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

EDITORIAL

The environmental issues on planet earth display the impact of human being on the processes that exist on the earth such as landscape, surface and groundwater, lakes, coastal areas and melting of glaciers. The human activities in the context of industrial revolution from the last 250 years have significantly affected the natural resources, and accelerated the pollution as well as land degradation. We are facing the rapid changes on the planet earth which effect physical, chemical and biological system and their interactions leads to negative feedback and further amplification of their effects. In all these cases, the cause of environmental change can be traced as a consequence of direct intervention or through the global warming. We need to address well formulated policies to mitigate these changes on global scale. The lack of such policies, the security of food, water and energy is a potential risk. The sustainable development is the answer to these environmental issues.

The population of India is 1.25 billion approximately and it is the second most populous country after China in the world. The living standards have been increased in recent decades with increasing economic conditions in India. We have undergone with a rapid economic growth on the cost of country's environment in the form of deforestation, land degradation, air and & water pollution.

A high standard of living and improved infrastructures in India has put enormous pressure on timber consumption as well as constructions materials (stone and sand) which led to significant deforestation and severe soil erosion within the country. Most of the Indian rivers receives and carries the sewage waste from urban areas and it is one of the world's worst pollution. A 2013 report from India's Central Pollution Control Board found that more than 2,700 million liters per day of domestic sewage is discharged by cities located along the Ganges River.

The issue of the riparian forest plays an important role for maintaining the hydrology of the watersheds as well as maintaining the flow at downstream. Large number of riparian covers in India have been shrinking due to pressures of agriculture and other uses. It brings the concept of deforestation, which is another of the highly serious environmental issues in India. Degraded forest constitutes a considerable proportion of the total forest cover of India. The factor for degradation is due to the diversion of forest land into other land uses such as road networks in hills and housing, industrialization and river valley and hydropower projects. The diversion of forest land has been reduced after 1980 when Forest Protection Act was implemented. It is estimated that the number of Mangrove Forests have more than halved in the last 20 years.

The air pollution in India has grown at an alarming situation. The major cities fails to meet the ambient air on account of health-based standards. Most of cities are in state of severe air pollution and in addition, oxides of nitrogen and air toxics pollutants have another serious issue towards public health. We have come across some major initiatives to mitigate the air pollution in only metros where some improvement in air quality but in most cases the air pollution levels are still unacceptably high. But most of cities and towns are still experiencing severe air pollution. There is an urgent need for a policy interventions to mitigate air pollution.

Another issue is the status of surface and groundwater resources. The community wastes, industrial effluents, chemical fertilizers and pesticides are the main factors for deteriorate of surface as well as groundwater. It is essential to restore the water quality of our rivers and other water body as lakes is an important challenge. It is necessary to strengthen the suitable strategies for consecration of water, provision of safe drinking water and to maintain the clean water bodies.

The rapid growth urbanization and industrialization is responsible for 27% of people residing in slums of urban areas without proper sewerage and its treatment facilities. Hence, coping with rapid urbanization is a major challenge. It poses an important environmental issue for its urgent attention.

We invite and encourage the scientific contributions on these issues for creating a general awareness through EVERYMAN'S SCIENCE. It is one of the age old scientific journal published by Indian Science Congress Association and in the large circulation in the country for scientific awareness.

Prof. Arun Kumar
Manipur University, Imphal

All exact science is dominated by the idea of approximation.
- Bertrand Russell

ALOE VERA: PLANT WITH DIVERSE THERAPEUTIC PROPERTIES

Parul Tripathi and Aditi Singh*

In this review article attention is put towards the application of a common Indian medicinal plant, *Aloe vera that* has been put into use since centuries for its therapeutic and curative properties. *Aloe* gel, which is found in the interior of the leaves, is being used for topical application for many skin ailments. The gel works by hydrating and protecting a topical wound until the body can repair itself. The bitter latex comes from a layer of cells just beneath the outer skin and has been reported to be beneficial in treatment of intestinal troubles. This sap is taken internally and soothes digestive complaints by acting as a purgative or laxative. An *Aloe vera* leaf contains more than 200 different constituents - each of them in relatively minute quantities. The juice consists of, on an average, more than 99% water, thus all the constituents together amount to less than 1%. This indicates that curative actions may be brought about by very small amounts of active ingredients. Phytochemical composition may vary in different *Aloe* species, health benefits, and possible toxicities. Thus, it is important to not only study and research the relevant medicinal uses of the native *Aloe* species but also to identify the active components and understand their individual or combined biological mechanisms.

