PUBLICATIONS OF INDIAN SCIENCE CONGRESS ASSOCIATION

1. A Short History of the Indian Science Congress Association ₹ 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/-
   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/-
20. PROCEEDINGS of Annual Session of Indian Science Congress ₹ 1200/-
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
Website : http://www.sciencecongress.nic.in

* Members are entitled to 33.33% discount on the above prices
## GUIDELINES FOR SUBMISSION OF MANUSCRIPTS

1. Everyman’s Science intends to Propagate the latest message of science in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. Research articles usually meant for publication in periodicals devoted to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman’s Science. Instead, popular or easily intelligible 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 reader 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 (e) year of publication. For citations of books the author’s name should be followed by the (a) title of the book, (b) year of publication or edition or both, (c) page number, (d) name of publishers, and (e) place of publication.

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

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

All manuscripts and correspondences should be addressed to the Hon’ble Editor, Everyman’s Science. The Indian Science Congress Association 14, Dr. Biswesh Goha Street, Kolkata-700 017. Email: iscaical@vsnl.net, iscaical_3004@yahoo.com, Fax: 91-33-2287-2551
# CONTENTS

**EDITORIAL :**

**GUT MICROBIOTA AND OBESITY**  
*M. K. Chakrabarti*  
147-148

**ARTICLES :**

**THE ABUSE OF ANABOLIC-ANDROGENIC STEROIDS’ IN ATHLETES :**  
POTENTIAL HEALTH HAZARDS  
*Chaitra R. Sharma and Laxmi S. Inamdar*  
149-154

**ADDITIVES : A BOON TO NEW AGE INDUSTRY**  
*Mahima Srivastava*  
155-159

**MULTI-PHYSICS BASED MODELING AND SIMULATION OF AN AIRCRAFT BRAKE SYSTEM**  
*Krishna Lok S.*  
160-165

**PLANT ROOT SYSTEM STUDY—AN OVERVIEW**  
*Govindasamy Prabhu, Sonu Kumar Mahawer, Manoj Chaudhary, R. Srinivasan and Mahendra Prasad*  
166-170

**ALZHEIMER’S DISEASE : A NEURODEGENERATIVE MENACE OF ELDERLY**  
*Anindita Joardar*  
171-173

**THREE-DIMENSIONAL BIOPRINTING AND ITS APPLICATIONS**  
*Pravesh Kumar, K.S. Wisdom and Sneha Surendran*  
174-179

**FOOD PACKAGING TECHNOLOGY**  
*G. Rajesh, S. Balasubramanian, N. Manimehalai and T. Anand*  
180-186

**EFFECT OF NUTRIENTS ON COGNITIVE ABILITIES AND BRAIN DISORDER**  
*Shubha Srivastava*  
187-191

**KNOW THY INTITUTIONS**  
192-195

**CONFERENCES/MEETINGS/SYMPOSIA/SEMINARS**  
196-198

**S & T AROSS THE WORLD**  
199-204
Obesity has become a great health problem nowadays. A large number of people have been suffering from obesity. Sedentary life style and increased food consumption are the two main causes of this obesity epidemic. It has been shown by a group of scientists that the most frequent cause which leads to the obesity development is dysbalance between energy intake and energy expenditure. Studies reported that there is a relation between obesity and gut microbiome. Gut microbes can effect food intake and appetite, body weight composition and metabolic function through gastrointestinal pathways and modulation of the gut bacterial community.

It is known that trillions of bacteria inhabits the gut. The number is more than total cells in the human body. Four hundred to five hundred species is present in any one person. Of these 80 to 90 percent is nonculturable. Advanced molecular biology technique such as next generation sequencing has contributed significantly in our understanding of gut microbiota. The importance of gut microbes was realised in the early 20th century, when Elic Metchnikoff in 1907 had observed that rural dwellers in Bulgaria lived to very old ages despite extreme poverty and harsh climate. He theorised that health of this population could be enhanced and senility delayed by manipulating the intestinal microbiome with host friendly bacteria found in sour milk. Since then, research has continued to support his findings along with suggesting more benefits of gut microbes.

During the pregnancy, infant’s intestinal tract is free of microbes until exposed to maternal microbes during normal birth. Cessarian section babies differs in the composition of gut microbiota with the normally born babies. Feeding also represents another source of microorganism where breast fed babies have different gut microbiota composition in comparison to that of formula fed babies.

Composition of gut microbiota is constantly changing, affecting the health of the host by diet, disease state, medications, host genetics etc. A number of studies have shown connection between diet and microbiota indicating how the composition of different diets directly affect gut microbiota. Gut bacteria are beneficial to us and plays important physiological role in the vital processes such as digestion, vitamin synthesis, metabolism etc. It is well established that gut microbiota can increase energy production from diet, contribute to low grade inflammation and regulate fatty acid composition. These processes are proposed as a link between gut microbiota and obesity. However, the exact mechanism of linking between gut microbes and obesity is not well understood yet. For the last decade several studies suggested a relation between gut microbiota and obesity. Studies have shown that obese mice as well as humans had different gut
composition compared to lean. Gut microbiota contributes to energy metabolism through the production of short chain fatty acids by colonic fermentation of dietary fibre, protein and peptides. Most abundant short chain fatty acids are acetate, propionate and butyrate which are having beneficial effects on body weight.

A study has shown that butyrate and propionate are protective against diet induced obesity. In contrast, it has been noted that in genetically obese mice and obese human subjects fecal short chain fatty acid level increased due to decrease in colonic absorption with obesity. Free fatty acid receptor 2 is one of the short chain fatty acid receptors that has been shown to be activated by acetate and propionate followed by butyrate. Mice lacking this receptor were obese while its over expression in adipose tissue exhibited leanness under normal conditions.

Although a large number of studies have been made in relating gut microbiota and obesity, the exact mechanism of effect of gut microbiota in obesity is not clearly established. Extensive research is required for better understanding of gut microbiota to prove the beneficial effect of these in the treatment of different metabolic disorders including obesity.

Dr. M. K. Chakrabarti
Kolkata

Science is Organised Knowledge—
Herbert Spencer
THE ABUSE OF ANABOLIC-ANDROGENIC STEROIDS’ IN ATHLETES: POTENTIAL HEALTH HAZARDS

Chaitra R. Sharma and Laxmi S. Inamdar*

Anabolic-androgenic steroids (AAS) are synthetic derivatives of testosterone. They have potent anabolic effects in boosting musculoskeletal system, increasing a lean body mass, vigor and sustain male libido. Recent clinical studies have discovered novel therapeutic uses for physiological doses of AAS. However, chronic administration of AAS is often associated with various adverse effects that are generally dose related. The focus of this review is to provide brief introduction to AAS, prevalence of its use, beneficial and/or side effects associated with doping.

INTRODUCTION

What are anabolic-androgenic steroids?

“Anabolic steroids” is the familiar name for synthetic variants of the male sex hormone testosterone. The proper term for these compounds is Anabolic-Androgenic Steroids (AAS)-“anabolic” referring to muscle-building and “androgenic” refers to increased male sexual characteristics.

The use of testosterone and related steroids is a widespread phenomenon among top athletes, amateurs, teenagers and a large part of the population who simply desire to improve their physique. The popularity of testosterone and related steroids among drug users is due to the powerful effects of these substances on muscle mass and vitality. Anabolic-androgenic steroids (AAS) are synthesized from the male sex hormone testosterone and are being used since 1950s in an attempt to maximize the anabolic effects of testosterone. The anabolic activity of testosterone and its derivatives is primarily manifested in its myotrophic action, which results in greater muscle mass and strength. This, in conjunction with the stimulatory effects of androgens on the brain, which frequently results in a feeling of euphoria and increased aggressiveness, has led to the widespread use of AAS by athletes at all levels, as well as by “recreational” drug users. The AAS was first documented in a major sporting event during the world weight lifting Championship in Vienna in 1954.

It was reported that in US 1-2% of adolescent girls and 4-6% of adolescent boys have used AAS at least once. AAS have recently been placed on the Food and Drug Administration’s (FDA) list of controlled substances, because of the adverse effects seen in athletes taking accelerated dosages in attempts to enhance performance. Reported deleterious effects on abusers include hepatocarcinoma, coronary heart diseases, altered cholesterol and liver enzyme profile, balding,
psychological changes, reproductive and neuroendocrine disturbances. The World Anti-Doping Agency (WADA) listed prohibited substances in which AAS is further divided into exogenous, those not found naturally in the body and endogenous, those naturally found within the body. Examples of prohibited substances that fall within each of these categories are shown below in Table 1.

<table>
<thead>
<tr>
<th>Anabolic steroid type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exogenous</td>
<td>Stanozolol</td>
</tr>
<tr>
<td></td>
<td>Nandrolone</td>
</tr>
<tr>
<td></td>
<td>Oxandroline</td>
</tr>
<tr>
<td></td>
<td>Trenbolone</td>
</tr>
<tr>
<td></td>
<td>Metandienone (Dianabol)</td>
</tr>
<tr>
<td></td>
<td>Methyltestosterone</td>
</tr>
<tr>
<td></td>
<td>Gestrinone</td>
</tr>
<tr>
<td></td>
<td>Danazol</td>
</tr>
<tr>
<td>Endogenous</td>
<td>Testosterone</td>
</tr>
<tr>
<td></td>
<td>Androstenediol</td>
</tr>
<tr>
<td></td>
<td>Androstenedione</td>
</tr>
<tr>
<td></td>
<td>Dehydroepiandrosterone</td>
</tr>
<tr>
<td></td>
<td>Dehydrotestosterone</td>
</tr>
</tbody>
</table>

Table 1: Examples of the Prohibited AAS by WADA-2017.

STRUCTURES OF ANABOLIC-ANDROGENIC STEROIDS (AAS)
AAS can be divided into two main groups: those with alkylation of the 17α position with the ethyl or methyl group or those with esterification of the 17β-hydroxyl group. Such modifications enable these substances to have a prolonged physiological effect for up to several months. The 17β groups are highly soluble with a slower rate of absorption in the blood circulation. The structure of the 17α group makes it highly intolerable to degradation by the liver thus increasing its half life. The mode of administration of the 17β is usually through injection while 17α is administered orally.

MECHANISM OF ACTION OF AAS:
Testosterone is a C19 steroid hormone that exists both free (unbound) and bound to plasma proteins. Although approximately 38% of testosterone is bound to the protein albumin, the major binding protein is sex hormone binding globulin (SHBG), which binds 60% of testosterone. The remaining (~2%) testosterone is unbound within the plasma. According to the free hormone hypothesis, it is the unbound testosterone that elicits the physiological response by binding to the androgen receptor where it is converted by 5α-reductase to the more active dehydrotestosterone. The mechanism of action of all AAS is similar to all other steroid hormones in that it binds to an intracellular protein, known as an androgen receptor (AR), in target tissues to form an AR complex in the cell nucleus. The AR is a type of nuclear receptor. The receptor binds to ligand with high affinity and with a degree of specificity. Activation of receptor into DNA-binding form (transcription factor) results, following binding with the steroid hormone. Specifically, they bind to hormone response elements (HRE). Direct contact of the nuclear receptors with transcription factors, or indirectly by coactivators, facilitate transcription and translation resulting in protein synthesis in the skeletal muscle as the structure of androgen receptors appears to be identical in muscle. This leads to enhanced muscle mass.

Ergogenic effects (anabolic efficacy):
Anabolism is defined as any state in which nitrogen is differentially retained in lean body mass through the stimulation of protein synthesis and/or a reduction in protein breakdown. There is a growing body of
evidence that AASs have positive anabolic actions on the musculoskeletal system, influencing lean body mass, muscle size, strength, protein metabolism, bone metabolism, and collagen synthesis. Athletes often experience a state of euphoria, increased aggressive behavior and diminished fatigue during steroid use. AASs have also been shown to improve exercise tolerance and the adaptability of muscle to overload by protecting against muscle fibre damage and increasing the rate of protein synthesis during recovery. In soft connective tissues, AASs enhance collagen synthesis in a dose dependent manner. In bone, testosterone supplementation increases bone mineral density via a direct suppressive effect on osteoclasts. The ergogenic effects of AAS are illustrated in Fig. 1.

**THERAPEUTIC USES OF AAS**

A number of clinical studies using a variety of experimental designs have shown that the potent anabolic effects of AAS have positive benefits to various patient populations at optimum physiologic doses or as per the doctor’s prescription. Physiological replacement doses of testosterone have been used therapeutically to:

- restore hormone levels in hypogonadal men, thereby increasing fat-free mass, muscle size and strength, and bone density.
- improve mood and alleviate depression.
- increase body weight, muscle mass, and strength in eugonadal patients with secondary wasting syndromes, such as infection with
HIV, when maintaining lean body mass may be beneficial for long-term survival and
- augment muscle mass in older men and prevent age-related sarcopenia that contributes to frailty and falls.\(^7\)

**ATHLETIC USES OF AAS**

It is an unfortunate fact that most athletes use more than one steroid at one single time. This state is often referred to as “stacking”. The stack or array of drugs often includes at least one oral and one injectable agent. The drugs may be taken at low doses initially, increased gradually, and then tapered.

**SECONDARY ADVERSE EFFECTS: A CONSTANT THREAT**

Historically, the side effects of AAS use have been overstated. Serious health problems are rare, and the more common adverse effects are benign and reversible.

The potential adverse effects of AAS can be divided into several categories, including cardiovascular, hepatic, behavioral, dermatologic, endocrine and reproductive related effects which are depicted in Fig.2.

**Cardiovascular:** Several AAS-induced adverse cardiovascular effects have been reported, including Myocardial infarction, hypertension, left ventricular hypertrophy (LVH), impaired diastolic filling, arrhythmia, erythrocytosis, altered lipoprotein profile, and thrombosis.

**Hepatic:** AAS can induce elevations in liver enzymes (alanine- and aspartate-aminotransferases), but this effect is typically seen with orally administered 17-alkylated AAS that exhibit high first-pass effects in the liver. An elevated risk for liver tumors, damage, hepatocellular adenomas and pliosis hepatitis are often associated with anabolic steroid use or abuse.

**Bone and connective tissue:** Anabolic steroids have been suggested to increase the risk of tendon tears in athletes. Studies in mice have suggested that anabolic steroids may lead to degeneration of collagen (proportional to duration of steroid administration) and potentially lead to a decrease in tensile strength. Mechanical failure has been suggested as a mechanism in anabolic steroid-using athletes. Skeletal muscle adaptations (i.e., hypertrophy and strength increases) take place rather rapidly in comparison to connective tissue. Therefore, tendon injuries in athletes are thought to occur from a rapid increase in training intensity and volume where connective tissue fails to withstand the overload.

**Dermatologic:** Dermatologic changes such as acne, striae, alopecia, and hirsutism are induced by the action of dihydrotestosterone on androgen receptors in skin and sebaceous glands. High doses of AAS cause acne by increasing skin surface lipids and the cutaneous population of propionibacteria acnes. Cutaneous striae are the result of rapid gains in body mass, in which the skin is unable to accommodate the rate of stretch, and a secondary effect that AAS may have on collagen reducing skin elasticity.

**Psychological and behavioral:** An issue that is often raised with anabolic steroid use is the psychological and behavioral effects. Increases in aggressiveness, arousal and irritability have been associated with anabolic steroid use. This has potentially beneficial and harmful implications. Anabolic steroids are associated with mood swings, elevations in arousal and increases in psychotic episodes. Studies have shown that nearly 60% of anabolic steroid users experience increases in irritability and aggressiveness.

**Central Nervous System:** AAS causes increased libido in men and women, which may be
difficult to control, other symptoms comprise of hypomania, destructive impulses, self destructive impulses. Long term steroid use can affect some of the brain pathways including dopamine, serotonin and opioid systems. Withdrawal symptoms can include severe depression⁸.

**Immunological:** Supraphysiological doses of AAS with an intact steroid nucleus are immunosuppressive, that is they reduce immune cell number and function. While those with alterations to the steroid nucleus are immunostimulatory as they induce the proliferation of T cells and other immune cells. A study from our laboratory reported that one of the 17α-alkylated AASs compounds stanozolol [17β-hydroxyl-17α-methyl-androsteno (3,2-c) pyrazole)] accelerates granulopoiesis and stimulates immune response (at physiologic level only), though it alters lipoprotein profile in mice⁹.

**Reproductive:** In male individuals, reduced gonadotropin secretion results in decreased testosterone levels, which inturn leading to AAS-induced hypogonadotropic hypogonadism manifested with testicular atrophy, oligospermia, azoospermia and other sperm abnormalities. Some male AAS abusers experience a lack of libido, erectile dysfunction, or even gynecomastia. Effects on the prostate gland include hyperplasia, hypertrophy, and possibly cancer. In female individuals, the changes

---

**Fig. 2. The adverse effects of anabolic-androgenic steroid administration.**
most often attributed to AAS abuse are menstrual irregularities (delayed menarche, oligomenorrhea, secondary amenorrhea), dysmenorrhea, anovulation, clitoral hypertrophy, libido changes, and uterine atrophy, with many of them being permanent\textsuperscript{10}.

**CONCLUSION**

The desire to succeed in athletic competition can be a powerful force, driving athletes to abuse AAS in supratherapeutic doses. Further, the use of AAS is becoming increasingly popular among the adolescents and athletes, yet the actual influence of these compounds on many physiological response, endocrine, neuro-endocrine and immune aspects, etc. is yet to be established clearly. Because of the widespread use of large doses of AAS, the adverse effects are of serious concern. AAS users should be aware that many of the adverse effects of AAS might be present without obvious warning signs. In order to maintain credibility with the athlete, it is important to provide accurate information to the athletes and adolescents in regards to these performance enhancing drugs, and provide education about alternative means and potential risks.

**REFERENCES**

ADDITIVES: A BOON TO NEW AGE INDUSTRY

Mahima Srivastava

Additives are compounds added to enable desired balance of properties to be achieved for any particular application. The use of such ingredients, commonly stated as additives, has played an essential role in the commercial development of base materials. They are used for a variety of purposes: to improve processing, modify performance or appearance, prevent or retard aging and to reduce cost. This article covers and discusses the most active heterocycles that have shown considerable actions such as stabilizers, preservatives, surfactants, retardants, curatives, accelerators, etc.

