to Arthur Ashkin, Bell Laboratories, Holmdel, USA"for the optical tweezers and their application to biological systems" and the other half jointly to Gérard Mourou, École Polytechnique, Palaiseau, France, University of Michigan, Ann Arbor, USA and Donna Strickland, University of Waterloo, Canada *"for their method of generating high-intensity, ultra-short optical pulses"*

The inventions being honoured this year have revolutionised laser physics. Extremely small objects and incredibly rapid processes are now being seen in a new light. Advanced precision instruments are opening up unexplored areas of research and a multitude of industrial and medical applications.

Arthur Ashkin invented optical tweezers that grab particles, atoms, viruses and other living cells with their laser beam fingers. This new tool allowed Ashkin to realise an old dream of science fiction – using the radiation pressure of light to move physical objects. He succeeded in getting laser light to push small particles towards the centre of the beam and to hold them there. Optical tweezers had been invented.

A major breakthrough came in 1987, when Ashkin used the tweezers to capture living bacteria without harming them. He immediately began studying biological systems and optical tweezers are now widely used to investigate the machinery of life.

Gérard Mourou and Donna Strickland paved the way towards the shortest and most intense laser pulses ever created by mankind. Their revolutionary article was published in 1985 and was the foundation of Strickland's doctoral thesis.

Using an ingenious approach, they succeeded in creating ultrashort high-intensity laser pulses without destroying the amplifying material. First they stretched the laser pulses in time to reduce their peak power, then amplified them, and finally compressed them. If a pulse is compressed in time and becomes shorter, then more light is packed together in the same tiny space – the intensity of the pulse increases dramatically.

Strickland and Mourou's newly invented technique, called chirped pulse amplification, CPA, soon became standard for subsequent high-intensity lasers. Its uses include the millions of corrective eye surgeries that are conducted every year using the sharpest of laser beams.

The innumerable areas of application have not yet been completely explored. However, even now these celebrated inventions allow us to rummage around in the microworld in the best spirit of Alfred Nobel – for the greatest benefit to humankind.

NOBEL PRIZE IN CHEMISTRY 2018

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2018 with one half to Frances H. Arnold, California Institute of Technology, Pasadena, USA *"for the directed evolution of enzymes"* and the other half jointly to George P. Smith, University of Missouri, Columbia, USA and Sir Gregory P. Winter, MRC Laboratory of Molecular Biology, Cambridge, UK *"for the phage display of peptides and antibodies"*

The power of evolution is revealed through the diversity of life. The 2018 Nobel Laureates in Chemistry have taken control of evolution and used it for purposes that bring the greatest benefit to humankind. Enzymes produced through directed evolution are used to manufacture everything from biofuels to pharmaceuticals. Antibodies evolved using a method called phage display can combat autoimmune diseases and in some cases cure metastatic cancer.

Since the first seeds of life arose around 3.7 billion years ago, almost every crevice on Earth has filled with different organisms. Life has spread to hot springs, deep oceans and dry deserts, all because evolution has solved a number of chemical problems. Life's chemical tools – proteins – have been optimised, changed and renewed, creating incredible diversity.

This year's Nobel Laureates in Chemistry have been inspired by the power of evolution and used the same principles – genetic change and selection – to develop proteins that solve mankind's chemical problems.

One half of this year's Nobel Prize in Chemistry is awarded to Frances H. Arnold. In 1993, she conducted the first directed evolution of enzymes, which are proteins that catalyse chemical reactions. Since then, she has refined the methods that are now routinely used to develop new catalysts. The uses of Frances Arnold's enzymes include more environmentally friendly manufacturing of chemical substances, such as pharmaceuticals, and the production of renewable fuels for a greener transport sector.

The other half of this year's Nobel Prize in Chemistry is shared by George P. Smith and Sir Gregory P. Winter. In 1985, George Smith developed an elegant method known as phage display, where a bacteriophage – a virus that infects bacteria – can be used to evolve new proteins. Gregory Winter used phage display for the directed evolution of antibodies, with the aim of producing new pharmaceuticals. The first one based on this method, adalimumab, was approved in 2002 and is used for rheumatoid arthritis, psoriasis and inflammatory bowel diseases. Since then, phage display has produced anti-bodies that can neutralise toxins, counteract autoimmune diseases and cure metastatic cancer.

NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE 2018

The Nobel Assembly at Karolinska Institutet has decided to award the 2018 Nobel Prize in Physiology or Medicine jointly to James P. Allison and Tasuku Honjo *for their discovery of cancer therapy by inhibition of negative immune regulation*

Cancer kills millions of people every year and is one of humanity's greatest health challenges. By stimulating the inherent ability of our immune system to attack tumor cells this year's Nobel Laureates have established an entirely new principle for cancer therapy.

James P. Allison studied a known protein that functions as a brake on the immune system. He realized the potential of releasing the brake and thereby unleashing our immune cells to attack tumors. He then developed this concept into a brand new approach for treating patients.

In parallel, Tasuku Honjo discovered a protein on immune cells and, after careful exploration of its function, eventually revealed that it also operates as a brake, but with a different mechanism of action. Therapies based on his discovery proved to be strikingly effective in the fight against cancer.

Allison and Honjo showed how different strategies for inhibiting the brakes on the immune system can be used in the treatment of cancer.

The seminal discoveries by the two Laureates constitute a landmark in our fight against cancer.

Cancer comprises many different diseases, all characterized by uncontrolled proliferation of abnormal cells with capacity for spread to healthy organs and tissues. A number of therapeutic approaches are available for cancer treatment, including surgery, radiation, and other strategies, some of which have been awarded previous Nobel Prizes. These include methods for hormone treatment for prostate cancer (Huggins, 1966), chemotherapy (Elion and Hitchins, 1988), and bone marrow transplantation for leukemia (Thomas 1990). However, advanced cancer remains immensely difficult to treat, and novel therapeutic strategies are desperately needed.

In the late 19th century and beginning of the 20th century the concept emerged that activation of the immune system might be a strategy for attacking tumor cells. Attempts were made to infect patients with bacteria to activate the defense. These efforts only had modest effects, but a variant of this strategy is used today in the treatment of bladder cancer. It was realized that more knowledge was needed. Many scientists engaged in intense basic research and uncovered fundamental mechanisms regulating immunity and also showed how the immune system can recognize cancer cells. Despite remarkable scientific progress, attempts to develop generalizable new strategies against cancer proved difficult.

The fundamental property of our immune system is the ability to discriminate "self" from "non-self" so that invading bacteria, viruses and other dangers can be attacked and eliminated. T cells, a type of white blood cell, are key players in this defense. T cells were shown to have receptors that bind to structures recognized as non-self and such interactions trigger the immune system to engage in defense. But additional proteins acting as T-cell accelerators are also required to trigger a full-blown immune response Many scientists contributed to this important basic research and identified other proteins that function as brakes on the T cells, inhibiting immune activation. This intricate balance between accelerators and brakes is essential for tight control. It ensures that the immune system is sufficiently engaged in attack against foreign microorganisms while avoiding the excessive activation that can lead to autoimmune destruction of healthy cells and tissues.

During the 1990s, in his laboratory at the University of California, Berkeley, James P. Allison studied the T-cell protein CTLA-4. He was one of several scientists who had made the observation that CTLA-4 functions as a brake on T cells. Other research teams exploited the mechanism as a target in the treatment of autoimmune disease. Allison, however, had an entirely different idea. He had already developed an antibody that could bind to CTLA-4 and block its function. He now set out to investigate if CTLA-4 blockade could disengage the T-cell brake and unleash the immune system to attack cancer cells. Allison and co-workers performed a first experiment at the end of 1994, and in their excitement it was immediately repeated over the Christmas break. The results were spectacular. Mice with cancer had been cured by treatment with the antibodies that inhibit the brake and unlock antitumor T-cell activity. Despite little interest from the pharmaceutical industry, Allison continued his intense efforts to develop the strategy into a therapy for humans. Promising results soon emerged from several groups, and in 2010 an important clinical study showed striking effects in patients with advanced melanoma, a type of skin cancer. In several patients signs of

remaining cancer disappeared. Such remarkable results had never been seen before in this patient group.