INTRODUCTION

Aloe vera, a member of family Liliaceae, has gained immense popularity because of its wide restorative and medicinal properties. It is native to Mediterranean and African countries.It being a hardy perennial tropical plant, can be easily cultivated in drought prone areas as it grows optimally in bright sun light. While many species of *Aloe* grow in sandy soil[1] the plant grows best when supplied with an excess of 50 cm of rain annually in nitrogen rich, alkaline soil. Soil nitrogen should ideally be maintained at 0.40%–0.50%. Harvesting of leaves starts after 7-8 months of planting. Typically, the outermost 3–4 leaves are harvested by pulling each leaf away from the plant stalk and cutting at the white base. Care also has to be taken to reduce the loss of juice from the cut portion[2].

From its leaves two types of products are derived: *Aloe* latex and *Aloe* gel. These two substances vary considerably in their chemical composition and have been widely used for medicinal purposes since ancient times. Most of the therapeutic activities of *Aloe* leaf extracts have been attributed to the polysaccharides present in the inner leaf parenchymatous tissue[3], Though more than 75 dynamic ingredients from the internal gel have been found, these activities have not been corresponded well with every individual component[4]therefore it is thought that these medicinal properties ought to be allocated to a synergistic activityof the compounds contained in that as opposed to a single active agent[5].

Apart from *Aloe* being used as a cosmetic, it has been known for its anti-inflammatory, laxative, immunostimulant, antiseptic[6], wound and burn healing, antiulcer,antidiabetic and antitumor-activities[7]. These therapeutic activities are based on anecdotal evidence or research findings done almost specifically on *Aloe*.

PHYSIOLOGY OF THE PLANT

Aloe vera is a popular plant, but it is only one of about 400 species in the genus *Aloe*. They have rosettes of fleshy leaves, which may be smooth or spined. The mostof *Aloe* species have spines of

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different rigidity throughout the edges of their succulent leaves. The flowers are tubular shaped, and color varies from near white to yellow to orange to near-red.The *Aloe* leaf can be divided into two main parts, namely the outer green rind, including thevascular bundles, and the inner colourless parenchymatic tissue, containing the *Aloe* gel.

The three structural components of the *Aloe vera* pulp are the degenerated organelles, the cell wall and the viscous liquid present within the cells. These three parts of the inner leaf pulp have been shown to be different from each other both in terms of morphology and sugar composition[3].

TAXONOMIC CLASSIFICATION:

KINGDOM	PLANTAE
CLASS	ANGIOSPERMS
ORDER	ASPARAGALES
FAMILY	XANTHORRHOEACEAE
SUB-FAMILY	ASPHODELOIDEAE
GENUS	*Aloe*
SPECIES	*vera*

CHEMICAL COMPONENTS OF *ALOE* GEL:

Polysaccharides make up most of the dry matter of the *A.vera* parenchyma. Enzymes such as cyclooxidase, amylase, Alkaline phosphatase, catalase, cyclooxygenase, lipase, oxidase, carboxypeptidase, etc. are present in the protoplasm. Proteins like Lectins and Vitamins like B1, B2, B6, C, β-carotene, choline, folic acid, α-tocopherol,etc are also important components of *Aloe* gel. The plant produces at least six antiseptic agents such as urea nitrogen, lupeol, cinnamonic acid, salicylic acid, sulphurand phenols. Lupeol and salicylic acid present in the juice are very effective pain-killer[8].

PHARMACOLOGICAL ACTIVITY OF PLANT

Treatment of Skin Disorders: Aloe's action comprises of sealing the wound while causing an increased flow of blood to the wound, accelerating wound healing[9]. The wound healing property of *A.vera* gel has been attributed to Mannose-6-phosphate[10].

Uses in Dental Care: *A.vera* greatly minimizes the bleeding of gums due to its soothing and medicinal properties, reduces inflammation and soft tissue edema.Its gel when applied to dental implants is found effective to reduce inflammation. *A.vera* checks inflammation by its antimicrobial and anti-inflammatory effects[11].

Analgesic Application: The application of *A.vera* gel has shown reduction in joint pain and muscle pain due to arthritis[12]. The peptidase bradykinase was disengaged from aloe and appeared to separate the bradykinin, a provocative substance that prompts pain[13].

Anti-aging Uses: Aloe juice comprises of components like magnesium, selenium which are a part of enzymes like glutathione peroxidase and superoxide dismutase. They help the cells to become stronger and reduce the effect of free radicals of radiation[14].