INTRODUCTION

The broadest practical definition of an additive is any substance that becomes part of a product either directly or indirectly during some phase of processing, storage or packaging. Direct additives, which are discussed in this publication, are those that have intentionally been included for a functional purpose by the processor, whereas indirect additives are those migrating into products in very small quantities as a result of growing, processing or packaging. Their quantities are small, yet their impact is great. Without additives, we would be unfortunately lacking in the abundant and varied products that we enjoy today.

1. POLYMER STABILIZERS

Polymers are susceptible to degradation by the action of heat and light, especially in the presence of oxygen which is due to the structures of polymers themselves or due to the presence of impurities such as traces of transition metal ions and various chromophores. Most polymers absorb radiation down to wavelengths of 290 nm. Oxygen attack begins at weak spots of polymer molecule and proceeds by ionic and/or free radical mechanism. Carbonyl groups adjacent to an unsaturated bond are susceptible to photo-degradation after rearrangement of the \( \alpha, \beta \)- to \( \beta, \gamma \)-unsaturated group.

The degradation of polymers may be inhibited by the addition of antioxidants. The ratio of these chemicals to polymers is small, their effect is decisive for the endurance and life of polymers. Two mechanisms are considered to be important: chain transfer involving mainly peroxyl radicals [for example phenols and amines] and peroxide decomposition [for example phosphite ester]. The amine antioxidants used in rubber industry are 6-dodecyl-1,2-dihydro-2,2,4-trimethylquinoline and
polymeric 1,2-dihydro-2,2,4-trimethylquinoline. Peroxide decomposers are of two types: sulphur containing and phosphate esters.

2. INDUSTRIAL ADDITIVES

Nearly all materials under appropriate conditions are subjected to deterioration brought about by microorganisms and to curb their activity, preservatives (more appropriately referred as BIOCIDES) have become an important industrial additive. Preservation has now become a wide term and is applicable to edible as well non edible items. A successful industrial biocide should have a broad spectrum of activity, must be stable enough to withstand typical processing conditions, compatible with other ingredients and finally efficacy should be such that desired level of action is achieved at economical concentration.

The sulphur – nitrogen compounds are the largest class of heterocyclic biocides for example, thiaadiazine, isothiazoline and benzimidazole. These compounds are widely used as preservatives for latex paints, pigment slurries and as paper mill slimicide. 2-mercaptobenzothiazole exhibits effective fungicidal properties. Quaternary ammonium compounds donot penetrate the cell but disrupt the semi – permeable membrane of the microorganism.

3. VULCANIZING AIDS

Vulcanization refers to the process crosslinking to reduce plasticity thereby increasing strength and hardness. Heterocyclic compounds play an important role in this area of technology. Dithioamines are efficient vulcanizing systems producing high proportions of crosslinks. Most commercially useful compounds in this category are 4,4-dithiomorpholine and 4-morpholinyl-2-benzothiazoledisulfide.

Accelerators are yet another organic compounds which increase the rate of vulcanization. Nitrogen compounds are very effective in catalyzing reactions leading to production of activated sulfur. For example, 2-mercaptobenzothiazole and dibenzothiazolyl disulfide.

4. CURING AGENTS

This section deals with additives used to initiate and accelerate reactions of epoxides. Epoxy resins have varied industrial uses. A number of imidazole derivatives have been suggested as curatives for epoxy resins. These compounds

<table>
<thead>
<tr>
<th>COMPOUND</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,5 – dimethyl tetrahydro – 1,3,5 – thiadiazine-2-thione</td>
<td>Preservative for adhesives, emulsions.</td>
</tr>
<tr>
<td>5-chloro-2-methyl-4-isothiazolin-3-one</td>
<td>Preservative for cosmetics, personal care products.</td>
</tr>
<tr>
<td>Hexahydro-1,3,5-tris(2-hydroxyethyl)-s-triazine</td>
<td>Preservative for soluble cutting fluids.</td>
</tr>
<tr>
<td>N-(Trichloromethylthio)phthalimide</td>
<td>Fungicide for plastic, paints, resins.</td>
</tr>
<tr>
<td>10, 10’-oxybisphenoxarsine</td>
<td>Preservative for vinyl plastics.</td>
</tr>
<tr>
<td>2,3,5,6-Tetrachloro-4-(methyl-sulfonyl)pyridine</td>
<td>Preservative for latex paints.</td>
</tr>
</tbody>
</table>
provide long shelf lives at room temperature and cure at moderately elevated temperatures and are also less toxic.

Both nitrogen atoms of imidazole are involved in the cure⁷: the first step being reaction of the secondary atom with epoxy group and the second step the initiation of a catalytic polymerization by the tertiary nitrogen atom. More shelf life can be achieved by blocking the nitrogen atoms with various displaceable groups. The resin viscosity drops initially upon the application of heat, passes through a region of maximum flow and begins to increase as the chemical reactions increase the average length and the degree of cross-linking between the constituent oligomer. This process continues until a continuous 3-dimensional network of oligomer chains is created – this stage is termed gelatin. In terms of processability of the resin this marks an important watershed: before gelation the system is relatively mobile, after it the mobility is very limited, the microstructure of the resin and the composite material is fixed and severe diffusion limitations to further cure are created. Thus in order to achieve vitrification in the resin, it is usually necessary to increase the process temperature after gelation. Cure monitoring methods give a significant insight to the chemical process and define process actions towards achieving specific quality indices of the cured resin systems.

5. SURFACE MODIFIERS

Surfactants are widely used industrially and perform a variety of functions. As processing aids they help to disperse fillers and other ingredients and to form and stabilize emulsions. Anionic and non-anionic surfactants find many applications as wetting, spreading, emulsifying, dispersing and foaming agents. Cationic surfactants are mainly used as softners while amphoteric surfactants are less widely used. Cetyl pyridinium halides are used as germicides and sanitizing agents and morpholinium compounds find application in hair conditioning formulations.

Inhibitors are also surface modifiers. A metal surface can be regarded as a composite of localized electrodes connected through the bulk of the metal. In the presence of an electrolyte, for example surface moisture, these local-action cells are responsible for the chemical conversion of the metal to corrosion products. Organic corrosion inhibitors reduce or prevent these reactions; they are absorbed onto the metal surface and act by forming a barrier to oxygen and moisture, by complexing with metal ions or by removing corrodamts from the surface. A number of nitrogen- and sulfur-containing heterocyclic compounds are effective corrosion inhibitors, the imidazolines, benzotriazoles, quinaldic acid and 8-hydroxyquinoline being important types.

Oils, greases and waxes are used for the temporary inhibition of corrosion. They act as a barrier, preventing the condensation of water on the metal surface. Inhibitors such as piperidine⁸ and morpholine are incorporated to give added protection.

6. MISCELLANEOUS ADDITIVES

Some additional uses are summarized in this section.

[a] BLOWING AGENTS:

The term blowing agent refers to those substances which act as the source of gas in the production of foamed materials. It is a chemical
substance that is widely used in generating the gas to expand rubber, plastics and ceramics to create foam. In other words, it is called “baking powder” for rubber, plastics and ceramics. Compounds used as organic Chemical Blowing Agents are stable at ambient temperatures, but decompose at elevated temperatures to yield a large volume of gas, usually nitrogen. In general, the decomposition temperature should match the processing temperature of the polymer to be foamed. Tetrazole decomposes to give inert products which make it suitable for use with high temperature polymers.

The decomposition temperature becomes high when only blowing agent is used, and it may not satisfy the foam molding condition. In that case, the chemical added to adjust the decomposition temperature of blowing agent is called blowing agent activator.

[b] FOOD PRESERVATIVES:

The function of food preservative and antioxidants is to enhance the keeping ability, or stability of food products. Benzoic acid and its derivatives are among the most widely used antimicrobial agents; these, together with the propionates, sulfur dioxide, nitrates, nitrites and sorbic acid, account for the bulk of food preservatives. A number of those compounds find use, however, in various miscellaneous applications, including 3-acetyl-6-methyl-3H-pyran-2,4-dione as a mould and rope inhibitors in baked goods and hexamethylenetetramine as a preservative in some fish product.

Antimicrobials that destroy or delay the growth of bacteria, yeast and molds. E.g. nitrites and nitrates prevent botulism in meat products. Sulfur dioxide prevents further degradation in fruits, wine and beer. Benzoates and sorbates are anti-fungals used in jams, salads, cheese and pickles. Anti-oxidants that slow or stop the breakdown of fats and oils in food that happens in the presence of oxygen (Oxidation) leading to rancidity. Examples of anti-oxidants include BHT, BHA, TBHQ, and propyl gallate. Anti-enzymatic preservatives that block the enzymatic processes such as ripening occurring in foodstuffs even after harvest. E.g. Erythorbic acid and citric acid stop the action of enzyme phenolase that leads to a brown color on the exposed surface of cut fruits or potato.

Oxidation of the lipid structure in foods containing oils and fats produces carbonyl compounds which are responsible for the flavour and odour associated with rancidity; the use of a suitable antioxidant can delay this process. Several heterocyclic compounds are among the antioxidants suitable for use in food; ascorbic acid and certain of its derivatives and erythorbic acid. The quinoline derivative is mainly used as an antioxidant in animal feed, but it can also be used to preserve the colour of paprika, chilli powder and ground chilli.

[c] FLAME RETARDANTS:

Flame retardants are compounds added to manufactured materials, such as plastics and textiles, and surface finishes and coatings that inhibit, suppress, or delay the production of flames to prevent the spread of fire. They may be mixed with the base material (additive flame retardants) or chemically bonded to it (reactive flame retardants). Mineral flame retardants are typically additive while organohalogen and organophosphorus compounds can be either reactive or additive. Most organic flame retardants contain at least one of the following elements: phosphorus, nitrogen, bromine or chlorine.
REFERENCES
MULTI-PHYSICS BASED MODELING AND SIMULATION OF AN AIRCRAFT BRAKE SYSTEM

Krishna Lok S.

There are various types of Brake systems, in this manuscript, the focus is on the disc brake with a hydraulically actuated brake system. Modeling and simulation of a disc brake system for a typical tricycle aircraft are being presented. The various input parameters that are essential for simulation, presented in a tabular form and discussed its significance. The emerging field of multi-physics based modeling and simulation explained with a model figure and with a plot, indicating the disc brake system performance.

1. INTRODUCTION

The emerging field of multi-physics based modeling and simulation of an aircraft brake system involves various domain viz., Mechanical, Thermal, Hydraulic, etc. In around 1870s and 1880s, the safety brakes development took place. There are mainly three variants of brakes viz., Rim brakes, Disc Brakes, and Drum brakes1. This manuscript, discuss the modeling and simulation of a Disc brake system for an aircraft vehicle. The brake system is an important system from the point of view of the safety of an aircraft. From the simulation compute the performance of the brake system being used and modeled. The goal of any modeling and simulation system development is to increase reliability, reduce the performance time, improve performance (efficiency), and ensure stability2. The modeling and simulation of various domain like Mechanical, Electrical, Thermal, and Hydraulic it is termed as Multi-physics simulation. The modeling and simulation are carried out in Advanced Modeling Environment and Simulation (AMESim3) Software, similar other commercial software’s include Simulink4 along with Simscape, COMSOL Multiphysics® 5 formerly FEMLAB, Dymola, etc. A brake system that inhibits motion using the friction between two surfaces pressed together to convert the kinetic energy of the moving vehicle into heat. In the case of regenerative braking converts much of the energy to electrical energy, which is stored for later use. The brake is being used for slowing or stopping a moving vehicle or to prevent its motion, but may also take other forms such as the spoilers and a back parachute deployed into the air as in case of an aircraft. In this manuscript, a single brake system with the friction alone being presented for an aircraft.

The kinetic energy increases quadratically with velocity \((K = \frac{mv^2}{2})\), an aircraft moving with at 30
m/s has 100 times as much energy as one of the same mass moving at 3 m/s, and consequently, the theoretical braking distance. In practice, fast aircraft usually, have significant drag, and energy lost to air drag rises quickly with the speed.

2. VARIOUS MAIN COMPONENTS OF A BRAKING SYSTEM

This section is the main section of this manuscript, as this describes the various sub-components that make various systems as in a case here is a brake system (Fig. 1). These sub-components are used to make any system based on the requirement using the procedure of drag and drop approach. More accurate and powerful sub-component so will be the simulation results. In other words, higher the fidelity higher will be the response (output). Thus this section forms the vital section for future development work.

2.1 Brake On/Off Valve

The hydraulic brake on/ off valve or the control valve, actuated from the pedal, by mechanical force. The force exerted by the pedal, make the valve on (1) and off (0) state. The brake valve has a pressure source at 200 atmospheric bar and a tank for the hydraulic at the atmospheric 1 bar. Hydraulic fluid MIL-PRF-5606J is superseding MIL-H-5606H⁶, being used for modelling and simulation.

2.2 Hydraulic Actuator

The hydraulic actuators, modeled as single instead of eight separated pistons. The modeling of the single piston is sufficient here as the modeling being done for the no-fault/ no damage (healthy) system. If there is any damage it becomes mandatory to model and simulate these eight-piston separately. The piston diameter is 113 mm as indicated in Table 1. The brake plate gap is modeled using mass- spring-
damper (MSD) with a gap, as this model is very famous in vibration problem. Here novelty is the gap with MSD.

2.3 Frictional Surfaces

The eight frictional surfaces, modeled with a single stator and rotor combination. The gain is given a value of eight as there are eight of them. Again here the modeling for the no damage or any fault model behaviour computation, thus it is a representation of a healthy model.

2.4 Aircraft Mass

Complete Aircraft whole mass is given in this mass sub-component in figure 1 and the total mass indicated in Table 1. Here only the mass suffices the need as modeling and simulation, done for the brake system alone. The brake system is on the Main Landing Gears (MLG) of an Aircraft with a tri-cyclic arrangement. There are two MLGs in an aircraft, the model represents only a single MLG. Thus the force component requires multiplication by a factor two (2).

The parameters indicated in table 1 play a vital role in simulation as-well-as in the actual system. As these parameters decide the system performance. If these parameters values are absurd the output results will also be absurd. Here the simulation results follow the standard slogan of ‘Garbage in garbage out’.

2.5 Thermal Mass

Basic elements of the disc brakes are made of cast-iron disc, which rotates with the wheel, friction material (brake pads) and a calliper fixed to the steering knuckle. When the brakes being applied, hydraulically actuated piston move the friction pad into the contact piston with the rotating disc. Due to friction between surfaces of the pad and the disc, the kinetic energy of the rotating wheel gets converted into heat, by which vehicle is to stop after a certain distance. The heat generated by the wheel is of the order of around 800°C.

Table 1 shows the most critical parameters; these are essential in understanding the behaviour of a brake system. By varying these parameters compute the brake system performance. To model big or small damage/ fault these parameter values defined to the same extent of fault/ damage. A large number of models and simulation results are the vital output from the modeling and simulation activity.

Figure 2 shows the plot of aircraft coming to rest from the moving velocities of 40, 70, 100, and 130 m/s to 0 m/s in a time interval of 8.5, 14.5, 20.5, and 26.5 seconds. From the figure 2, observed that for a velocity variation of 30 m/s an interval of 6 seconds time maintained in all the four-speed intervals. This type of quantification is an advantage of modeling and simulation.

Figure 2 depicts that the speed remains constant or horizontal line until one applies the brake, once brake applied it gradually decreases linearly until it comes to rest (0 speed). Some literature does show a non-linear decrease of velocity it clearly indicates that brake is not applied uniformly or some problem in the brake system.

3. PERFORMANCE ASSESSMENT REQUIRED

The theoretical braking distance is calculated from the kinematic equation for a vehicle as $s = \frac{(V^2 - U^2)}{2a_{\text{max}}}$. Where V is final velocity, and U is the initial velocity. Here $a_{\text{max}} = mg = -9.81 \text{ m/s}^2$ is the maximum possible deceleration assuming that the tire being operated at its peak friction coefficient ($m = 1$). Stopping distance $£ 0.01v + 0.0067v^2$ and a MFDD (Mean Fully
Table 1: Critical Parameters and their values for a Brake System

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pressure of the Tank (Atmosphere)</td>
<td>1 BarA</td>
</tr>
<tr>
<td>2</td>
<td>Temperature of the Tank</td>
<td>20° C</td>
</tr>
<tr>
<td>3</td>
<td>Pressure at Source Port</td>
<td>100 BarA</td>
</tr>
<tr>
<td>4</td>
<td>Valve Natural Frequency</td>
<td>100 Hz</td>
</tr>
<tr>
<td>5</td>
<td>Valve damping ratio</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Characteristic Volume Flow Rate</td>
<td>1 L/min</td>
</tr>
<tr>
<td>7</td>
<td>Corresponding Pressure Drop</td>
<td>10 Bar</td>
</tr>
<tr>
<td>8</td>
<td>Equivalent C/S Area</td>
<td>10 mm²</td>
</tr>
<tr>
<td>9</td>
<td>Orifice Coefficient</td>
<td>0.7</td>
</tr>
<tr>
<td>10</td>
<td>Critical Flow Number</td>
<td>1000</td>
</tr>
<tr>
<td>11</td>
<td>Piston Diameter</td>
<td>113 mm</td>
</tr>
<tr>
<td>12</td>
<td>Thermal Dead Volume</td>
<td>100 cm³</td>
</tr>
<tr>
<td>13</td>
<td>Brake Mass</td>
<td>0.08 kg</td>
</tr>
<tr>
<td>14</td>
<td>Coefficient of Viscous Friction</td>
<td>10 N/(m/s)</td>
</tr>
<tr>
<td>15</td>
<td>Spring Rate</td>
<td>100 N/m</td>
</tr>
<tr>
<td>16</td>
<td>Spring Force</td>
<td>50 N</td>
</tr>
<tr>
<td>17</td>
<td>Elastic Gap or Clearance</td>
<td>1 mm</td>
</tr>
<tr>
<td>18</td>
<td>Elastic Contact Stiffness</td>
<td>1e+09 N/m</td>
</tr>
<tr>
<td>19</td>
<td>Contact Damping</td>
<td>1e+04 N/(m/s)</td>
</tr>
<tr>
<td>20</td>
<td>Static Friction Coefficient</td>
<td>0.55</td>
</tr>
<tr>
<td>21</td>
<td>Dynamic Friction Coefficient</td>
<td>0.5</td>
</tr>
<tr>
<td>22</td>
<td>Striebeck Constant</td>
<td>0.1 rev/min</td>
</tr>
<tr>
<td>23</td>
<td>Stick Displacement Threshold</td>
<td>1 degree</td>
</tr>
<tr>
<td>24</td>
<td>Equivalent Viscous Friction</td>
<td>9549.3 Nm/(rad/sec)</td>
</tr>
<tr>
<td>25</td>
<td>Aircraft Velocity</td>
<td>70 m/s</td>
</tr>
<tr>
<td>26</td>
<td>Aircraft Mass</td>
<td>20000 Kg</td>
</tr>
<tr>
<td>27</td>
<td>Coulomb Friction Force</td>
<td>100 N</td>
</tr>
<tr>
<td>28</td>
<td>Stiction Force</td>
<td>100 N</td>
</tr>
<tr>
<td>29</td>
<td>Inclination</td>
<td>0 degree</td>
</tr>
</tbody>
</table>
Developed Deceleration \( a_{\text{max}} \geq 5.76 \text{ m/s}^2 \) condition required for optimum performance.