PRIZE IN ECONOMIC SCIENCES 2018

The Royal Swedish Academy of Sciences has decided to award the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018 to William D. Nordhaus, Yale University, New Haven, USA *"for integrating climate change into long-run macroeconomic analysis"* and Paul M. Romer, NYU Stern School of Business, New York, USA*"for integrating technological innovations into long-run macroeconomic analysis"*

William D. Nordhaus and Paul M. Romer have designed methods for addressing some of our time's most basic and pressing questions about how we create long-term sustained and sustainable economic growth.

At its heart, economics deals with the management of scarce resources. Nature dictates the main constraints on economic growth and our knowledge determines how well we deal with these constraints. This year's Laureates William Nordhaus and Paul Romer have significantly broadened the scope of economic analysis by constructing models that explain how the market economy interacts with nature and knowledge.

Technological change – Romer demonstrates how knowledge can function as a driver of long-term economic growth. When annual economic growth of a few per cent accumulates over decades, it transforms people's lives. Previous macroeconomic research had emphasised technological innovation as the primary driver of economic growth, but had not modelled how economic decisions and market conditions determine the creation of new technologies. Paul Romer solved this problem by demonstrating how economic forces govern the willingness of firms to produce new ideas and innovations.

Romer's solution, which was published in 1990, laid the foundation of what is now called *endogenous growth theory*. The theory is both conceptual and practical, as it explains how ideas are different to other goods and require specific conditions to thrive in a market. Romer's theory has generated vast amounts of new research into the regulations and policies that encourage new ideas and long-term prosperity.

Climate change—Nordhaus' findings deal with interactions between society and nature. Nordhaus decided to work on this topic in the 1970s, as scientists had become increasingly worried about the combustion of fossil fuel resulting in a warmer climate. In the mid-1990s, he became the first person to create an *integrated assessment model*, i.e. a quantitative model that describes the global interplay between the economy and the climate. His model integrates theories and empirical results from physics, chemistry and economics. Nordhaus' model is now widely spread and is used to simulate how the eco- nomy and the climate co-evolve. It is used to examine the consequences of climate policy interventions, for example carbon taxes.

The contributions of Paul Romer and William Nordhaus are methodological, providing us with fundamental insights into the causes and consequences of technological innovation and climate change. This year's Laureates do not deliver conclusive answers, but their findings have brought us considerably closer to answering the question of how we can achieve sustained and sustainable global economic growth.

(Source : https://www.nobelprize.org/prizes/)

भारतीय विज्ञान कांग्रेस संस्था

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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

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

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

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

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

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

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

2. **सत्र सदस्य :** यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराना भूल जाएँ, तो उनकी सदस्यता, सत्र सदस्यता के 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 हैं। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं हैं। सत्र सदस्य को विभागों के व्यवसाय बैठकों और साधारण बैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

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

3. **छात्र सदस्य :** जो व्यक्ति स्नातक स्तर से नीचे पढ़ाई कर रहा हैं, उसे वार्षिक सदस्यता शुल्क ₹ 100/- मात्र देने पड़ेंगे अपना नाम छात्र सदस्य के 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 सकें, बशर्ते वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश करें। उसे वोट करने का या कार्यालय को नियंत्रण करने का अधिकार प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसाय बैठकों में भाग लेने की योग्यता प्राप्त नहीं हैं।

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

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

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

5. **संस्थान सदस्य :** एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के 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 हैं, जो उनका प्रतिनिधि हों। एक संस्थान सदस्य

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

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

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

एक संस्थान जो एकसाथ ₹ 50,000/- (विदेशियों के लिए U.S. $ 25,000) मात्र दें, सदा के लिए इस संस्था के संस्थान दाता बन सकते है, जिसे वह एक व्यक्ति को नामांकित करके उसे अपने संस्थान के प्रतिनिधि के 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 विना मूल्य प्राप्त कर सकते हैं।

6. **Donor :** Any person paying a lump sum of ₹ 10,000/- (for foreign** U.S. $ 5,000) only, can become an Individual Donar 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.

---

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 From for New Membership/Application for Renewal of Membership).