Anti-microbial Activity: The saponins found in Aloe perform strongly as anti-microbials. The activity of *A.vera* gel against bacteria (gram positive and gram negative) has been demonstrated by many methods. Anthraquinones extracted from the *A.vera* have shown wide antimicrobial properties like antiviral and/or virucidal effects on enveloped viruses[11].

Anti-Tumour Activity : A number of glycoproteins and polysaccharides present in *A.vera* gel have reported antiulcer and antitumor effects. The anti-cancer activity of Aloe indicates that its activityis through incitement of the scavenging white platelets of the immune system. Consuming *A.vera* internally has been found to heal radiation burns[15].

Treats Respiratory Disorders: This versatile plant has been found very useful for treating

respiratory problems. It contains Vitamin C which provides protection from cold, cough and flu.

Stimulates Metabolism: Drinking *Aloe vera* juice daily helps the body to burn calories more quickly *via* stimulating metabolism. It also encourages the bowels to move and helps with elimination if a person is constipated[16].

Anti-Oxidant Effects: *Aloe vera gel is well known for its antioxidant properties as* Glutathione peroxidase, superoxide dismutase enzymes and a phenolic anti-oxidant were found to be present in *A.vera*gel[16].

Anti-Inflammatory Action: *Aloe* gel reduce inflammation so is highly effective in treatment of burns[17], cuts, scrapes, abrasions, allergic response, rheumatic fever, acid indigestion, rheumatoid arthritis, ulcers, many inflammatory conditions, including the liver, stomach, small intestine, colon, kidney and pancreas. It helps in soothing pain, inflammation and infections. *A.vera* is an excellent plant for treating eczema, cuts, insect bites, sunburns, etc.

Antiseptic: The antiseptic activity of *Aloe* is due to six antiseptic agents namely salicylic acid, lupeol, cinnamonic acid, urea nitrogen, sulphur and phenols. These compounds have inhibitory action on bacteria, fungi and viruses[11].

Anti Diabetic: The dried gel of *Aloe* lowers the triglyceride levels in the liver and plasma and also lowers down the blood sugar level by decreasing insulin resistance. It assists in improving the blood quality by decreasing the levels of triglyceride andcholesterol[16].

Stress: *Aloe* juice is beneficial in healthy functioning of the body. It reduces cell-damaging process during stress condition and minimizes physiological and biochemical changes in the body. *A.vera*is an excellent example of a functional food that provides protection from oxidative stress[16].

Wound Healing Effect: Wound healing is a reaction to harmed tissue that outcomes in the rebuilding of tissue uprightness. It was observed that *Aloe* gel could improve wound healing after topical and systemic administration[17].

Cosmetic and Skin Protection Application: The plant extract is widely used as skin moisturizing agent and for treating pimples. It has also been found useful in the treatment of many skin infections, such as benignboils or skin cysts and have been shown to reduce the growth of fungi that cause tinea. At present it is widely used in skin care products, cosmetics and as nutraceuticals. *A.vera* is also known for its anti-ageing properties[16].

CONCLUSION

Aloe vera, an ancient Indian herb, has a long history as a medicinal plant with diverse therapeutic uses. Through human trade and migration, this plant earned a reputation to cure burns and wounds throughout ancient civilizations. India is one of those countries that are talented with the exceptional topographical elements essential for cultivation of *A.vera* and other potential medicinal plants. Although it was claimed that some of the biological activities of this plant can be attributed to the polysaccharides present in the leaf gel, it is an overwhelming assignment to connect singular polysaccharides to particular remedial properties.With the innovative advancements in the field of analytical chemistry, it has become easier to extract and characterize the active compound of the leaf gel and it is possible that more data in such manner will be made available at a quicker rate. Fascinating pharmaceutical applications such as skin penetration improvement effects and intestinal absorption enhancement activities have recently been shown for *A.vera* gel. The dried gel has also showed potential as an excipient in modified release matrix type tablets. More applications are discovered as research

from different viewpoints is conducted on this versatile plant to provide a better understanding of its composition and effects.

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FOLKLORIC HEALING POWER OF MEDICINAL PLANTS IN DIABETES MANAGEMENT

Sanjukta Chatterji and Geeta Watal*

Diabetes mellitus is a serious metabolic disorder affecting nearly 25% of the world population. Several drugs currently employed to treat diabetes are facing backlash due to their severe side effects. An increasing number of people are therefore seeking alternative therapies from medicinal plants possessing ethno-medicinal relevance and minimal side effects.