Earlier the author and others have extensively worked on the landing gear system like multi-physics based simulation of an oleo-pneumatic shock absorber\(^9\). Combining the Finite Element Analysis (FEA) with multi-physics based simulation termed as co-simulation. For different load cases, identified the hot-spots for locating the strain gages. This is possible ideally by modeling and simulating the stress results\(^{10}\).

### 4. CONCLUDING REMARKS

The manuscript presents the modeling and simulation of an aircraft brake system using multi-physics environment. From the modeling and simulation, quantified the distance travel after braking. Arrived at the maximum temperature attained at the brake pads. Computed the brake system performance. These are possible by varying the parameters, these various combinations are possible only in simulation, in an experiment both time and cost are high. In the case of co-simulation of FEA with multi-physics based simulation results
render in identifying hot spots specifically in a large structure like landing gear. As the structure is large and sensors are small, lends accurate location is a boon from the simulation analysis.

An important aspect of the safety of a system is paramount in any system development, as in the case of a brake system. The goal of system safety is to find risk in the system and cut out that risk to an acceptable level using the simulation process. It is important to keep in mind the many caveats involved in ensuring system run and continue to run as expected.

Future work lies in the novel sub-component development as described in various components of a brake system, next to the introduction section.

REFERENCES

PLANT ROOT SYSTEM STUDY—AN OVERVIEW

Govindasamy Prabhu*, Sonu Kumar Mahawer, Manoj Chaudhary, R. Srinivasan and Mahendra Prasad

An enormous volume of works have been carried out on the above ground plant systems (photosynthesis, respiration, stem, leaf etc.) compared to the below ground system (root) due to accessibility of simple and feasible methodologies. Particularly, in India, the research works on the plant root system is meagre compared to developed countries. There are numerous methods being employed to study the plant root systems at international levels. Therefore, the focus of this article is to examine all the available methodologies and their potential utility to the researchers, with a special emphasis to how Indian scientific communities can utilize the simple and feasible methodologies.

INTRODUCTION

The root is an important part of plants, it performs various functions which are essential to growth and development of the plants. The functions are support and anchorage; absorption and transportation of water, nutrients and growth hormones. Further, many plants have modified their roots. The main functions of the modified roots are photosynthesis (tinospora), nitrogen fixing (legumes-root nodules), improved respiration (rhizophora, rice etc.,) and storage of food (carrot, beets etc.)

Factors affecting root growth

Numerous soil factors such as soil physical factors (soil texture, structure, soil water content and aeration), soil chemical properties (salinity, soil pH, and heavy metals) and biological properties (nematodes, microorganisms like gall forming and nodule forming) are directly or indirectly influence the plant root growth. Here we have discussed on the major soil factors i.e. soil physical properties. Important three soil physical properties are described below :

**Soil texture and structure**

Both soil texture and structure affect the plant root growth by checking the diffusion of water, nutrients and air. For example, a preferred soil structure for a seedbed should be a crumb structure so that the beds will be soft and porous for easy penetration of roots of young seedlings. Likewise, silt, loam and clay soils are ideal for crop production because those textures show greater water holding capacity, high plasticity, stickiness and swelling, whereas sandy soils are obviously not suitable due to the absence of these properties that makes the plant growth very difficult.

**Soil aeration**

Majority of living microbes, plants and animals require oxygen for survival. Deprived soil aeration...
is a major soil physical factor limiting the seedling establishment. Deficiency of oxygen influence the root elongation and other plant metabolic processes, which results in low uptake of nutrients. Decreased soil oxygen level occurs mainly due to high compaction and increased soil bulk density. Fall of oxygen level below 10 to 15% in the soil inhibit the root growth; further, the growth stops completely at 3 to 5%.

Soil water

It is very essential for plant root growth. Too much of water (water logging condition) depletes the soil oxygen level and increases level of other detrimental gases such as methane, CO₂ and ethylene which affect the root growth. Further, tips of tap root system are killed by a constant increase in water level. On the other hand, dry soil (drought) also adversely affects the plant root growth because it is serving as a connecting interface between plant and the soil. However, the effect of drought is mainly noticed on the stem growth than the root growth. Therefore, generally drought impacts the root function by changing the permeability (to water and nutrients) of cell wall and decrease in the shoot to root ratio.

METHODOLOGIES TO STUDY ROOT SYSTEMS

Study of plant underground part is always fascinating area for plant scientists, but it is not easy like that of above ground portion, because of the paucity of suitable methodologies. The available methodologies are costly, time consuming, less accurate and laborious. An enormous volume of experiments are being conducted on this aspect, in particularly on the development of a suitable and less expensive methodology. For a successful study of rhizosphere, we need to have a perfect methodology. Two approaches are currently available to study the root architecture of the plants, viz. a. Destructive and b. Non-destructive.

a. Destructive method

The destructive method involves collection of root samples through excavation or processes of soil profiling. Further this method has been categorized as 1. Monoliths, 2. Auger method and 3. Excavation.

1. Monoliths: Monoliths are defined as a large single upright block of soil. In this method, the soil monoliths are taken from the interested area to study a specific objective. The size of the monolith can vary from 24 to 30 cm wide, 5 to 8 cm thick and 3 to 5 feet in depth where there is well-established vegetation (Figure 1a). Further, the separation of roots from the soil would be done by soaking and washing under running water. After thorough washing, roots are mounted on a smooth board. The root system is lighted for photography and then the picture is used for the estimation of root quantitatively. This system can be used for both annual and perennial crops.

2. Auger method: The auger consists of a cylindrical tube with 15 cm height and inside diameter of 7-15 cm (Figure 1b). In this method, a known depth of soil sample is collected by hand or mechanical sampling machines. Further, the quantification of root volume and length can be done after washing the roots from the soil. This method can be highly useful for both annual and perennial crops.

3. Excavation: Excavation is a process of digging a pit around the selected plants without disturbing the lateral root system. For grasses or herbs, 20 to 80 cm distance will be more appropriate and for trees would be 10 m. Before the excavation, the selected plant’s top parts must be removed for the safety reason. The process of removing soil around the plant root system (experimental plant) is known as excavation (Figure 1c). After proper exposure of root system, vertical drawing has to be made and different root diameter can
be indicated by the use of pencils of different colour. The drawings are further used to make different measurements of roots. This method can be also used for both annual and perennial systems.

Disadvantages
- Collection of all roots (100% recovery) is difficult
- It is laborious and time consuming
- Replication of samples are more tedious

b. Non-destructive methods

The non-destructive method involves the observation of root without disturbing the root system through glass walls or rays. Some of the methodologies are rhizotron, Ground Penetrating Radar (GPR), and X-ray Computed Tomography (CT), Electrical Resistivity Tomography (ERT), Projection Tomography Techniques (PET) and Magnetic Resonance Imaging (MRI). We briefly describe here only some of the important methods.

1. Rhizotron: It is a non-destructive and in-situ method for directly studying the roots. In this method an acrylic tube is buried at 60 cm soil depth with 45° angle at one side of the crop rows to maximize the visibility of roots (Figure 3a). The images of roots will be captured in a high resolution camera from specific depths. Further, the captured root images will be processed in software for quantification of root length and root area.

Advantages and disadvantages of the destructive methods

Advantages
- Entire root system of a plant can be studied clearly
- It is less expensive
- Well suitable to study the root growth in cracks and biological channels
- This is the only suitable method to study the root system in stony and sandy soils

Disadvantages
- Entire root system of a plant can be studied clearly
- It is less expensive
- Well suitable to study the root growth in cracks and biological channels
- This is the only suitable method to study the root system in stony and sandy soils
for GPR is 0.25 to 1.5 m. First step in GPR measurement is calibration, because electromagnetic strength decreases with increasing the profile depth and leading to deeper objects less detectable. GPR transmits short pulses of electromagnetic waves into the ground through an antenna along each scan line. Those electromagnetic pulses reflect back to the receiver after the contact with a different electromagnetic surface. Then the receiver converts the energy in a similar shaped waveform in a low frequency. Further, based on the hyperbolic pattern, presence of roots are confirmed.

3. X-ray Computed Tomography (CT): It is also a non-destructive method used to measure the plant roots. The principle of this method is based on the absorption quantity of X-rays by an object. For this 3D volumetric images will be obtained using an X-ray CT scanner (Source). In every scanner there will be a source and detector. During measurements both make a synchronous movement around the root system so that all angles of measurements are covered. In the process, X rays penetrate through the roots and some rays are absorbed. The ray’s absorption is directly proportional to the density of roots. Further, specific technological tools are being used to get an angular projection (example, 160 kV and 201 mA using a 0.1 mm Al filter to obtain 3003 angular projections) and root segmentation (example VGStudio MAX 2.2).

Estimation of plant roots is entirely based on the scanned image (3D images) of the experimental roots (Figure 4).

**Advantages and disadvantages of the non-destructive methods**

**Advantages**
- Easy to study the plant roots
- Less laborious and faster method
- This is the only suitable method to track the plant root growth throughout the growing season

**Disadvantages**
- It is expensive
- Accuracy is lesser compared to destructive methods
- Not suitable to study the root system in stony and sandy soils

**IMAGE PROCESSING PLATFORMS**
- Graph sheet, rhizocron software, GPR software, WINRHIZO, IMAGEJ, root scanner, root graph, root snap, root reader, root scope, root fly, smart root, root trace etc. Here we describe an open source software IMAGEJ.

- IMAGEJ is an open source software for image analysis. The software can be downloaded from the link [https://imagej.nih.gov/ij/download.html](https://imagej.nih.gov/ij/download.html) (V 1.51r, U.S. National Institutes of Health, Bethesda, Maryland, USA). This software has both manual and automatic image analyzing options. When we use an artificial light source (low cost rhizotron) to get clear images, the acquired images always have background noises. In such circumstances, one should use the

![Fig. 4. Image of rice roots using X-ray Computed Tomography (CT)](image)
manual image analysis option. IMAGEJ can accept all picture formats such as TIFF, GIF, JPEG, PNG, DICOM, BMP, PGM, and FITS. It can measure root length and root area of a plant.

CONCLUSION

Contribution of root systems to soil organic carbon pool has stimulated the interest of scientific communities to focus more on the below ground system. Therefore, this article aimed to expose the currently available methodologies, and their pros and cons. In Indian context, researchers can utilize the traditional methods (destructive) in combination with the rhizotron and root scanner (non-destructive). Use of GPR system in India would be a future alternative. Scientists can also pursue to develop or invent low cost rhizotrons using acrylic tubes and modern camera systems. There is huge scope to excel in the field of rhizosphere research for better plant growth and soil health.

REFERENCES

ALZHEIMER’S DISEASE : A NEURODEGENERATIVE MENACE OF ELDERLY

Anindita Joardar

Alzheimer’s Disease (AD) is the most common cause of dementia. This is an incurable, neurodegenerative and terminal disease. The exact cause and progression of the disease are not well understood. This article outlines the possible causes, risk factors, etiology and management of the AD to create awareness among people.

INTRODUCTION

Dementia is a clinical manifestation in which decline in mental abilities and memory (cognitive functions) takes place in patients. The affected individual is not able to carry out his day-to-day activities. Older people with dementia are present worldwide. WHO predicts that around 71% of 81.1 m dementia cases will be in the developing world by 2040! There are no preventive or curative measures for most dementia cases. The most common cause of dementia is Alzheimer’s Disease or AD (around 60% cases). It is a progressive neurodegenerative disorder. The cases are confirmed by US National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer’s Disease and Related Disorders Association Criteria (NINCDS- ADRDA).

ETIOLOGY

Alzheimer’s Disease (AD) has a multi-factorial etiology. Various factors may increase the risk of dementia, viz. diet and lifestyle, mid-life history of disorders like hypertension, type 2 diabetes etc. and genetic predisposition. The behavioural and psychological symptoms are apathy, depression, sleep alterations, anxiety etc. In India, patients suffering from AD have delusions, hallucinations, anxieties, phobias and caregiver distress. These are similar to those reported from developed countries. Early life exposure to deleterious conditions like poverty, infectious diseases, malnutrition, pre-natal stress may influence ageing process. Early life negative events and physical attributes including brain development, body growth, socioeconomic conditions, head injury contributes as risk factors of AD. Intellectually stimulating and socially engaging physical activities lowers the risk of AD. Also diet rich in fruits, vegetables and fibres significantly reduce development of AD.

PATHOLOGY OF AD

This incurable, degenerative and terminal disease was first described by German physicist, Alois Alzheimer in 1906 and was named after him. Both amyloid plaques and neurofibrillary tangles are visible in brains of AD patients on autopsy. AD has been identified as a protein mis-folding disease, caused by accumulation of abnormally folded ‘Aβ’ (amyloid β) protein and ‘tau’ proteins in the brain.
Majority of AD cases are sporadic. A few of the familial forms follow autosomal dominant inheritance, which usually have an onset before 65 yr. Most of the inherited AD are attributed to mutations in one of the three genes: Amyloid Precursor Protein (APP), Presenilin 1 (PS1) and Presenilin 2 (PS2). Amyloid plaques are formed between nerve cells in the brain. Aβ is formed after sequential cleavage of APP, a transmembrane glycoprotein of unknown function. Beta amyloid form clumps, that deposit outside neurons. APP can be cleaved by α, β and γ secretase to from Aβ proteins of various lengths. A number of isoforms are generated varying in length viz. Aβ-40 and Aβ-42. Shorter forms e.g. Aβ-40 is more common and is produced by cleavage in trans-golgi network. Aβ-42, produced in endoplasmic reticulum is more fibrillogenic and is associated with plaques. Mutations in PS1 and PS2 alter the γ secretase activity, such that Aβ-42 is produced. Beta amyloid peptide activates the surrounding microglia and astrocytes producing inflammatory mediators e.g. components of complement pathway, acute phase proteins, interleukin-6 etc. This may help in the formation of Aβ.²

The other protein implicated in AD, tau protein, forms prion like misfolded oligomers. Neurofibrillary tangles are insoluble twisted fibres found inside the neurones. The tangles primarily consist of tau, which forms part of microtubule, which helps transporting nutrients and other important substances from one part of neurons to the other. In AD, tau protein is abnormal and microtubule structure collapse.

Nonetheless most of AD cases do not exhibit autosomal dominant inheritance and are sporadic, genetic differences may act as risk factors. One of the risk factors is ε4 allele of apolipoprotein E. This allele has been widely studied and is a well established risk factor for AD. Many studies have been conducted to find an association of interleukin-6–174G/C polymorphism and AD with varying results.³ There are other genes which may act as risk factors or have protective effects on AD.

**DIAGNOSIS AND TREATMENT**

AD is diagnosed clinically from patient history, clinical observations, presence of characteristic neurological and psychological features and absence of alternative conditions. Advanced medical imaging with computed tomography (CT) or magnetic resonance imaging (MRI) and Single Photon Emission Computed Tomography (SPECT) or Position Emission Tomography (PET) can be used to help exclude other cerebral pathology.

Currently used treatments have symptomatic benefits. Developing countries have traditional herbal medicinal practices that are good anti-dementia therapies. Several species of medicinal plants e.g. blueberry, cannabis, clubmoss, curcumin, garlic, ginseng, pomegranate etc. have activities relevant to dementia.

Modern treatments of AD are pharmaceutical, psychosocial and caregiving. Mementine (NMDA receptor antagonist) is the drug of choice. Acetylcholine esterase inhibitors are also used. Antipsychotic drugs are also used for reducing aggression and psychosis. Psychosocial therapies include behavioural, emotional, cognitive and stimulatory. Since AD has no cure, caregiving must be carefully managed over the course of the disease. Clinical research is focused on treating the pathology of the disease. Immunotherapy and vaccination for the amyloid protein is one of the treatment modalities under investigation.

**SCENARIO IN INDIA**

In India, more than 4m people are estimated to be suffering from AD and other forms of dementia,
giving the country the third highest case-load in the world, after China and the US. AD in India is a hidden problem. Only a fraction of patients are diagnosed and treated. According to India Ageing Report, 2017, the elderly population, which is growing at a fast rate of 3%, may increase the AD cases. According to a study, social stigma surrounding AD and dementia is impeding early diagnosis, care and research.

AD modifies survival and increases the risk of death. Understanding the burden and cost of AD is crucial for future healthcare and socioeconomic policy. Teaching of coping strategies to the caregivers has improved their psychological health. National Policies to increase awareness, specialized training for health professionals, authorities, research and a proper counseling of caregivers etc. may help the growing number of AD and other dementia patients in the long run.

CONCLUSION

Alzheimer’s Disease (AD), being an incurable, degenerative disease requires special care of patients. Various factors like lifestyle, diet, genetic predisposition are thought to cause the disease. Palliative treatment, social awareness and early diagnosis are important. Trained care-giving is an essential part of the disease.

ACKNOWLEDGEMENT

Infrastructural facilities of the Neurogenetic unit (laboratory) provided by the Director, Bangur Institute of Neurosciences are gratefully acknowledged.

REFERENCES


THREE-DIMENSIONAL BIOPRINTING AND ITS APPLICATIONS

Pravesh Kumar*, K.S. Wisdom and Sneha Surendran

There is very high demand for human organs for transplantation and better drug screening systems without the need of human volunteers. Further, in-vivo skin synthesis is a challenge in bio-medical science. The 3D bioprinting is the most exciting and ground-breaking innovation to solve these problems by creating living organs like heart, lungs and kidney. Bioprinters are used for making the skin which can replace the damaged skin. Bioprinting may one day become a life-changing breakthrough that was once thought as science fiction. Bioprinted tissue have the capacity to replace human volunteers from drug testing facilities.