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

भारतीय विज्ञान कांग्रेस संस्था

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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

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

सेवा में/To

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

स्टैम्प आकार का फोटो / Stamp Size Photograph

महोदय/Dear Sir,

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

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

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

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

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

विभाग/Sections

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

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

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

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

श्री/सुश्री/श्री/श्रीमती/डॉ०/प्रो०/Mr./Ms./Shri/Shrimati/Dr./Prof (कृपया टिक करें)/(Please tick)

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

शैक्षणिक योग्यता/Academic Qualifications :

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

पदनाम/Designation

सम्पर्क का पता/Address of communication :

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

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

किसी भी सरकारी अनुमोदित पहचान पत्र (अनिवार्य)/Any Govt. approved ID Card (Mandatory) :

वर्तमान वर्ष विश्वविद्यालय प्रवेश-पत्र/Current Year University Admit Card :

स्थायी पता/Permanent Address :

दिनांक/Date : भवदीव/Yours Faithfully

हस्ताक्षर/Signature

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

Note : (i) All Bank Drafts should be drawn in favour of *The Indian Science Congress Association*, membership subject to realisation of the bank draft, Payable at any branch in Kolkata.

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

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

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

(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) 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।

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

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

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

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

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

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

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

GUIDELINES FOR SUBMISSION OF MANUSCRIPTS

1. Everymans'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 devoated 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 Assocaition 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 with 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. Biresh Guha Street, Kolkata-700 017.* Email : iscacal@vsnl.net. iscacal_2004@yahoo.com, Fax : 91-33-2287-2551

Registered with the Registrar of Newspapers for India under No. R. N. I. 12058/1966

PUBLICATIONS OF INDIAN SCIENCE CONGRESS ASSOCIATION

1.	A Short History of the Indian Science Congress Assocation	₹ 10/-
2.	A decade (1963-1972) of Indian Science Congress Association in India	₹ 10/-
3.	Science and Integrated Rural Development	₹ 10/-
4.	Survey, Conservation and Utilisation of Resources	₹ 10/-
5.	Science and Technology in India during the Coming Decades	₹ 15/-
6.	Impact of the Development of Science and Technology on Environment	₹ 150/-
7.	Basic Research as an Integral Component of Self Reliant Base of Science and Technology	₹ 90/-
8.	Man and the Ocean	₹ 140/-
9.	High Altitude Studies	₹ 75/-
10.	Indira Gandhi on Science, Technology and Self Reliance	₹ 100/-
11.	Environmental Priorities in India and Sustainable Development	₹ 25/-
12.	Resources and Human Well Being : Inputs from Science and Technology	₹ 25/-
13.	Scientific Research in India Progress in Earth Sciences	₹ 120/-
14.	Frontiers of Science and Technology, the Indian Context Vol. I	₹ 50/-
15.	Frontiers of Science and Technology, the Indian Context Vol. II	₹ 175/-
16.	Natural Disaster Management : The West Bengal Scenario	₹ 45/-
17.	A Tribute to Prof. P. C. Mahalanobis	₹ 35/-

18.	Platinum Jubilee Lectures	1994-1995, 1995-97,	1997-98 & 1998-99	
	Part-I-Physical Sciences	₹ 100/-	₹ 150/-	₹ 165/-
	Part-II-Biological Sciences	₹ 90/-	₹ 175/-	₹ 225/-
	Part-III-Engineering & Earth Sciences	₹ 70/-	₹ 128/-	₹ 240/-
	Part-IV-Social Sciences	₹ 50/-	₹ 85/-	₹ 130/-

19.	Platinum Jubilee Lectures, Biological Sciences (1999-2000) & (2000-2001)	₹ 250/-
20.	PROCEEDINGS of Annual Session of Indian Science Congress	₹ 1200/-
21.	Selected Lectures (2004-2005) & (2005-2006)	₹ 320/-
22.	**EVERYMAN'S SCIENCE Published Bimonthly**	

Individual- ₹ 300/- Institutional- ₹ 500/-

For Order, Write to : ISCA, 14 Dr. Biresh Guha Street, Kolkata-700 017
Fax : 91-33-2287-2551, E-mail : es.sciencecongress@nic.in/iscacal@vsnl.net
Website : http://www.sciencecongress.nic.in

* Members are entitled to 33.33% discount on the above prices