INTRODUCTION

Diabetes mellitus is a disorder of altered metabolism resulting due to hereditary and environmental reasons. This consequently gives rise to 'hyperglycemia' or increased blood sugar levels, due to anomalies in either insulin secretion or insulin action or both in the body. Persistent hyperglycaemia during diabetes causes secondary complications affecting eyes, kidneys, nerves and arteries[1]. The general prevalent practice for diabetes management includes diet, exercise, use of oral hypoglycemic drugs and insulin. Currently available synthetic drugs for controlling diabetes are costly and produce adverse side effects. For example, sulfonylureas can cause weight increase and hypoglycemia and are not advised in patients with advanced liver or kidney diseases. Metformin, a widely prescribed class of antidiabetic drugs, has reported to exhibit gastrointestinal side effects in a significant percentage of patients. It also may have a rare risk for lactic acidosis and may be contraindicated in patients with cardiac or respiratory insufficiency. Thiazolidinediones have a very slow onset of action and have an attendant risk for fluid retention. There is also some concern about possible cardiovascular effects such as aggravation of congestive heart failure[1].

Besides the currently existing remedial alternatives, several herbal medicines have been suggested for the management of diabetes mellitus. Medicinal plants are easily accessible, affordable and possess the additional benefit of producing no side effects[1]. Reports show that herbal treatment has been used throughout the world since ancient times for the cure of diabetes mellitus. Due to their ethno-medicinal background in treating diabetes, a large number of such medicinal plants are now being scientifically explored in order to validate their antidiabetic potential[2].

Medicinal plants continue to be an important therapeutic aid for alleviating ailments of humankind. Over the last 2500 years, there have been very strong traditional systems of medicine such as Chinese, Ayurvedic, and the Unani, born and practiced, more in the eastern continent. These traditions are still flourishing, since; approximately 80% of the people in the developing countries rely on these systems of medicine for their primary health care needs[3]. These plants contain substances that can be used for therapeutic purposes, of which are precursors for the synthesis of drugs[4].

The present research article provides an overview of a diverse range of folkloric medicinal plants with several of them scientifically explored by our research group for their antidiabetic activity.

Role of Medicinal Plants in Diabetes management

India is a rich source of a large number of plants

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including plants having medicinal value. It has an official documentation of 45,000 plant species and approximately 7,500 species of medicinal importance[3]. India has a flourishing past of using several potent herbs and herbal constituents to treat diabetes. Many such plants have been scientifically and systematically investigated for their valuable use in treating diabetes and have also been reported in numerous scientific journals from time to time. In the present research article, some commonly available Indian medicinal plants spanning across different families and traditionally used in treating diabetes, have been described for creating readers' awareness and familiarity. Scientific evidence of a variety of medicinal plants for their antidiabetic activity scientifically explored by our research group have also been enumerated below. Moreover, Table 1 provides information about their scientific names, common names, family names and the parts of the plants used to treat diabetes since ancient times[1,5].

Plants described below have already been worked up systematically and scientifically for their antidiabetic profile in our laboratory by our research group.

- ***Annona squamosa*** (Family: Annonaceae) commonly known as 'Custard apple', is cultivated mainly for its edible food. Cold aqueous extract of *Annona squamosa* has been reported for its antidiabetic activity in STZ-nicotinamide induced type 2 diabetic rats[6]. Hot aqueous and ethanolic extracts of its leaves were found to possess hypoglycemic and antidiabetic properties for the first time by our research group[7].
- ***Aegle marmelos*** (Family: Rutaceae) commonly called as 'Bael' in Hindi, is used as herbal medicine for the treatment of diabetes mellitus[8]. Lowering in blood glucose level occurred with its green leaves. The crude aqueous leaf extract and its alkaloid fraction exhibited hypoglycemic effect in alloxan induced diabetic rats[9]. Aqueous decoction of its root bark[10] and fruits[11] have also been reported for its hypoglycemic activity. The antidiabetic and hypolipidemic effects of aqueous extract of its seeds has been reported in diabetic rats by our research group[12].
- ***Cynodon dactylon*** (Family: Poaceae) commonly known as 'Doob' in India, is a weed that has been reported for its antidiabetic effect in traditional system of medicine[13]. Our research group discovered that the aqueous and ethanolic extracts of whole plant exerted maximum hypoglycemic and hypolipidemic effects in STZ diabetic rats at a dose of 500 mg/kg[14].
- ***Ficus bengalensis*** (Family: Moraceae) commonly known as 'Indian Banyan Tree or Bargad', is distributed throughout India. A more potent hypoglycaemic action was shown by glycoside isolated from the bark when compared to crude ethanolic extract. The activity was found to be just half of the synthetic drug, tolbutamide[15]. Leucocyanidin and pelargonidin compounds isolated from bark have shown hypoglycemic activities[16]. Oral administration of bark extract showed significant anti-hyperglycemic effect in STZ induced diabetic rats by raising serum insulin levels[17]. Most recently the hypoglycemic as well as antidiabetic property has been reported in its aerial roots by our research group[18].
- ***Murraya koenigii*** (Family: Rutaceae) commonly known as 'Curry patta' in Hindi, is used as a spice and condiment in India and other tropical countries. Its leaves mixed with butter are used for the treatment of diabetes. Aqueous extract of its leaves caused hypoglycemia in normal and alloxan diabetic dogs[19]. Oral feeding of leaves for 60 days to normal rats showed hypoglycemic effect associated with increase in the concentration of hepatic glycogen[20]. Aqueous extract of its leaves are reported to possess hypoglycemic and antidiabetic effects by our research group in normal and alloxan diabetic rabbits as well as STZ induced rats[21].