INTRODUCTION

Three-dimensional (3D) printing is a manufacturing method for making a physical object from a 3D digital model, typically by laying down many successive thin layers of material. The structure is formed by chemical approach and additive processes by coatings layers one over the other until the intact object is shaped. The consecutive films and layers of a particular material are laid down under the computer control. The objects that are created in these printers can be of any shapes, sizes or geometry. The materials like plastic, metal, ceramics, powders, liquids, or even living cells are fused or deposited layer by layer to produce a 3D object. This process is also called as additive manufacturing (AM), rapid prototyping (RP), or solid free-form technology (SFF).

The 3D bioprinting is a biomedical variant of additive manufacturing technology. It is the layer by layer biological synthesis of the functional 3D tissue and organ constructs by using computer-aided digital model and tissue spheroids as self-assembling building blocks\(^1\). To bioprint, a functional human organ or tissue construct needs a corresponding digital model or an organ blueprint. Computer-aided design (CAD) software is used to make these digital models.

THE HISTORY OF 3D BIOPRINTING

Scientists at the Wake Forest Institute for Regenerative Medicine used a 3-D printer to build a synthetic scaffold of a human bladder in 1999. They then coated the scaffold with cells taken from their patients and successfully grew working organs. This set the stage for true bioprinting. In 2002, scientists printed a small functional kidney capable of filtering blood and producing urine in an animal model. The first international workshop on bioprinting and biopatterning was held at the University of Manchester (United Kingdom) in September 2004. In 2010, Organovo- a bioprinting company headquartered in San Diego printed the first blood
vessel. Till then they successfully implanted bioprinted nerve grafts into rats and developed ExVive™ Human Kidney Tissue. In 2017, this company introduces 3D bioprinted liver as leading therapeutic tissue in preclinical development².

**COMPONENTS OF A 3D BIOPRINTER**

**Print headmount** - the Print head is attached to a metal plate running along a horizontal track. The x-axis motor propels the metal plate (and the print heads) from side to side, allowing the material to be deposited in either horizontal direction.

**Elevator** - A metal track running vertically at the back of the machine, the elevator, driven by the Z-axis motor, moves the print heads up and down.

**Platform** - A shelf at the bottom of the machine provides a platform for the organ to rest on during the production process. The platform may support a scaffold, a petri dish or a well plate.

**Reservoirs** - The reservoirs attach to the print heads and hold the biomaterial to be deposited during the printing process. These are equivalent to the cartridges in your inkjet printer.

**Print heads/syringes** - A pump forces material from the reservoirs down through a small nozzle or syringe, which is positioned just above the platform. As the material is extruded, it forms a layer on the platform.

**Triangulation sensor** - A small sensor tracks the tip of each print head as it moves along the x-, y- and z-axes. The software communicates with the machine, so the precise location of the print heads is known throughout the process.

**Microgel** - Unlike the ink, you load into your printer at home, bioink is alive, so it needs food, water, and oxygen to survive. This nurturing environment is provided by a microgel - think gelatin enriched with vitamins, proteins, and other life-sustaining compounds³.

**Bioink** - Organs are made of tissues, and tissues are made of cells. To print an organ, a scientist must be able to deposit cells specific to the organ, bioink is made up of these cells.

**APPROACHES FOR 3D BIOPRINTING**

3D bioprinting is based on three vital approaches: biomimicry, autonomous self-assembly, and mini-tissue building blocks.

**Biomimicry**

Identical replicas of the cellular and extracellular components of a tissue or organ can be manufactured by this method. This can be achieved by reproducing specific cellular functional components of tissues, for example, mimicking the branching patterns of the vascular tree or manufacturing physiologically right biomaterial types and gradients. For this approach to succeed, the replication of biological tissues on the microscale is necessary.

**Autonomous self-assembly**

Another approach to replicating biological tissues is to use embryonic organ development as a guide. The early cellular components of a developing tissue produce their own ECM components, appropriate cell signaling and autonomous organization and patterning to yield the desired biological micro-architecture and function. It requires an intimate knowledge of the developmental mechanisms of embryogenesis and organogenesis as well as the ability to manipulate the environment to drive embryonic mechanisms in bioprinted tissues.

**Mini-tissues**

The concept of mini-tissues is relevant to both of the above strategies for 3D bioprinting. Organs and tissues comprise smaller, functional building blocks or mini-tissues. These can be defined as the smallest structural and functional component of a tissue, such as a kidney nephron. Mini-tissues can
be fabricated and assembled into the larger construct by rational design, self-assembly or a combination of both.

BIOPRINTING TECHNIQUES

The three main bioprinting techniques of inkjet, laser-assisted, and extrusion bioprinting each have specific strengths, weaknesses, and limitations.

Inkjet printing

Inkjet bioprinting was the first bioprinting technology and is very similar to conventional 2D inkjet printing. A hydrogel pre-polymer solution with encapsulated cells (called a bioink) is filled in the ink cartridge. The cartridge is then connected to a printer head and acts as the bioink source during the electronically controlled printing process. During printing, the printer heads are deformed by a thermal or piezoelectric actuator and squeezed to generate droplets of controllable size. The advantages of inkjet printing are low, high printing speed and relatively high cell viability (usually from 80% to 90%). However, because current printer heads are based on microelectromechanical system (MEMS) devices, there is a relatively small deformation generated by either thermal or piezoelectric actuation at the nozzle opening. As a result, MEMS-based printer heads cannot squeeze out high viscosity materials (>15 mPa/s) and do not work well with bioinks with high cell density (>1 x 10^6 cells/ml).

Laser-assisted printing

The laser-assisted printing system is based on a donor layer that responds to laser stimulation. The donor layer comprises a ‘ribbon’ structure containing an energy-absorbing layer like titanium or gold on the top and a layer of bioink suspended on the bottom. A focused laser pulse is applied to stimulate a small area of the absorbing layer, and it vaporizes a portion of the donor layer, creating a high-pressure bubble at the interface of the bioink layer and propelling the suspended bioink. The falling bioink droplet is collected on the receiving substrate and subsequently crosslinked. It avoids direct contact between the dispenser and the bioinks. This non-contact printing method does not cause mechanical stress to the cells, which results in more than 95% cell viability. In addition, it can also print highly viscous materials, and more types of bioinks can be used than in inkjet printing. These features of laser bioprinting are promising, but the side effects of laser exposure on the cell are not yet fully understood. And also laser diodes with high-resolution and intensity are expensive, and control of the laser printing system is complex.

Extrusion printing

Extrusion printing is a modification of inkjet printing. In order to print the viscous materials, extrusion printer uses either an air-force pump or a mechanical screw plunger to dispense bioinks. By applying a continuous force, extrusion printing can print uninterrupted cylindrical lines rather than a single bioink droplet. Almost all types of hydrogel pre-polymer solutions of varying viscosity as well as aggregates with high cell density can be printed with extrusion bioprinters. While extrusion bioprinters can print a wider range of materials, they also expose the encapsulated cells to higher mechanical stresses that are thought to reduce cell viability. Most prevailing commercial bioprinters, including the Bioplotter (EnvisionTec, Gladbeck, Germany) and Novo Gen 3D Bioprinting platform (Organovo, San Diego, USA), are based on extrusion technology. Extrusion bioprinting provides excellent compatibility with photo, chemical and thermal cross-linkable hydrogels of very different viscosities at a reasonable cost.

PROCESS OF 3D BIOPRINTING

Bioprinters cannot print without instructions. To successfully form bioprinted tissues, it is necessary...
to generate the printing paths, select appropriate bioinks, control the bioprinter and perform quality control after printing. The typical bioprinting process is as follows: (1) draw the printing geometry and manually verify its feasibility; (2) select appropriate cell types and hydrogels, and load the bioinks; (3) sending of designing paths to bioprinter system through control language and protocols; (4) structures formation from bioprinter under the control of a computer; (5) checking of bioprinted tissues via microscopy after bioprinting. After the bioprinting process, successfully printed constructs are transferred to an incubator for culturing. The bioprinting process is not currently highly automated, and many manual operations at a variety of steps can result in slow processing speeds and increase the chance of mistakes and errors. To ensure printing quality and to improve the printing process, CAD and modeling technology are widely used. These CAD techniques can utilize computer automation systems to assist and accelerate the design process. Bioprinting models, like models used in conventional rapid prototyping, are often converted to the STereoLithography (STL) file format as an intermediate between model and print path generation. These files contain accurate surface information of complex 3D geometries, and can be designed via graphic user interfaces, or created from clinical images like magnetic resonance imaging (MRI) and computed tomography (CT), printing paths are created by “slicing” these STL model into layers and creating bioprinter toolpaths that trace out the perimeter and interior features of each slice. The thickness of these layers is referred to as the resolution of a printer and is usually in the range of 100–500 μm depending on the machine and material used. These toolpaths are the instructions read and executed by the bioprinter for each layer and can include material selections. Layers are formed sequentially and stacked as the model is built up in an additive process creating a 3D object from a collection of 2D layers.

APPLICATIONS OF 3D BIOPRINTING

Bioprinting Tissues and Organs

Tissue or organ failure due to aging, diseases, accidents, and birth defects is a critical medical problem. Current treatment for organ failure relies mostly on organ transplants from living or deceased donors. However, there is a chronic shortage of human organs available for transplant. In 2009, 154,324 patients in the U.S. were waiting for an organ. Only 27,996 of them (18%) received an organ transplant, and 8,863 (25 per day) died while on the waiting list. Therapies based on tissue engineering and regenerative medicine are being pursued as a potential solution for the organ donor shortage. Although tissue and organ bioprinting is still in its infancy, researchers had used 3D printers to create a knee meniscus, heart valve, spinal disk, other types of cartilage and bone, and an artificial ear.

Construction of drug screening systems

Bioprinting is also promising in the design of drug screening systems. Compared to manual methods, bioprinting can deposit cells uniformly on the surface of micro-devices. Such uniformity is highly desirable for testing and screening the interactions between cells and drugs. Chang et al. (2010) developed an air-pressure based extrusion bioprinter to prototype a drug testing platform for the liver with alginate encapsulated immortalized hepatocytes. In this system, the authors were able to show differential drug metabolism. Snyder et al. (2011) expanded on this system by printing microfluidic channels in a co-culture system of liver and mammary cells to investigate tissue damage from radiation. Bioprinting has also been used to seed
cell layers uniformly on each side of the interface of micro-devices for the formation of organ-on-a-chip devices. Organ-on-a-chip systems mimic parts of typical organ functions to investigate the interactions between drugs and their potential effects on tissues. Bioprinting may play an important role in organ-on-a-chip technology, given it is a practical solution for the formation of uniform and highly controllable tissue layers at low cost.

**Anatomical Models for Surgical Preparation**

The individual variances and complexities of the human body make the use of 3D-printed models ideal for surgical preparation. Having a tangible model of a patient’s anatomy available for a physician to study or use to simulate surgery is preferable to relying solely on MRI or CT scans, which aren’t as instructive since they are viewed in 2D on a flat screen. The use of 3D-printed models for surgical training is preferable for training. 3D-printed neuroanatomical models can be particularly helpful to neurosurgeons by providing a representation of some of the most complicated structures in the human body. The intricate sometimes obscured relationships between cranial nerves, vessels, cerebral structures, and skull architecture can be complicated to interpret based solely on radiographic 2D images. Even a small error in navigating this complex anatomy can have potentially devastating consequences. A realistic 3D model reflecting the relationship between a lesion and normal brain structures can be helpful in determining the safest surgical corridor and can also be useful for the neurosurgeon to rehearse challenging cases. Complex spinal deformities can also be studied better through the use of a 3D model. Pioneering surgeons at Japan’s Kobe University Hospital have used 3D-printed models to plan liver transplantations. They use replicas of a patient’s organs to determine how to best carve a donor liver with minimal tissue loss to fit the recipient’s abdominal cavity. These 3D models are made of partially transparent, low-cost acrylic resin or polyvinyl alcohol materials that have water content and texture similar to living tissues, allowing a more realistic penetration by the surgical blades.

**Cosmetic Applications**

Recently 3D face bioprinters are successfully created. These printers can evaporate the existing flesh and simultaneously replace it with new cells to exact patient specification. People could, therefore, download a face scan from the Internet and can be applied to themselves.

**ADVANTAGES AND DISADVANTAGES OF BIOPRINTING**

The major benefit of bioprinting is simple; saving lives. By utilizing new technology, bioprinting will be able to reproduce vital human organs that will reduce, or eliminate the need for donors, as well as recreate other important body parts, making surgery far simpler. Preserving human life is a huge boon to society, raising life expectancy and reducing the amount of terminal patients. This benefit extends to the testing departments of much new upcoming advancement. For drug development, it will allow a lot more testing to be done, decreasing the amount of time and monetary costs for a new drug to be pushed onto the market for public use.

The costs of bioprinting are quite high financially; a basic, prototype machine was priced at around $200,000, which is an exorbitant sum that not every medical center can afford. Bioprinting is not cheap, and will mostly be only available to the wealthy classes of society. Also, until further research and development take place, creating complex, full organs are out of the question, as the body may reject the foreign implementation, wasting time and effort.
CONCLUSIONS

Bioprinting is an advanced fabrication technique for the dispensing of cell-laden hydrogels, with a bright future accompanying numerous challenges and problems. Bioprinting has shown great potential in tissue engineering applications at its early research stage where many in vitro and even in vivo experiments have already hinted at the feasibility of bioprinted artificial organs. Due to advantages in micro scale, high throughput, cell deposition, the applications of bioprinting are expanding rapidly. Bioprinting has become a strong fabrication tool to create complex micro and macro-scale biomedical systems. Even with the progress that has been made, bioprinting remains an emerging and growing technology with incredible potential.

REFERENCES

2. http://organovo.com/about/history/
Packaging is an essential part of processing, preservation and distribution of foods. Fish being extremely perishable food deteriorates rapidly and thereby the quality and potential life is reduced if they are not handled and stored properly. It needs a suitable packaging that can limit undesired microbial growth and sensory deterioration. Recent packaging technologies which are becoming increasingly significant include intelligent packaging, active packaging, etc. These emerging technologies play a considerable role in shelf life extension, prevention of undesirable changes to the appearance, flavor, odor, and texture. Moreover, there are advances in packaging of retort-processed seafood, frozen seafood, ready-to-serve and retail-ready seafood products, advances in bulk packaging for the transport of fresh and processed fish or fishery products, advances in the manufacture of sausage casings and advances in vacuum and modified atmosphere packaging of fish, crustaceans and other shellfishes. This paper discusses emerging technologies for the effective packaging of sea foods and reviews advances in packaging technology, focuses on developments in active packaging, controlled release packaging, environmentally-compatible packaging and emerging edible chitosan coatings technologies.

INTRODUCTION

In recent years there are notable advances in the packaging technology of fish and fishery products. The three basic functions of food packaging (storage, preservation and protection) are still required today for better maintenance of quality and handling of foods. Advance packaging technologies which are becoming increasingly significant include intelligent packaging, active packaging, etc. Since fresh fish can get spoiled very quickly, the development of packaging technology for post-harvest preservation and methodology convert to as fresh condition. The advance packaging helps in getting high price for the fishery product. The devices as indicators can provide directly information about product quality which is resulting from microbial growth or chemical changes within foodstuffs. The using of those indicators to inside or outside of cover we can call smart of intelligent packaging. Smart packaging utilizes chemical sensor or biosensor to monitor the food quality and safety from the producers to the costumers. A modern quality and safety assurance system should prevent contamination through monitoring, recording, and controlling of critical parameters during a product’s entire life cycle, which includes the post processing phase and extends over the time of use by the final consumer.
ROLES OF FOOD PACKAGING

The principal roles of food packaging are to protect food products from outside influences and damage, to contain the food, and to provide consumers with ingredient and nutritional information. Prolonging shelf life involves retardation of enzymatic, microbial, and biochemical reactions through various strategies such as temperature control; moisture control; addition of chemicals (salt, sugar, carbon dioxide, or natural acids) removal of oxygen; or a combination of these with effective packaging. Containment involves ensuring that a product is not intentionally spilled or dispersed. The communication function serves as the link between consumer and food processor. It contains mandatory information such as weight, source, ingredients and nutritional value and cautions for use required by the law. Secondary functions of increasing importance include traceability, tamper indication, and portion control. More recent innovations used include surface variations sensed by finger tips and palms, sound/music or verbal messages, and aromas emitted as part of an active packaging spectrum. The goal of food packaging is to contain food in a cost-effective way that satisfies industry requirements and consumer desires, maintains food safety and minimizes environmental impact.

ACTIVE FOOD PACKAGING

Active packaging is accurately defined as ‘packaging in which subsidiary constituents have been deliberately included in or on either the packaging material or the package headspace to enhance the performance of the package system’. Developments in active packaging have led to advances in many areas, including delayed oxidation and controlled respiration rate, microbial growth and moisture migration. Other active packaging technologies include carbon dioxide absorbers/emitters, odor absorbers, ethylene removers, and aroma emitters. Active packaging technologies include some physical, chemical, or biological action which changes interactions between a package, product, and/or headspace of the package. The most common active systems scavenge oxygen from the package or the product and may even be activated by an outside source such as UV light. However, allows packages to interact with food and the environment and play a dynamic role in food preservation. The packaging systems are developed with the goal of extending shelf life for foods and increasing the period of time that the food is high quality. Active packaging is typically found in two types of systems; sachets and pads which are placed inside of packages and active ingredients that are incorporated directly into packaging materials.

ACTIVE PACKAGING: SACHETS AND PADS

In order to absorb or emit gases to a package or headspace, sachets and pads are very commonly used. Sachets were developed in the late 1970s in Japan. For oxygen scavenging, the sachets essentially utilize the process of rusting, or the oxidation of iron compounds in the presence of oxygen and water. Oxygen absorbers are usually made of powdered iron or ascorbic acid. Iron based scavengers typically do not pass the metal detector inspections on most packaging lines, and in these incidences ascorbic acid is advantageous. These pads prevent the growth of molds or bacteria by absorbing water into superabsorbent polymer granules placed between two layers of micro porous nonwoven polymer. Although sachets work well in many applications, they are not appropriate for every situation. Sachets cannot be used in liquid foods.
They may not be used in a package made of flexible film, as the film will cling to the sachet and prevent it from performing its function.

APPLICATION OF ACTIVE PACKAGING

The following are commercial applications of active packaging system

- Oxygen scavenging
- Carbon dioxide emitters and scavengers
- Moisture control
- Ethylene absorbers
- Antimicrobials

OXYGEN SCAVENGERS

High level of oxygen present on food packages may facilitate microbial growth, off-flavor and off-odor development, colour changes and nutritional losses, thereby causing significant reduction in the shelf life of food. The control of oxygen level in food packages limit the rate of such deteriorative and spoilage reaction in food. Oxygen scavenger has been applied to materials incorporated into package structures that chemically combine with, and thus effectively remove, oxygen from the inner package environment. The substance is usually contained in sachets made of a material highly permeable to air but it can also be included in bottle closures or in the plastic film matrix. The most common substances used are iron powder and ascorbic acid. The scavengers may be of self-reaction type or moisture dependent. In this latter case, the reaction only takes place after moisture has been absorbed from the food product, while in the first case, the reaction starts as soon as the scavenger is exposed to air. In both cases however, water is essential for the chemical reaction to occur. Scavengers also differ in the reaction speed, from immediate action (0.5 to 1 day) to slow action (4 to 6 days), on the application, particularly the moisture content of the food, and on the function, i.e., oxygen scavenging only or dual function, such as absorbing or generating carbon dioxide, besides removing the oxygen.

CARBON DIOXIDE EMITTERS AND SCAVENGERS

The function of carbon dioxide within a packaging environment is to suppress microbial growth. Therefore, a carbon dioxide generating system can be viewed as a technique complementary to oxygen scavenging. Since the permeability of carbon dioxide is three to five times higher than that of oxygen in most plastic films, it must be continuously produced to maintain the desired concentration within the package. High carbon dioxide level (10-80%) are desirable for food such as meat, poultry and seafood in order to inhibit surface microbial growth and extend shelf life.

MOISTURE CONTROL

The main purpose of moisture control is to lower the water activity of the product, thereby suppressing microbial growth. Control of moisture is important for food preservation. Moisture control agents help control water activity, thus reducing microbial growth; remove melting water from frozen products and blood or fluids from meat products; prevent condensation from fresh produce; and keep the rate of lipid oxidation in check. In most cases, the packaging material itself is responsible for the control of moisture transfer between the internal and external environment, providing an adequate barrier. Desiccants such as silica gels, natural clays and calcium oxide are used with dry foods while internal humidity controllers are used for highly perishable foods.

ETHYLENE ABSORBERS

Ethylene is a natural plant hormone produced by ripening produce. It accelerates produce respiration,
resulting in maturity and senescence. Removing ethylene from a package environment helps extend the shelf life of fresh produce. The use of ethanol as an anti-microbial agent, particularly for surface sterilization and disinfection, is well known. It acts against vegetative cells of microorganisms in high concentrations, and it also has a preserving action in low concentrations. The most common agent of ethylene removal is potassium permanganate, which oxidizes ethylene to acetate and ethanol. The level of ethanol in the packaging headspace depends obviously on the sachet size and on product water activity.

ANTIMICROBIAL

Antimicrobial agent is one of the applications of active packaging. It prevents surface growth of pathogenic microorganisms in food by use of antimicrobial agents where large portion of spoilage and contamination occurs. It allows a controlled release of antimicrobial agents into the food surface during storage and distribution. The classes of antimicrobial agents are Silver ions, Ethyl alcohol, Chlorine dioxide, Organic acids, Spice-based essential oils and Metal oxides. These are all used for reduce the growth rate and maximum population of microorganisms (spoilage and pathogenic) by extending the lag phase of microbes or inactivating them.

INTELLIGENT PACKAGING

Intelligent packaging systems exist to monitor certain aspects of a food product and report information to the consumer. The purpose of the intelligent system could be to improve the quality or value of a product, to provide more convenience, or to provide tamper or theft resistance. Intelligent packaging can report the conditions on the outside of the package, or directly measure the quality of the food product inside the package. In order to measure product quality within the package, there must be direct contact between the food product or headspace and the quality marker. In the end, an intelligent system should help the consumer in the decision making process to extend shelf life, enhance safety, improve quality, provide information, and warn of possible problems. Intelligent packaging is a great tool for monitoring possible abuse that has taken place during the food supply chain. Perhaps intelligent packaging will be able to inform a consumer of an event that occurred such as package tampering that may save their life. Examples include time-temperature indicators (TTIs), ripeness indicators, biosensors, and radio frequency identification. These smart devices may be incorporated in package materials or attached to the inside or outside of a package. However, the U.S. Food and Drug Administration (FDA) recognizes TTIs in the 3rd edition of the Fish and Fisheries Products Hazards and Control Guidance, so their importance may increase in the seafood industry.

APPLICATION OF INTELLIGENT PACKAGING

- Time Temperature Indicators (TTIs)
- Gas Indicators
- Thermo chromic Inks
- Radio Frequency Identification (RFID)
- Leak indicators (CO₂, O₂)
- Pathogen indicators

TIME TEMPERATURE INDICATORS (TTIs)

The intelligent packaging design that is leading the way in packaging technology is the time temperature indicator (TTI). TTI is useful because it can tell the consumer when foods have been temperature abused. If a food is exposed to a
Everyman's Science Vol. LIV No. 3 August-September 2019

higher temperature recommended, quality of food can deteriorate much quicker. A TTI can be placed on shipping containers or individual packages as a small self-adhesive label, and an irreversible change, like a color change, will result when the TTI experiences abusive conditions. TTIs are particularly useful with chilled or frozen foods, where the cold storage during transportation and distribution are important for food quality and safety. TTIs are also used as freshness indicators for estimating the shelf life of perishable products. A TTI technology known as Time strip is currently being employed by Nestle in their food service products in the UK.

THERMO CHROMIC INKS

Inks are available that are temperature sensitive and can change colors based on temperature. These inks can be printed onto packages or labels such that a message can be conveyed to the consumer based on the color of the ink they are seeing. Thermo chromic inks can let a consumer know whether a package is too hot to touch, or cold enough to drink. Thermo chromic inks are becoming a popular technology for beverages. The inks used can be adversely affected by UV light and temperatures over 121°C, so consumers should not fully rely on the inks message when it comes to deciding the proper time to consume a food.

GAS INDICATORS

Food is a complicated material to package because it is capable of respiration and therefore may change its own atmosphere when inside a package. The gas composition within a package can easily change due to the interaction of food with its environment. Gas indicators are a helpful means of monitoring the composition of gases inside a package by producing a change in the color of the indicator through a chemical or enzymatic reaction. The indicators must be in direct contact with the gaseous environment directly surrounding the food in a package. Indicators are capable of signaling whether there is a gas leakage in the package, or they may be used to verify the efficiency of an oxygen scavenger. Oxygen in the air can cause oxidative rancidity, unwanted color changes in foods, and allow aerobic microbes to grow on foods. Oxygen indicators typically result in a color change when oxygen is present, and the presence of oxygen can indicate that the package has a leak or, has been tampered with. Oxygen indicators can also indicate improper sealing of a package. Gas indicators are also being developed to detect water vapor, ethanol, and hydrogen sulfide.

RADIO FREQUENCY IDENTIFICATION (RFID)

Radio Frequency Identification (RFID) tags are an advanced form of data information carrier that can identify and trace a product. They are currently used for tracking expensive items and livestock. In a typical system, a reader emits a radio signal to capture data from an RFID tag. The data is then passed to a computer for analysis. RFID tags contain a microchip connected to a tiny antenna. This allows for the tags to be read for a range of 100 feet or more in more expensive tags, to 15 feet in less expensive tags. The RFID tag could offer much more than a conventional barcode. In contrast to a barcode, RFID does not need to be in a direct line of sight to be recognized by a scanner. RFID tags could also store information such as temperature and relative humidity data, nutritional information and cooking instructions. They could be integrated with a time temperature indicator or a biosensor to carry time temperature information or microbiological data. RFID technology in the food system is still in the early stages. Simple applications like tracking and identification are the focus of
most food science matters, and these must be perfected before more complex applications can come to light.

LEAK INDICATORS (CO₂, O₂)

A leak indicator gives information on the package integrity throughout the whole distribution chain which attached into the package. The indicator can be formulated as a label, a printed layer, a tablet, or it may also be laminated in a polymer film. The leak indicators are used in modified atmosphere packaging which is classified as active packaging method. In these cases MAP, the atmosphere consists of a lowered concentration of O₂ and a heightened concentration of CO₂. A leak in MAP means a considerable increase in the O₂ concentration and a decrease in the CO₂ concentration, which in turn, enable aerobic microbial growth to take place. Thus, the leak indicators for MAPs are much more than active packaging, since they become smart packaging and they should rely on the detection of O₂ rather than on the detection of CO₂. Internal gas-level indicators are placed into the package to monitor the inside atmosphere. Oxygen indicators interact with oxygen penetrating the package through leakages to ensure that oxygen absorbers are functioning properly. When oxygen is absent in the headspace (>0.1%), the indicator displays a pink color. When oxygen is present (<0.5%), it turns blue. A typical oxygen indicator consists of a redox-dye (such as methylene blue), an alkaline compound (such as sodium hydroxide, potassium hydroxide) and a reducing compound (such as reducing sugars). Carbon dioxide indicators are also used in modified atmosphere packages (MAP) in which high carbon dioxide levels are desired. The indicators display the desired concentrations of carbon dioxide inside the package.

PATHOGEN INDICATORS

Very important in food chain is monitoring and detection of a certain pathogen microorganism which can cause various diseases endangering of humane health. Commercially available Toxin Guard by Toxin Alert Inc. (Ontario, Canada) is a system to build polyethylene-based packaging material, which is able to detect the presence of pathogenic bacteria (Salmonella sp., Campylobacter sp., Escherichia coli O157 and Listeria sp.) with the aid of immobilized antibodies. As the analyte (toxin, microorganism) is in contact with the material it will be bound first to a specific, labeled antibody and then to a capturing antibody printed as a certain pattern. The method could also be applied for the detection of pesticide residues or proteins resulting from genetic modifications. Another example of microbial indicators for the detection of specific microorganisms like Salmonella sp., Listeria sp. and E. coli is Food Sentinel System. This system is also based on immunochemical reaction, the reaction taking place in a bar code. Specific indicator material for the detection of Escherichia coli O157 enterotoxin has been developed at Lawrence Berkeley National Laboratory. This sensor material, which can be incorporated in the packaging material, is composed of cross polymerized polydiacetylene molecules and has a deep blue color.

CONCLUSIONS

The new advances have mostly focused on delaying oxidation and controlling moisture migration, microbial growth, respiration rates, and volatile flavors and aromas. New packaging technology of active and intelligent packaging is very helpful of consumer to indicate the quality of food. A modern quality and safety assurance system should prevent contamination through the monitoring, recording, and controlling of critical parameters such as temperature during a food product’s entire life.
cycle. The advancement of electronic devices that can be made cheaply will also help drive the innovate direction of active and intelligent packaging. As society continues to advance, the expectations of the consumer will continue to advance. The use of active and intelligent packaging will likely become more popular as more technologies make their way to the market, innovate packaging in active and intelligent systems will become more common place. Perhaps active and intelligent packaging will completely replace traditional packaging itself.

REFERENCES


The brain is highly susceptible to oxidative damage because of its high metabolic load and its abundance of oxidizable material. Particular nutrients influence cognition abilities protecting the brain from damage, and counteracting the effects of aging. The present review focuses on the implementation of particular nutrients to design novel treatment of various mental disorders.

INTRODUCTION

Global dietary patterns are increasingly characterized by greater intake of high caloric sugar sweeteners, salt, animal fats, and edible oils. Meanwhile, energy expenditure is being reduced at work, at home, and during leisure activities, affecting all age groups. Despite the acute urgency of the problem, we still have much to learn about how these risk factors contribute to chronic diseases, and how to reverse the trend.

In recent years, research shows that nutrition and diet can affect cognitive performance both positively and negatively, and that environmental and cognitive enrichment can modulate the effects of nutrition and diet\(^1\). In addition to protecting heart disease and cancer, a balanced diet and regular exercise can also protect the brain and ward off mental disorders. Factors that have a positive effect on cognition include antioxidants, anti-inflammatory agents, and estrogens. Due to a high rate of oxygen metabolism, the brain accumulates oxidative damage with age. Many practical questions regarding the design of diets to improve brain function that constitute healthy brain food remain to be answered. But we are beginning to uncover the basic principles that are involved in the actions of foods on the brain. We now know that particular nutrients influence cognition by acting on molecular systems or cellular processes that are vital for maintaining cognitive function. This raises the exciting possibility that dietary manipulations are a viable strategy for enhancing cognitive abilities protecting the brain from damage, promoting repair and counteracting the effects of aging\(^1\). This knowledge can design novel treatments for mental and neurological disorders. Understanding the molecular basis of the effects of food on cognition will help us to determine how best to manipulate diet in order to increase the resistance of neurons to insults and promote mental fitness.

CAUSES

Oxygen makes life possible, but it can also take life away. Each of our hundred-billion brain cells uses oxygen to stoke the fires of consciousness. Highly-reactive forms of oxygen called free radicals create chemical reactions that damage brain cells. If free radicals get out of control, cells will be damaged faster than they can be repaired. Free radicals cause damage to brain cells by taking...
electrons from the body’s healthy molecules to balance themselves. The body can usually handle a small amount of free radicals, but when the number of free radicals becomes excessive, and then the danger sets in. A large amount of free radicals leads to even more free radicals, and this excessive free radical formation damages cells and tissues. When this oxidative damage affects our brain the effect sneaks up slowly, and ever so quietly steals away a person’s memory and personality, eventually eroding his ability to even take care of himself.

The brain uses most oxygen and produces most energy of any part of body, and thus it is highly susceptible to oxidative stress. Oxidative stress is inflammation caused by uncontrolled free radicals. Free radicals can propagate throughout the cell, damaging the cell and even lead to cell death. Although Cells have their own antioxidant defences enzymes to process the free radicals, but they are not 100% efficient and we must use dietary antioxidants to process the rest. The brain’s antioxidant defences becoming overwhelmed is one of the main mechanisms of brain aging, and this has been linked to neurodegenerative diseases such as Parkinson’s, Alzheimer’s, dementia, schizophrenia, autism, stroke and many other\(^2\). Thus, a healthy, antioxidant rich diet is especially beneficial for the brain and is likely involved in the association between plant food consumption and higher IQ scores. Having learnt about antioxidants and aging as well as the role of anti oxidants and free radicals, would help in understanding the magic of antioxidants more clearly.

**LIST OF DISEASES CAUSED BY POOR NUTRITION**

- Dementia
- Attention deficit disorder in children
- Schizophrenia
- Depression
- Bipolar disorder
- Type III diabetes
- Alzheimer’s Disease
- Epilepsy
- Multiple Sclerosis
- Parkinson’s Disease
- Stroke
- Autism
- Meningitis

**Today’s Lifestyle Challenges**

- Fast paced lifestyle
- Eating on the run
- Missing/ skipping of meals
- No time for Exercise
- Smoking & alcohol consumption
- Stress & anxiety
- Environmental concerns
- Medication
- High intake of caffeine beverages

**Exposure of heavy metals**

Out of 35 metals that concern us because of occupational or residential exposure; 23 of these are the heavy elements or “heavy metals”: antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese, mercury, nickel, platinum, silver, uranium, vanadium, zinc and tin. Interestingly, small amounts of these elements are common in our environment and diet and are actually necessary for good health, but large amounts of any of them may cause acute or chronic toxicity (poisoning). The numbers of people are at risk for neurodegenerative disorders, which are progressively increasing as the result of an ever-aging population and an escalation of poor diets and lifestyles, but effective treatments and approaches for primary prevention are lacking.

Neurodegeneration can be found in many different levels of neuronal circuitry ranging from
molecular to systemic. Mitochondrial DNA mutations as well as oxidative stress both contribute to aging.

THE MOST IMPORTANT FACTOR FOR MAINTAINING GOOD HEALTH

- +ve Mental Attitude
- Daily Exercise
- Adequate Rest and
- Good Nutrition

Lack of these factors may cause Hypertension, Diabetes, Obesity, Heart disease and brain disorder.

Today’s meal...
- Lack of vitamins and minerals
- Lack of fiber
- High amounts of fat and cholesterol
- Empty calories
- Free radicals which damage the heart, lungs, skin, brain and tissues.

In this scenario health is our daily concern.

How can we save ourselves through diet?

Antioxidant levels diminish with age, therefore the aging brain appears to be an easy target for oxidative damage. This underscores the importance of getting enough antioxidants through diet and supplements. There are many natural foods that have antioxidant nutrients to fight off aging. Although it is good to make a habit of having anti oxidant diet which includes natural rich anti oxidant food sources, good antioxidant supplements too provide an option for people who could not do so. Our body naturally circulates many nutrients creating antioxidant enzymes which control the free radicals and their chain reactions. Numerous studies have found that there might be an association between abnormal metabolism (diabetes type II, obesity and metabolic syndrome) and psychiatric disorders. In a large study of patients with manic depression or schizophrenia, the rate of diabetes was found to be higher than in the general population.

This is a fact that without optimum levels of micronutrients, the right levels of antioxidation activity can’t be achieved. The right amount of micronutrients and antioxidation activity, on the other hand, provide our body the capacity to resist age related deterioration.

Vitamin C is the most prevalent antioxidant nutrients. They are the most popular anti oxidant vitamins. Vitamin C supplements can enhance memory, IQ and other mental functions in the body as it is involved in making neurotransmitters which affects mood. Vitamin C neutralizes free radicals that damage DNA and other cellular structures. Although vitamin C is not solely responsible for the increased longevity, it is a marker for a diet high in fruits and vegetables.

![Fig. 1: Free radical chain reaction breaks cell membrane and creates many problems. Antioxidants donate an electron to free radical and prevent from damage.](image)

Vitamin E - a crucial brain protector since the brain is composed mostly of fat. One molecule of vitamin E can protect 200 fatty acid molecules from free radical damage, thereby helping brain cells remain functionally healthy for a longer life. Seeds, nuts, and soybeans – and their unrefined...
expeller pressed oils have the highest concentrations of vitamin E. Significant quantities are found in brown rice, oats, fresh wheat germ, and in eggs from free-range chickens. Smaller concentrations occur in dark green leafy vegetables, brussels sprouts, and broccoli.

Folic acid (also known as folate, vitamin B9, vitamin B6 (or folacin), pteroyl-L-glutamic acid, pteroyl-L-glutamate are forms of water soluble vitamin B9.

Folic acid is itself not biologically active, but its biological importance is due to tetrahydrofolate and other derivatives after its conversion to dihydrofolic acid in the liver. Recent studies have shown that moderate calorie restriction and increased folic acid consumption improves mental health. Folic acid, found in foods like spinach and oranges, has been shown to reduce age related decline in cognitive function, and can enhance the effects of anti-depressant medications. The results of a recent randomized clinical trial indicate that a three-year folic acid supplementation can help reduce the age-related decline in cognitive function.

**Omega-3 fatty acids** — found in Fish (salmon), flax seeds, krill, chia, kiwi fruit, butternuts, walnuts provide many benefits, including improving learning and memory and helping to fight against such mental disorders as depression and mood disorders\(^7\) schizophrenia, and dementia. Dietary deficiency of omega-3 fatty acids in humans has been associated with increased risk of several mental disorders, including attention-deficit disorder, dyslexia, dementia, depression, bipolar disorder, Alzheimer\(^8\) and schizophrenia.

**Coenzyme Q10** is very effective in the protection of brain against oxidative damages that is often linked to a number of brain diseases. Although Coenzyme Q10 is available in milk, cheese and beef, the amount of coQ 10 required by the brain is more than one may get from food sources. So, supplementation of coQ10 is ideal in such conditions. Coenzyme Q10 is very effective in the protection of brain against oxidative damages that is often linked to a number of brain diseases. Although Coenzyme Q10 is available in milk, cheese and beef, the amount of CoQ 10 required by the brain is more than one may get from food sources. So supplementation of coq10 is ideal in such condition.\(^9\)

**Ginkgo leaves**- contain potent proanthocyanidins that protect cerebral blood vessel walls by neutralizing free radicals. Ginkgo is particularly effective in quenching the super-oxide anion and hydroxyl free radicals.

**Curcumin**— is a powerful antioxidant and anti-inflammatory compound found in the curry spice turmeric, which has a long history of dietary and medicinal use in India.

**Selenium: A Boost to Vitamin E** Selenium is also one of the most powerful detoxifiers of heavy metals that damage the brain and other organs. Selenium binds to mercury, lead, arsenic, and cadmium, which all disrupt brain chemistry by displacing important minerals like iron, zinc, and copper. Selenium is able to “chelate” these metals – a word derived from Greek word for “claw.” In a sense, selenium grabs hold of these molecules and removes them from brain cells.

**Vitamin B1** is necessary for proper functioning of the nervous system and good mental health. It is needed to convert glucose into brain energy, and is required to create myelin.

**Vitamin B** is beneficial to the body as it helps to keep the brain healthy. It helps increase the RBC’s carrying oxygen to the grey matter of the brain resulting in increased memory. In general brain supplements should contain some form of Vitamin B\(_1\), B\(_2\), B\(_3\), B\(_5\), B\(_6\), and B\(_12\) to help improve proper functioning of the brain. Vitamin B\(_1\)
is known to minimize the progression of Alzheimer’s disease. Vitamin B₆ is known to improve the condition of people suffering from Parkinson’s, Alzheimer’s or depression. Vitamin B₁₂ is necessary for proper nerve functioning as its deficiency has been linked to variety of brain disorders including normal cognitive decline. Caffeine, alcohol, or excessive consumption of sugar can deplete your body’s store of B vitamins more rapidly, as can smoking or the use of prescription drugs. B vitamins are water-soluble and are not retained too long in the body.

**Magnesium**—When magnesium is chronically deficient or depleted, then brain metabolism and power suffer. Several factors contribute to the lack of magnesium in our diet. Our brain needs magnesium to build the protective myelin sheaths that insulate the nerve fibres which network your nervous system. Magnesium is an important brain nutrient because it protects the brain from neurotoxins. A single food will not meet your daily magnesium needs. A variety of fruits, vegetables, and grains can supply your magnesium requirements as well as make for a more delectable menu. Nuts, seeds, dark leafy greens, and whole grains have magnesium, but most other foods have little, "Cooked and processed foods also lose a lot of magnesium making it a very deficient mineral."

Diet that has fish, poultry, nuts, and certain fruits and vegetables may reduce the risk of Alzheimer’s disease. People least likely to develop the disease eat more olive oil-based salad dressing, nuts, fish, tomatoes, poultry, cruciferous vegetables such as broccoli, fruits, and dark and green leafy vegetables.

**REFERENCES**

The Central Institute for Cotton Research (CICR) is a premier institution of cotton research in India under the aegis of Indian Council of Agricultural Research (ICAR), New Delhi. It was established in 1976 with headquarters at Nagpur (Maharashtra) and two Regional Stations at Coimbatore (Tamil Nadu) and Sirsa (Haryana). The institute has a 425 acre research farm at Nagpur, 55 acre farm at its regional station Sirsa and 88 acre farm at regional station Coimbatore.

The institute has a major mandate to conduct basic and strategic research for cotton improvement in the country. Over the years, CICR has emerged as a leader in science and technologies through its significant scientific contributions that lead to the spectacular progress of cotton production through public private partnerships. The role of CICR in solving various problems confronting cotton production in the country is widely acknowledged through the awards received by the institute.

CICR has close collaborative linkages with ICAC (International Cotton Advisory Committee, Washington), ICGEB, ICRISAT, CIRCOT, IARI, NBRI, NCL, PPV&FRA, NBA, DBT, DST, RCGM, GEAC, Ministry of Environment and Forest, APEDA, NHB, DAC and DCD (Directorate of Cotton Development), seed industry and the pesticide industry. The institute has close linkages with Agricultural Universities located in the cotton growing regions of the country through its All India Coordinated Research Project on Cotton. The Central Institute for Cotton Research takes pride in
the four international patents in South Africa, China, Uzbekistan and Mexico, several Indian patent applications, significant technologies that were disseminated to lakhs of farmers and the large number of training programmes conducted on different aspects of cotton production for Indian and foreign scientists/extension personnel.

The institute has been recognized all over the world for its outstanding work on plant breeding, crop improvement, crop production technologies, development of Bt-cotton, development of immunological diagnostic kits, basic research on insect resistance to insecticides. Cry toxins and xenobiotics, development and dissemination of IRM (Insecticide Resistance Management) and IPM (Integrated Pest Management) technologies for conventional and Bt-cotton. A few notable achievements of the institute are listed below:

- The institute partnered in the ‘International Cotton Genome Initiative ICGI’ programs and has contributed to the development of cotton genome - published in the world’s leading journal ‘Nature’.

- The institute is widely acknowledged for its basic research that led to the development of several processes, products, technologies and pre-breeding advanced genetic stocks that are either highly adaptable to biotic and abiotic stress or excellent in fiber quality attributes. Recently a new G. arboreum genetic stock was developed with the highest ever fiber strength of 29 g/tex.

- The CICR varieties, LRA 5166, LRK 516, Surabhi, Suraj and many others possess excellent adaptability characteristics and are being commonly utilized in majority of the highly adaptive commercial private hybrids that are grown across the country. LRA 5166 LRK 516 Surabhi Suraj.

- CICR has developed and released 30 improved genotypes including twelve varieties of Gossypium hirsutum (MCU 5 VT, LRA 5166, Supriya, Kanchana, Anjali, CNH 36, Arogya, Surabhi, Sumangala, CNH 120 MB, Suraj, CNHO 12, CSH 3129 and CCH 2623), Three varieties of G. arboreum (CISA 310, CISA 614 and CNA 1003 (Rojâ)), one 14 Indian Council of Agricultural Research variety of G. barbadense (Suvin), nine intra- hirsutum hybrids (Savitha, Suguna, Surya, Kirthi, Omshankar, CSHH 198, CSHH 238, CSHH 243 and CSHG 1862), two interspecific (G. hirsutum x G. barbadense) hybrids (HB 224 and Shruthi) and one intra-arboreum hybrid (CISA 2).

  - The World’s best extra-long staple variety ‘Suvin’ was developed by CICR.

  - The recent variety Suraj has excellent fibre quality (length 31.7 mm, strength 25.9 g/tex with 3.8 mic) and is now being promoted for High Density Planting Systems (HDPS).

  - Forty (40) genetic stocks (G. hirsutum – 24, G. arboreum – 10 and Introgressed - 6) have been registered for their unique, novel and distinct characteristics. These would serve to generate important cotton genotypes with economically important traits and unique morphological markers.

  - The institute has one of the world’s largest germplasm collections of 11,345 belonging to four species of cotton (G. hirsutum-8265, G. barbadense-305, G. arboreum-1936 and G. herbaceum-565) besides a number of land races (Hirsutum-7, Barbadense-1, Arboreum-6 and Herbaceum-1), wild species (26), interspecific derivatives (40) and perennials (193). These serve as valuable resources of biodiversity with innumerable economically important traits.

  - To reduce the cost of hybrid seed production, a Thermosensitive Genetic Male Sterile line (TGMS 1-1) was identified and characterized in desiccotton (G. arboreum). It produces completely fertile male flowers at minimum temperature of less than 18°C and produces completely sterile male flowers at
minimum temperature more than 24°C with continuous good sunshine. Complete male sterility could be obtained only during summer flowering (i.e. month of May) for consecutive four years. This line could be successfully employed for hybrid seed production in summer with 30% boll setting efficiency.

- Several other innovative aspects of useful research include the discovery of apomixes trait, cleistogamy, temperature sensitive male sterility and five-loculed genotypes. Under the Diversification and utilization of male sterility system, 82 genotypes were converted under CMS background, 66 genotypes were converted under GMS background. 12 GMS based hybrids were found to be promising in multi-location trials.

- CICR developed, patented and commercialized ‘farmer-usable’ kits to detect Bt cotton. The kits are being used on a large scale by farmers and seed testing agencies in the country since 2002 to curb the spread of illegal and spurious Bt cotton seeds.

- The institute has developed ‘PCR based Kits’ to detect various pathogens including the dreaded cotton leaf curl virus.

- Over the past few years, the institute has been successfully promoting Desi cotton varieties which require low production cost for high yields to enhance sustainability in the Melghat tribal tract of Amravati District of Vidarbha. The programmes have become very popular with increased adoption levels and generated new hopes to cotton farmers in the region.

- The institute is known for its pioneering work on fundamental research on insect resistance to insecticides and Bt toxins. Scientists of the institute developed stochastic models and developed IRM (Insecticide Resistance Management) strategies for the country. The institute provided leadership for national dissemination of the IRM and IPM (Integrated Pest Management) technologies for conventional and Bt-cotton.

- Recently, three novel lectins have been identified by the institute as promising candidate genes for the control of sap-sucking insect pests (aphids, leaf hoppers, and whiteflies).

- Two new bio-pesticide formulations, mealy-kill and mealy-quit were developed for the control of mealybugs and sucking pests.

- New Bt genes were designed indigenously, synthesized into gene constructs and are being used in the genetic transformation of cotton. The institute has developed several other transgenic events with Bt genes in G. hirsutum cotton. The institute played a stellar role in supporting research for the introduction and popularization of Bt-cotton in India.

- The institute developed several package of practices, poly-mulchtechniques, multi-tier cropping systems, innovative inter-cropping Indian Council of Agricultural Research systems, and several other crop production strategies to optimize input use and maximize benefits from Bt-cotton.

- The institute developed and demonstrated a new concept of ‘High Density Planting Systems’ (HDPS) that has potential to improve yields of rainfed cotton, especially in Maharashtra, Madhya Pradesh and Andhra Pradesh. More than 5000 one acre frontline demonstration trials were conducted with HDPS over three years. Results showed that the productivity of cotton in HDPS with straight varieties was found to be a viable option to improve the Multi-tier cropping system Inter-cropping system High Density Planting Systems (HDPS) field view productivity of cotton particularly under rainfed conditions at reduced production costs.

- The institute has developed many implements and devices and has filed patent applications for
‘solar powered knapsack sprayer’ and ‘bullcok drawn planter’ that have been developed and commercialized.

- CICR has recently established a ‘voice-mail’ weekly advisory system called ‘e-kapas’ network to connect 100,000 farmers for technology dissemination and backstopping. Advisories and alert services are being issued to the registered cotton growers in 8 local languages so as to enable them initiate proactive measures.

- The institute has won national and international awards for its outstanding work in development and dissemination of IRM strategies in about 200,000 hectares in 30 districts of nine cotton growing states in fields of about 90,000 farmers, resulting in net financial benefit of 500 million per year due to 50-60% reduction in pesticide use and enhanced yields.

- Recently the Central Institute for Cotton Research, Nagpur was conferred the ‘National Award 2014- Best Research Institute – Krishi Sansthan Samman’ by Mahindra Samriddhi India Agri Awards 2014.

- CICR hosted ‘KrishiVasant 9-13 February 2014’, the country’s biggest ever Agricultural Exposition in which an estimated 8 to 10 lakh farmers attended from all across India.

- In addition to the research programmes, the Institute is engaged in first line transfer of technology. These include Frontline demonstration (FLD), On-Campus/Off-Campus demonstrations, Seed Village Programme and IPM/IRM demonstrations. Farmer-Scientist Interaction programmes are organized periodically for enabling in-depth interaction between farmers and researchers.

- The Institute undertakes regular technical training programmes for 2-8 weeks for specialists and on-farm training courses for cotton growers usually of one to two days duration. The Govt. of India recognized the institute as the centre for conducting National/Model Training Courses on Cotton Production Technology. More than 1500 senior level extension functionaries belonging to all major cotton growing states of the country have been trained in these mediums to long-term programmes. In addition, the institute undertakes short term sponsored training programmes by the State governments, NGO’s private companies/corporations and other organizations. Periodic International training programmes are also organized for cotton professionals from other cotton growing countries of Africa and south and south-east Asia such as Vietnam, Myanmar, Indonesia, Sri Lanka, Bangladesh etc.

Contact:
Director
AR-Central Institute for Cotton Research
P.B.No.2, Shankarnagar P.O., Nagpur-440010 Maharashtra
Phone :710-3275536, 0710-3275617 0710-3275637 0710-3277529(F)
www.cicr.org.in
GEOSPATIAL CONCLAVE, 13–14 JANUARY 2020, A.B. CENTENARY HALL, KOLKATA

Theme
Application of Geospatial Technology in Water Resource Management

Sub themes:
1. Morphological Analysis.
2. Climate Change and Predictions.
3. Hazard and Disaster Management.
4. Natural Resource Management
5. Landuse, Planning and Urban Management.
6. GIS in Socio-Economic and Cultural Issues.
8. Advancement in Geo-Spatial Techniques.
9. Geospatial Techniques in Smart Agriculture

Contact:
SAIARD, 58, R.K.Sarani, P.O.-Behala, Kolkata-60; 6289169916, 8777433044; saiardkolkata@gmail.com; www.saiard.co.in

INTERNATIONAL CONFERENCE ON OBSERVING THE FIRST BILLION YEARS OF THE UNIVERSE USING NEXT GENERATION TELESCOPES, 20–24 JAN 2020 • INDORE, INDIA

Topics:
- Reionization of hydrogen and helium
- First sources of light
- Updates on 21-cm experiments
- Updates on X-ray, UV, IR experiments
- Obstacles in the observations
- Modelling and simulations of the first billion years
- Cosmology via intensity mapping of 21-cm and signals in other wavelengths
- Cross-correlation and other synergy studies between observations in 21-cm and other wavelengths
- Constraints on dark matter/dark energy
- Statistical estimators of the expected signals and statistical inference tools

Contact:
Suman Majumdar, Discipline of Astronomy, Astrophysics and Space Engineering (DAASE), Indian Institute of Technology Indore, Khandwa Road, Simrol, Indore-453552 firstbillion@iiti.ac.in, firstbillion.iiti@gmail.com
NCFMP2020—2ND NATIONAL CONFERENCE ON FRONTIERS IN MODERN PHYSICS 2020, 06-07 FEB 2020, KOLKATA, INDIA

Topics:
- Material Science,
- Synthesis and Characterization of Materials,
- Materials under extreme conditions, Device Modeling and Simulation,
- Theoretical and Computational Physics,
- Biophysics and Applications,
- Particle Physics,
- Plasma Physics,
- Bio-Medical Instrumentation, Electronics,
- Computational Fluid Dynamics,
- Mathematical Modeling

Contact:
Dr. Swarup Kumar Neogi, Organising Secretary, Department of Physics, Adamas University, Barasat – Barrackpore Road, P.O. – Jagannathpur, District – 24 Parganas (North), Kolkata-700 126, West Bengal, Tel: 91-9830826794 Phone: 9830 224 321; Email: auncfmp@gmail.com

BIOSANGAM 2020 — INTERNATIONAL CONFERENCE ON BIOTECHNOLOGICAL INTERVENTIONS FOR SOCIETAL DEVELOPMENT, 21-23 FEB 2020, PRAYAGRAJ, INDIA

Topics:
- Agricultural Biotechnology
- Biotechnological Product and Process Development,
- Environmental Biotechnology,
- Healthcare and Pharmaceutical Biotechnology,
- Interdisciplinary Research, Design, Innovations and IPR,
- OMICS and Computational Biology

Contact:
Dr. Nand Kumar Singh, Chairman Department of Biotechnology Motilal Nehru National Institute of Technology Allahabad Prayagraj-211004 (UP) India, Phone: +91-532-2271231 (O); Mob.: +917070377440 +91-9794049630 Fax: +91-532-2545341, mnnit@biosangam.com
INTERNATIONAL CONFERENCE ON MANAGEMENT AND RECYCLING OF METALLURGICAL WASTE, INDIAN INSTITUTE OF TECHNOLOGY (BHU) VARANASI, 22-23 FEB 2020.

Topics:
- Process wastes: Mineral processing, waste, sludges, residues etc
- Metallurgical wastes: slags, dross, dusts, fumes and leach residues
- Hazardous metallurgical wastes
- Electronic wastes
- Battery wastes
- Metal recycling: Ferrous, Non-ferrous, Precious metals
- Fly ash: management and mitigation
- Recycling and Recovery methodology: Physical, mechanical and Chemical
- Purification and separation techniques
- Other wastes: Rubber, paper and plastics recycling
- Green energy derived from waste
- Miscellaneous fabrication wastes
- Waste Management
- Environmental concerns in recycling

Contact:
Convener, MetWaste-2020, Department of Metallurgical Engineering, Indian Institute of Technology (Banaras Hindu University), Varanasi, Uttar Pradesh, INDIA-221005, email: metwaste2020@gmail.com, website: www.metwaste.iitbhu.ac.in

9TH ANNUAL CONFERENCE OF THE NEUROLOGICAL SURGEONS’ SOCIETY OF INDIA, 27-29 FEBRUARY, 2020, BISWA BANGLA CONVENTION CENTRE, KOLKATA.

Contact:
Conference Secretariat, Dr. Dibyendu Kumar Ray, Senior Consultant, Neurosurgeon, AMRI, Saltlake, Kolkata, Organising Secretary, NSSICON 2020, M : +91 98830 93698
S&T ACROSS THE WORLD

IMPROVING ELECTRICAL GRIDS COULD HELP PROTECT THE CLIMATE

Preventing losses of electricity as it travels from the source to where it’s used could cut greenhouse gas emissions by half a billion metric tons a year. Climate change discussions tend to focus on how electricity is produced. But much of the world’s electricity is lost before it ever reaches people’s homes or businesses, according to researchers Sarah Jordaan and Kavita Surana.

In a new study, Jordaan and Surana estimate that energy lost in the grid results in the release of nearly a billion tons of extra carbon dioxide equivalents into Earth’s atmosphere each year. That number, they say, could potentially be cut in half — a reduction that’s roughly the equivalent of eliminating all greenhouse gas production from the United Kingdom.

“Ensuring that we have a more efficient grid is extremely important,” said Jordaan, an energy systems scientist at Johns Hopkins University’s Washington, D.C. campus. “It’s something that all countries should really be thinking through more seriously in moving towards a lower carbon future.”

The researchers analyzed 142 countries, representing the vast majority of electricity produced in the world. For each country, they had data from the International Energy Agency on the total amount of electricity lost in the power grid in 2016, plus a breakdown of the sources such as coal and solar that had produced each country’s power. They also used published data on how much greenhouse gas is typically produced by each type of power generation.

Combining these data to come up with estimates of potential greenhouse gas savings was no easy task. For one thing, the available data lumps together two very different ways in which electricity can be “lost” in the grid. One way is through mechanical inefficiencies, also known as technical losses — for example, when the resistance of wires causes electricity to escape as heat. The other way is when electricity is used but not paid for.

From a greenhouse gas perspective, technical losses are a bigger problem, because every kilowatt-hour that’s wasted as heat must be made up for through increased production. Any effects from pilfering would be smaller and less direct, since the stolen electricity is still being used and thus reducing overall demand. Still, the researchers argue that pilfering can also result in excess greenhouse gas emissions, since people are less likely to conserve power when they are not paying for it. For example, in the African island country of Comoros, past research suggests that the use of formerly pilfered power drops by one-third once people are forced to pay.

Pilferage doesn’t necessarily mean that people are surreptitiously stealing power by tampering with machinery, noted Robert Stoner, the deputy director for science and technology at the MIT Energy Initiative. In developing nations, it’s not uncommon for people and even government agencies to refuse to pay their bills, often in protest over unreliable service.

To separate the technical losses from pilfering, the researchers extrapolated from the few locations where past research has examined grid losses in more detail. Most developed countries lose about 5% to 6% of the electricity they produce, primarily from technical losses, although Singapore has achieved the most efficient grid in the world with losses of just 2%. In developing nations, the losses
are often much higher, and they are dominated by pilferage, according to the researchers. The highest losses are seen in countries suffering from conflict or natural disasters — for example, Haiti and Iraq both lost more than half their power in 2016.

The new analysis suggests that technical losses and pilferage together result in an additional 949 million metric tons of CO₂ equivalents being released into the atmosphere each year. That number could potentially be reduced by about 411 million tons per year by improving grid infrastructure to reduce technical losses. For example, utility companies could replace old transformers with more efficient models, and they could work to create more distributed power systems so the electricity doesn’t have to travel as far, said Surana, a public policy researcher at the University of Maryland in College Park.

If power companies manage to prevent pilfering in addition to reducing technical losses, the researchers estimate that emissions could be reduced by an additional 133 million metric tons of CO₂ equivalents per year, for a total savings of 544 metric tons.

It may seem that developing nations are the place to focus grid improvement efforts, since they lose a greater fraction of their power. But developed nations like the U.S. and China produce far more greenhouse gas emissions overall, so relatively minor improvements to their grids can make a big difference to the climate. For example, the U.S. lost about 6% of its power in 2016. The study suggests that by reducing those losses to 3.2%, Americans could cut their greenhouse gas emissions by about 29 million metric tons per year — more than the total yearly emissions of Lebanon.

The authors believe their estimates are conservative, and the true global savings could be even larger. But MIT’s Stoner, who was not involved in the research, said he thought they were more likely to be overestimates. “These are sort of very broad-strokes estimates based on some very simple assumptions, which I would characterize as back of the envelope almost, and certainly likely to be on the upper end of what is really realizable,” said Stoner.

Despite the uncertainties, Anders Arvesen, a researcher who conducts life cycle assessments of electrical systems at the Norwegian University of Science and Technology, called the study a “timely contribution.” He was one of the independent peer reviewers for the study, which was published last month in the journal Nature Climate Change.

“It is a crude estimate, but it is the first estimate of this kind,” said Arvesen. “I think [the study] shows that the electricity grid losses are important on a scale that is relevant for global climate assessments and discussions.”

There are already efforts underway to improve grid infrastructure. For example, the U.S. Department of Energy is working on an ambitious Grid Modernization Initiative, and India has been working on its own initiative, called the National Smart Grid Mission, since 2016.

Nevertheless, the study authors don’t think policymakers fully appreciate the potential of power grids to combat climate change. In the greenhouse gas mitigation strategies submitted as part of the Paris Agreement, only 32 countries mentioned electrical grid efficiency, while 110 countries mentioned renewable energy.

“When we started, we thought this would be an obvious thing to do. But we were surprised that it wasn’t,” said Surana. “I think it’s largely overlooked.”

Of course, noted Jordaan, the most important thing is still to move away from fossil fuels and toward renewable energy sources. But in the fight to avert climate change, grid improvements may be another
weapon in the arsenal — one we can’t afford to ignore.

Source: https://www.insidescience.org/news/ by Nala Rogers

**HOW DIET CHANGED LANGUAGE**

Eating softer processed foods changed the position of humans’ adult teeth, making it easier to say sounds like “f” and “v,” new research suggests.

(Inside Science) — What you eat may influence what sounds your language regularly uses, a new study finds. In a sense, eating soft foods like fava beans helped humans say words like “fava beans,” researchers said.

More than 2,000 different sounds exist across the roughly 7,000 to 8,000 languages that humans speak today, from ubiquitous cardinal vowels such as “a” and “i” to the rare click consonants found in southern Africa. Scientists had long thought this range of sounds was fixed in human biology since at least the emergence of our species about 300,000 years ago.

However, in 1985, linguist Charles Hockett noted that labiodentals — sounds produced by positioning the lower lip against the upper teeth, including “f” and “v” — are overwhelmingly absent in languages whose speakers are hunter-gatherers. He suggested tough foods associated with such diets favored bites where teeth met edge on edge, and that people with such teeth would find it difficult to pronounce labiodentals, which are nowadays found in nearly half the world’s languages.

As is true for most children today, our ancestors generally grew up with upper teeth jutting over and protruding in front of lower teeth — overbite and overjet, respectively. Paleontological evidence suggested that in the past, the wear and tear from tough foods could lead overbites and overjets to fade after adolescence, resulting in edge-on-edge bites. However, overbites and overjets now often last long into adulthood because the rise of practices such as cooking and milling led to softer diets.

To explore Hockett’s idea further, researchers developed computer models of the human skull, teeth and jaw in overbite, overjet and edge-on-edge bite configurations. They next analyzed the amount of effort these configurations needed to pronounce certain labiodental sounds. They thought Hockett’s suggestion “was bizarre, unlikely but ultimately fascinating, so we set out to test whether we could find such a link,” said study co-lead author Damian Blasi at the University of Zurich in Switzerland.

The scientists found that overbites and overjets required 29 percent less muscular effort to produce labiodental sounds than edge-on-edge bites. In addition, overbites and overjets made it easier to accidentally mispronounce bilabial sounds such as “m,” “w” or “p,” which are made by placing the lips together, as labiodental ones.

“This shows how the shift in one cultural behavior, such as how food is produced, can have dramatic and far reaching consequences on our biology and our linguistic behavior,” said evolutionary morphologist Noreen von Cramon-Taubadel at the University at Buffalo in New York, who did not take part in this research.

In addition, the researchers discovered hunter-gatherer societies only have about 27 percent the number of labiodentals found in agricultural societies. Moreover, when they focused on the Indo-European language family — which stretches from Iceland to the eastern Indian state of Assam and has records stretching back more than 2,500 years on how sounds in some of its languages were pronounced — they found the use of labiodentals increased steadily following the development of agriculture. All in all, they estimated that labiodentals only had
a 3 percent chance of existing in the Indo-European proto-language that emerged about 6,000 to 8,000 years ago but are now found in 76 percent of the family’s languages.

“It is often assumed that the structure and the processes we see in languages today were the same as 10,000 years ago,” Blasi said. “Now we have a very strong case to think that there are some global and very frequent linguistic phenomena that are surprisingly recent in times of human history.”

Although the researchers suggest that overbite and overjet make it easier to produce labiodentals, “that doesn’t mean that labiodentals will emerge within all languages,” said study co-lead author Steven Moran at the University of Zurich. “It does mean that the probability of producing labiodentals increases slightly over time and that means that some languages are likely to acquire them, but not all languages will.”

In the future, “we are interested in applying our novel methods to other speech sounds beyond just labiodentals,” Moran said. “Nearly half of all known speech sounds are unique to particular languages.”

The scientists detailed their findings in the March 15, 2019 issue of the journal Science.

Source : https://www.insidescience.org/news/ by Charles Q. Choi

TORTOISE-SHAPED PILL INJECTS INSULIN INTO STOMACH LINING

Pill uses a dissolving spring-loaded needle to spare people with diabetes from normal injections.

A pill shaped like a tortoise could one day help deliver insulin to people with diabetes, a new study finds.

Researchers have long sought ways to deliver insulin using pills instead of unpleasant injections. However, many medications are vulnerable to the acidity and digestive enzymes found in the digestive tract.

To overcome this challenge, researchers have developed an easily swallowed blueberry-sized capsule that can inject delicate molecules into the stomach lining. The stomach wall has no pain receptors, so the scientists believe that patients should not feel the injection.

To help the device settle against the inside of the stomach, the researchers drew inspiration from the leopard tortoise, which is found in eastern and southern Africa. The reptile’s dome-like shell helps the tortoise right itself if it rolls onto its back. A similar shape would likely help the capsule orient itself along the bottom of the stomach wall to ensure its needle could find purchase, despite any forces that may jostle it about.

The tip of the device’s needle, made of freeze-dried insulin, is attached to a compressed spring that is held in place by a disk made of sugar. When water in the stomach dissolves the disk, the spring releases and injects the needle into the stomach wall.

In tests in pigs, the device successfully delivered up to 0.3 milligrams of insulin, enough to lower blood sugar to levels comparable to those produced via traditional injections. The scientists could also increase the dose to 5 milligrams, comparable to what someone with Type 2 diabetes would need.

The researchers saw no sign of tissue damage or other problems from the stomach injections. The device is made from biodegradable materials and stainless steel parts that should allow it to pass harmlessly through the gut after delivering the insulin.

Experiments also showed the device — dubbed the self-orienting, millimeter-scale applicator, or SOMA — could work for other drugs currently delivered via injection. “We anticipate our first human trials in the next three to five years,” said study co-senior author Giovanni Traverso, a gastroenterologist and
biomedical engineer at Harvard Medical School in Boston.

The scientists detailed their findings in the Feb. 8 issue of the journal Science.

Source: https://www.insidescience.org/news by Charles Q. Choi

QUANTUM COMPUTER BESTS ALL CONVENTIONAL COMPUTERS IN FIRST CLAIM OF ‘SUPREMACY’

The age of quantum computing may have begun not with a flashy press conference, but with an internet leak. According to a paper posted briefly—and presumably mistakenly—to a lab site, physicists at Google have used a quantum computer to perform a calculation that would overwhelm the world’s best conventional supercomputer. Although the specific computation has no known use, the result means scientists have passed a milestone known as “quantum supremacy.”

“It’s a great scientific achievement,” says physicist Chad Rigetti, founder and CEO of Rigetti Computing in Berkeley and Fremont, California, which is developing its own quantum computers. “Google called their shot,” he adds, noting that the company detailed exactly how it would demonstrate quantum supremacy a couple of years ago. Greg Kuperberg, a mathematician at the University of California, Davis, calls the advance “a big step toward kicking away any plausible argument that making a quantum computer is impossible.”

According to the Financial Times, which broke the story, the paper appeared last week on the website of NASA’s Ames Research Center in Moffett Field, California; some of the researchers there are paper authors. Readers downloaded the manuscript before it vanished, and it is circulating online. John Martinis, the physicist who leads Google’s quantum computing effort in Santa Barbara, California, declined to comment on the paper, but others in the field think it is legitimate.

A quantum computer aims to exploit the strange aspects of quantum mechanics to perform types of calculations that would swamp a classical computer. Whereas a classical computer depends on “bits” of information that can be set as either zero or one, a quantum computer employs qubits which can be set to zero, one, or—thanks to quantum mechanics—any combination of zero and one at the same time. That enables a quantum computer to process a multitude of inputs simultaneously. For example, a 10-qubit quantum computer could process $2^{10}$, or 1024, possible inputs at once instead of analyzing them one at a time.

But such a computer’s real power comes from other quantum phenomena. For certain computational problems, all potential solutions can be thought of as quantum waves simultaneously sloshing among the qubits. Set things up right and those waves interfere with one another so that incorrect answers cancel one another and the right answer pops out. Such interference should enable a full-fledged quantum computer to hack current internet encryption schemes by factoring the huge numbers that underlie them.

That feat would require thousands of qubits, so Martinis and colleagues conceived a problem on which a quantum computer with just dozens of qubits could best any conventional rival. The 53 qubits in their device consist of tiny circuits of superconducting metal that can be in a low-energy state to denote zero, a high-energy state to denote one, or both at the same time—at least until measured, when such two-way states collapse one way or the other. The researchers then made pairs of qubits interact in various ways through a fixed but random set of operations.

Taken as a group, the qubits output any number between zero and $2^{53}$. Thanks to quantum
interference caused by the operations, some numbers should show up more often than others. And as the number of qubits grows, calculating that uneven distribution of outputs would become overwhelmingly difficult for an ordinary computer. So, if experimenters see the telltale unequal pattern of outputted numbers, they have evidence their quantum device calculated something a conventional computer cannot.

As with any quantum computing effort, the key was to preserve the qubits’ delicate quantum states throughout the process. If they fuzz out then all outputs become equally likely. But the Google team reports that it managed to see the telltale pattern in the generated numbers. To prove the pattern wasn’t just noise, researchers compared the results for smaller trials and subgroups of the qubits with supercomputer simulations. They couldn’t do that for the biggest instances of the problem, however. What the quantum computer could do in a little over 3 minutes would take a supercomputer 10,000 years to reproduce, they estimate.

Some researchers say the demonstration isn’t so much a computation as an effort to cook up a quantum state that’s hard to simulate. “Quantum computers are not ‘supreme’ against classical computers because of a laboratory experiment designed to essentially … implement one very specific quantum sampling procedure with no practical applications,” says Dario Gil, director of IBM Research in Yorktown Heights, New York, which is also developing machines with superconducting qubits.

The Google computer also lacks the ability to correct errors, which may be key to making a full-fledged quantum computer. That requires encoding a single, more stable “logical” qubit in several less reliable “physical” ones, to enable the machine to maintain quantum states much longer, Kuperberg explains. Rigetti, however, notes that Google’s achievement may put the company in an ideal position to demonstrate such error correction, too.

Gil voices another worry long held by many the field: that after all the hype surrounding quantum supremacy, quantum computing may experience a letdown like the one that plagued the field of artificial intelligence from the 1970s until the current decade, when technology finally caught up with aspirations. In the leaked paper, however, the 76 authors optimistically conclude: “We are only one creative algorithm away from valuable near-term applications.”

भारतीय विज्ञान कांग्रेस संस्थान
14, डॉ बिरेश गुहा स्ट्रीट, कोलकाता-700 017, भारत

दूरभाष : (033) 2287-4530, 2281-5323
फैक्स : 91-33-2287-2551
वेबसाइट : http://sciencecongress.nic.in
ई-मेल : es.sciencecongress@nic.in

सदस्यता की शर्तें और सदस्यों की विशेषाधिकार

संस्था की सदस्यता उन सभी लोगों के लिए खुली हैं, जो मनःकष्ट या उसके समान स्तर पर शैक्षिक योग्यता अर्जन कर चुके हैं, और जिन्हें भारत में विज्ञान को तकनीकी में रूचि है।

1. वार्षिक सदस्य : जो व्यक्ति नये रूप से वार्षिक सदस्यता प्राप्त करना चाहता है उसे वार्षिक सदस्यता शुल्क ₹ 200/- के साथ भारी शुल्क ₹ 50/-* (विभिन्न भागों के लिए** U.S. $ 70) मात्र देने पड़ेगी। वार्षिक सदस्यता शुल्क प्रतिवर्ष के 01 ऑक्टोबर को देने हो जाएगा। जो भी 15 जुलाई के भीतर अपनी सदस्यता शुल्क नहीं भुगता सकता वह उस साल के लिए अपनी बोट देने की क्षमता से विध्वंस हो जाएगा और वह उस वर्ष के लिए संस्था के कार्यालय को भी नियंत्रण नहीं कर पाएगा। वार्षिक सदस्य अपनी सदस्यता दोबारा अगले साल 15 जुलाई के भीतर बिना शुल्क दिए पुनः अपनी सदस्यता प्राप्त कर सकता है।

सदस्यगण अपना पेपर कांग्रेस सदस्य के समय पेश कर सकते हैं। उन्हें वार्षिक विज्ञान कांग्रेस सदस्य की कार्यविवरण को एक प्रति बिना मूल्य में प्राप्त हो सकती है। इसके लिए संस्था के रोजनामा "एनरीजिस साइंस" को प्रति बिना मूल्य उस साल के लिए प्राप्त कर सकते हैं। सदस्यता के नवीनकरण के लिए कुछ इंसान ISCA वेबसाइट से फार्म डाउनलोड करें।

2. सत्र सदस्य : यदि कुछ कारणों से वार्षिक सदस्य अपनी सदस्यता उस वर्ष के 15 जुलाई के अंदर दोहराने भूल जाएं, तो उनकी सदस्यता, सत्र सदस्यता के रूप में बिना बोट डालने की क्षमता में सीमित कर दिया जाएगा। सत्र सदस्यों के ₹ 200/- (विभिन्न भागों के लिए $ 50) अदा करना पड़ेगा। एक सत्र सदस्य को लेख/पोस्टर प्रस्तुतीकरण का अधिकार प्राप्त होगा जिस कांग्रेस सत्र का वह सदस्य है। एक सत्र सदस्य वोट प्रक्रिया में भाग लेने के योग्य नहीं है। सत्र सदस्य को विभागों के व्यवसाय बैठकों और साधरण बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।

3. छात्र सदस्य : जो व्यक्ति स्त्रोत सत्र से तीन से पहले पढ़ाई कर रहा है, उसे वार्षिक सदस्यता शुल्क ₹ 100/- मात्र देने पड़ेगे। अपना नाम छात्र सदस्य के रूप में लिखाने के लिए, वहाँ उसके आवेदन पत्र पर उसके प्राचार्य/विभागाध्यक्ष/संस्थान के प्रधान के हस्ताक्षर हैं। एक छात्र सदस्य को यह अधिकार दिया जाएगा, कि वह अपना पेपर कांग्रेस सत्र के समय पेश कर सके, वहाँ वह पेपर वह किसी वार्षिक सदस्य या संस्था के कोई अवैतनिक सदस्य के साथ पेश कर सके। उसे वोट करना या कार्यालय को नियंत्रण करना से अधिकार प्राप्त नहीं होगा। छात्र सदस्य को विभागों के व्यवसाय बैठकों में भाग लेने की योग्यता प्राप्त नहीं है।

4. आवीर्ण सदस्य : एक सदस्य अपने भविष्य की सात वार्षिक सदस्यता शुल्क एक बार में ₹ 2,000/- (विभिन्न भागों के लिए U.S. $ 500) मात्र अदा करनें पर सकता है। एक व्यक्ति जो 10 साल या उससे अधिक नियमित रूप से सदस्यता प्राप्त कर चुका है, उसे उसकी संस्था सदस्यता शुल्क के उपर प्रति वर्ष ₹ 50/- की छूट दी जाएगी, यदि वह उसकी संयुक्त सदस्यता शुल्क ₹ 1,200/- से नीचे न हों (विभिन्न भागों के लिए U.S. $ 12.50 और U.S. $ 300 क्रमशः)। एक आवीर्ण सदस्य को उसके पूरे जीवन काल में सदस्यता को पर्यंत विशेषाधिकार प्राप्त होगे।
5. संस्थान सदस्य : एक संस्थान जो ₹ 5,000/- सदस्यता शुल्क के रूप में दे वही संस्था के संस्थान सदस्य उस विद्वान वर्ग के लिए बन सकता है, (विदेशियों के लिए U.S. $ 2,500). इसमें वह विज्ञान कांग्रेस के वारिष्ठ सदस्य में अपने एक व्यक्ति का नाम नामांकित कर सकता है, जो उनका प्रतिनिधि हो। एक संस्थान सदस्य को वारिष्ठ विज्ञान कांग्रेस सदस्य को कार्यरत करने की एक पृष्ठ प्रति विना मूल्य में प्राप्त हो सकते हैं। इससे साथ वे संस्था के रोजनामाच् “एडीमेन्स साइंस” को प्रति भी विना मूल्य प्राप्त कर सकते हैं।

6. दाता : कोई भी व्यक्ति जो एकसाथ ₹ 10,000/- (विदेशियों के लिए U.S. $ 5,000) मात्र दे, वह संस्था के दाता बन सकते हैं। एक व्यक्ति दाता को वह सारे अधिकार और विशेष अधिकार प्राप्त कर सकते हैं। एक संस्था के लिए एक सत्ता ₹ 50,000/- (विदेशियों के लिए U.S. $ 25,000) सदस्यता शुल्क दे, यह संस्था के संस्थान दाता बन सकता है, जिसे वह विज्ञान कांग्रेस के वारिष्ठ सदस्य में भेज सकते हैं। एक संस्थान के दाता वारिष्ठ विज्ञान कांग्रेस के कार्यरत कर सकते हैं। कार्यरत करने की प्रति भी विना मूल्य प्राप्त कर सकते हैं।

* भारी शुल्क ₹ 50/- सिर्फ एक नये वारिष्ठ सदस्य के लिए जुटती है। वह संस्था सदस्य/आजीवन सदस्य/संस्थान सदस्य/आजीवन सदस्य/दाता के लिए जुटती नहीं है।

** (एक विदेशी सदस्य का अर्थ है, जो भारत के बाहर का नामांकित हो।)

(अ) पेपर पेश करना : एक पृष्ठ पेपर की प्रति उसके साथ तीन साधन की प्रति जो 100 शब्दों से ज्यादा न हो और जिसमें कोई आंक या फांसिला न हो, वह प्रायः क्षण 15 सितम्बर के अंदर अनुभवी अध्यक्ष तक पहुँच जाना चाहिए।

(ब) सभी वाणी के सत्ता जो विज्ञान कांग्रेस सदस्य में भाग लेने के परवर्ती लौटे समय के रिकेट में रियायत प्राप्त कर सकता है, वायू ,कि उनकी यात्रा के खर्च का धोखा भी भाग सकार (केन्द्रीय या राज्य), कोई कानूनी सत्ता या कोई विश्वविद्यालय या कोई नागरिक ने उठाए और उनकी कुल कमाई या परिस्थितियों ₹ 5,000/- (प्रति मास पीछा हायर रूप) से अंकित नहीं है। कृपया ISCA वेबसाइट से रेखेपत्र रियायत फार्म डाउनलोड करें।

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

(ड) समय समय पर संस्था द्वारा तथा कोई मूल्य दर पर विज्ञानमृग, सभागार भावुक सुविधाओं की प्रति भी सभी वाणी के सत्ता कर सकते हैं।

(ई) भवन में भारतीय विज्ञान कांग्रेस संस्था द्वारा आयोजित परिसंचार, सम्मेलन और वारिष्ठ कांग्रेस में सभावाहिनी के सत्ता द्वारा प्राप्त कर सकते हैं।

ध्यान दें : (1) सभी बैंक ड्राफ्ट पे दिनहार्ट The Indian Science Congress Association के नाम से ही लिखा जाए, सदस्यता के विषय में बैंक ड्राफ्ट की प्राप्ति और जो कोई कारण के किसी भी शाखा में देने है। दर्जनों से वह विवेक किया जा सकता है, कि वे अपनी सदस्यता संख्या का उल्लेख भारतीय विज्ञान कांग्रेस संस्था के कार्यरत के साथ पता चारा के बज्ज कर सकते हैं।

(2) भारतीय विज्ञान कांग्रेस संस्था द्वारा यूनिओन, इंडिया, पी. ऑ., ई. सी. एस. या बैंक से भुगतान ग्रहण नहीं किया जाएगा। कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता को नवीकरण के लिए) में विविधता विना भरने से नहीं लिया जाएगा।

(3) नकदी केवल ISCA मुख्यालय में हाथ से लिया जाएगा। कृपया ड्राफ्ट द्वारा लिफाफे के भीतर नकदी नहीं भरें।
Membership of the Association is open to persons with Graduate or equivalent Academic Qualifications and interested in the advancement of Science in India.

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

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

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

4. **Life Member**: A Member may compound all future annual subscriptions by paying a single sum of ₹ 2,000/- (for foreign $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 $12.50 and U.S. $300 respectively). A life Member shall have all the privileges of a member during his/her lifetime.
5. **Institutional Member**: An Institution paying a subscription of ₹ 5,000/- (for foreign** U.S. $ 2,500) only, can become an Institutional Member of the Association for that financial year. It shall be eligible to nominate one person as its representative to attend Annual Session of the Science Congress. An Institutional Member shall be eligible to receive, free of cost, a copy of the complete set of Proceedings of the Annual Science Congress Session as also a copy each of the Associations journal Everymans Science.

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

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

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

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

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

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

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

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

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

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

(2) No money order, I.P.O., ECS or cheque will be accepted by ISCA. No Membership will be taken without duly filled in prescribed Membership Form (Application 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, डॉ विनेश गुहा स्ट्रीट, कोलकाता-700 017, भारत

दूरभाष : (033) 2287-4530, 2281-5323
फैक्स : 91-33-2287-2551
वेबसाइट : http://sciencecongress.nic.in
ई-मेल : es.sciencecongress@nic.in

सदस्यता के लिए नया आवेदन पत्र

सेवा में
महासचिव (सदस्यता कार्य)
भारतीय विज्ञान कांग्रेस संस्था
14, डॉ विनेश गुहा स्ट्रीट,
कोलकाता-700 017

महोदय,

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

मैं इसके साथ ------- सदस्यता शुल्क के रूप में नकद र -------/बैंक ड्राफ्ट संख्या ------- दिनांकित ------- प्रबंधक बैंक ------- 01 अप्रैल 20------- से 31 मार्च 20------- तक भेज रहा/रही हूँ।

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

विभाग

1. कृषि और व्यापक विज्ञान
2. पशु, पशुचिकित्सा और मस्त्र विज्ञान
3. मानवाधिकारी और व्यवहारविद विज्ञान (जिसमें सम्मिलित, हैं, पुरातत्व-विज्ञान, मनोविज्ञान, शैक्षिक विज्ञान और सेना विज्ञान)
4. रसायन विज्ञान
5. भौ-पद्धति विज्ञान
6. अभियन्ता विज्ञान
7. पर्यावरण विज्ञान
8. सूचना और संचारण विज्ञान और प्रौद्योगिकी (जिसमें कंप्यूटर विज्ञान भी सम्मिलित है)
9. भौतिक विज्ञान
10. गणित विज्ञान (जिसमें सांख्यिकीय सम्मिलित है)
11. चिकित्सा शाखा (जिसमें शीर्ष विज्ञान भी सम्मिलित है)
12. नया जीवविज्ञान (जिसमें जीव स्पष्ट, जीव भौतिकों और आणविक जीवविज्ञान और जीव-प्रौद्योगिकी भी सम्मिलित है)

(v)
13. भौतिकीय विज्ञान
14. वस्त्रप्रति विज्ञान

<table>
<thead>
<tr>
<th>कुलनाम</th>
<th>प्रथम नाम</th>
<th>मध्य नाम</th>
</tr>
</thead>
</table>

शैक्षणिक योग्यता :
(अंतिम शैक्षणिक योग्यता प्रमाण-पत्र अंक-सूची का स्वतंत्र:सत्यापित जिन्दगी प्रति संलग्न करना है)

पदाधि:
सम्पर्क का पता :
(राज्य, शहर/नगर और पिन कोड सहित)

dूरभाष संख्या/मोबाइल संख्या औरई-मेल :
किसी भी सरकारी अनुमोदित पहचान पत्र (अनिवार्य) :

वर्तमान वर्ष विश्वविद्यालय प्रवेश-पत्र :

स्थायी पता :

दिनांक :

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 देन हो।

(ii) सभी सदस्यता और सदस्यता के नवीकरण के लिए आवेदन-पत्र आवेदकों को अपने खुद के पते उपलब्ध कराकर बाहिर न करें जो देखभाल के पते प्रस्तुत करने बाहिर है।

(iii) भरी शुल्क `10/- सिर्फ एक नये वार्षिक सदस्य के लिए जुरू है। वह सदस्य/आजीवन सदस्य/संस्थान सदस्य/छात्र सदस्य/दाता के लिए जुरू नहीं है।

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

(v) भारतीय विज्ञान कांग्रेस संख्या द्वारा मनीआउट, आई. पी. ऑ., ई. सी. एस. या चेक से भुगतान ग्रहण नहीं किया जा सकता।

(vi) कोई भी सदस्यता निर्धारित सदस्यता फार्म (आवेदन-पत्र नई सदस्यता/सदस्यता को नवीकरण के लिए) में विभेदित निर्मा भरने से नहीं लिया जा सकता।

(vii) नकदी के केवल ISCA मुख्यालय में हाथ से लिया जा सकता। कृपया ड्राफ्ट द्वारा लिस्टरफ़े के भीतर नकदी नहीं भेजें।

(vi)
Application Form For New Membership

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

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

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

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

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

(Please type or fill up in Block Letters)

Name (in Block Letters):
Mr./Ms./Shri/Shrimati/Dr./Prof. (Please tick)

Surname  First Name  Middle Name

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

Designation

Address of communication:
(including state, city/town and pin code)

Phone No./Mobile Number & E-mail:

Any Govt. approved ID Card (Mandatory):

Current Year University Admit Card:

Permanent Address:

Date:  Yours Faithfully

Signature

Note:
(i) All Bank Drafts should be drawn in favour of The Indian Science Congress Association, membership subject to realisation of the bank draft, Payable at any branch in Kolkata.
(ii) All Application Forms for Membership and the renewal of Membership must be submitted by providing the address of the applicants themselves only and not any care of address.
(iii) Admission fess of ₹ 50/- is needed only for becoming a new Annual Member and not for Sessional Member/Life Member/Institutional Member/Student Member/Donor.
(iv) Members are requested to mention their Membership No. while making any correspondence to ISCA office.
(v) No Money Order, I.P.O., ECS or Cheque will be accepted by ISCA.
(vi) No Membership will be taken without duly filled in prescribed Membership Form (Application Form for New Membership/Application For Renewal of Membership).
(vii) Cash will only be taken by hand at ISCA Hqrs. Pl. do not send the cash by Post within the envelope.
MEMBERS OF THE COUNCIL FOR 2019-2020

General President
Prof. K. K. Rangappa, Mysore

Immediate Past General President
Dr. Manoj Kumar Chakrabarti, Kolkata

General President-Elect
Dr. (Mrs.) Vijaya Laxmi Saxena, Kanpur

General Secretary (Membership Affairs)
Dr. S. Ramakrishna, Bengaluru

General Secretary (Scientific Activities)
Dr. Assoor J. Jain, Kanpur

Treasurer
Dr. Shashank Desai, Mumbai

Elected Members of the Executive Committee
Dr. Ashok Kumar Saxena, Kanpur
Mr. Sanjeevendra Swamy, Kanpur
Prof. S. Ramamurthy, Tirupati
Mrs. Randhawa Mittal, Jalandhar
Prof. M. B. Patil, Naidu, Tirupati
Dr. O. N. Paramasivam, Coimbatore
Prof. S. R. Satam, Pune, Bhopal
Prof. D. Narayana Rao, Guwahati
Prof. V. S. Kishor, Jodhpur
Prof. K. Byrappa, Mysuru

Representative of Department of Science & Technology, Government of India
Dr. R. K. Shukla, New Delhi

Local Secretaries
Dr. Y. G. Shrakshiki, Bengaluru
Dr. K. C. Narayanasamy, Bengaluru

Past General Secretaries
Dr. (Mrs.) Shalini Prabha Arora, 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, Kanpur
Prof. Avijit Banerji, Kolkata
Dr. Nilanjan Bhattacharjee, Kolkata
Prof. Arun Kumar, Indore
Prof. Ganganath, Bangalore
Prof. Premendu Mathur, Pondicherry

Past Treasurers
Dr. S. B. Mabat, Kolkata
Prof. Dnyanendra Kumar, Allahabad
Prof. Ranjit Kumar Verma, Mungre

Sectional Presidents
Dr. U. Ramakrishna Belara, Meghalaya
Prof. Prakash Chand Joshi, Haridwar
Prof. Surendra M. Makwana, Vallabhvidyapeeth
Prof. Diwan S. Rawat, Delhi
Prof. R. B. Singh, Delhi
Dr. Aziz Kumar Das, Jamnagar
Dr. Ranjeet Singh Rawal, Ahmedabad
Prof. Md. Aminur Huda, New Delhi
Dr. S. Krishna, Mysuru
Prof. S. K. Nimbhorkar, Aurangabad
Dr. Deo N. Srivastava, New Delhi
Prof. Sadag Kumar Ghosh, Kolkata
Prof. Santhosh Chidambaram, Manipal
Prof. (Ms.) V. Vimala, Meerut

Elected Members of the Council
Mrs. Kumkum Swamy, Kanpur
Prof. Nibedita Chakrabarti, Kolkata
Prof. Sunil Prakash Trivedi, Lucknow
Dr. M. G. Ragunathan, Chennai
Dr. K. T. Chandra Shekar, Mysuru
Prof. C. Mathumitha Selvam, Kattankulathur
Dr. A. M. Saxena, Lucknow

Representative of The Kolkata Municipal Corporation
Dr. Jyoti Prakash Sarkar, Kolkata

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

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

GUIDELINES FOR SUBMISSION OF MANUSCRIPTS

1. Everyman’s Science intends to Propagate the latest message of science in all its varied branches to its readers and through them, to every one interested in Science or Engineering or Technology. Research articles usually meant for publication in periodicals devoted to particular branches of Science & Technology and addressed to specialised sections of the readers, are not appropriate for Everyman’s Science. Instead, popular or easily intelligible expositions of new or recent developments in different branches of Science are welcome.

2. Manuscripts should be typed 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 reader 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 numbering and (e) year of publication.

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

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

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

All manuscripts and correspondences should be addressed to the Home, Editor, Everyman’s Science, The Indian Science Congress Association 14, Dr. Biresh Guna Street, Kolkata-700 017. Email: isciscal@vsnl.net, isciscal_3004@yahoo.com, Fax: 91-33-2287-2551.
PUBLICATIONS OF INDIAN SCIENCE CONGRESS ASSOCIATION

1. A Short History of the Indian Science Congress Association  ₹ 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/-
   Part-I-Physical Sciences  ₹ 100/-
   Part-II-Biological Sciences  ₹ 150/-
   Part-III-Engineering & Earth Sciences  ₹ 165/-
   Part-IV-Social Sciences  ₹ 225/-
20. PROCEEDINGS of Annual Session of Indian Science Congress  ₹ 1200/-
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
Website : http://www.sciencecongress.nic.in

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