Moringa oleifera (family: Moringaceae) commonly known as Drumstick tree and is indigenous to Northwest India. They are also well known for their pharmacological actions and are used for the treatment of diabetes mellitus[22]. The aqueous extract of the leaves has been found to possess antidiabetic activity by our research group[23].

Psidium guajava (Family: Myrtaceae) is a semi deciduous tropical tree commonly known as 'Amrood' in Hindi and is widely grown throughout India for its fruits. *Psidium guajava* have already been reported to have hypoglycemic effect on blood glucose level (BGL) of normal and streptozotocin induced mild diabetic as well as severely diabetic rats[24]. However, surprisingly the ripe fruit peel aqueous extract has been discovered recently as a hyperglycemic agent by our research group and the observed hyperglycemic effect has been correlated with its low concentration of Mg[25].

Emblica officinalis (Family: Euphorbiaceae) is commonly known as 'Amla' in Hindi. It grows in India as well as tropical and subtropical regions of world. The fruits of *E. officinalis* have been reported to have hypolipidemic activities[26]. The aqueous extract of seeds was found to have antidiabetic activity by our research group[27].

Trichosanthes dioica (Family: Cucurbitaceae) is a dioecious perennial herbaceous vegetable. It is commonly known as 'Parval' in Hindi and is widely grown throughout India. Its fruits are a rich source of Vitamin C and minerals (Mg, Na, K, Cu, S). Effect of fruit powder has also been studied on blood sugar[28]. Glycemic elemental profile of *Trichosanthes dioica* has also been studied by our research group[29].

Withania coagulans (Family: Solanaceae) is commonly known as Indian cheese maker. The hot aqueous extract of *W. coagulans* fruits has been shown to exert antidiabetic effect[30]. The same hot aqueous extract of *W. coagulans* fruits has also increased the glucose utilization in isolated rat hemidiaphragm cells[31]. However, our research group has found better antidiabetic effect in cold aqueous extract[32].

Raphanus sativus (Family: Brassicaceae) is most valued by the inhabitants of many Western and Eastern countries as a food and medicine. Radish juice is used as a household remedy for the prevention and treatment of gall stone, jaundice, flatulence, indigestion, and in various gastric ailments. The juice of radish has a tonic and laxative action on the intestine and indirectly stimulates the flow of bile[33] In addition, radish juice has been found to possess antidiabetic activity by our research group[34].

F. religiosa (Family: Moraceae) is also commonly known as 'Sacred Tree' in English and 'Bodhi or Peepal' tree in Hindi. The tree is reported to have numerous therapeutic utility in traditional and folk medicines such as in the cure of respiratory disorders and traditional use of the plant in folk medicine educe its efficacy in the cure of respiratory disorders and certain skin diseases[35]. The aqueous extract of *F. religiosa* stem bark has been reported to have significant antidiabetic activity in streptozotocin-induced diabetic models[36]. The aqueous extract of *F. religiosa* has been reported for its glycemic profile on blood glucose level (BGL) of normal and streptozotocin (STZ) induced sub- and mild-diabetic rats during fasting blood glucose (FBG) and glucose tolerance test (GTT) studies and also to determine the elements responsible for their antidiabetic effect. This is the first reporting of elements involved in the anti-diabetic efficacy of the aqueous extract of *F. religiosa* leaves[37].

CONCLUSION

Currently, several countries are confronted with the problem of enormous rise in the number of people suffering from diabetes. It has been estimated that 25% of the world population is affected by this disease. Currently, India is having the largest number of diabetics and is therefore termed as the 'diabetic capital of the world'. The World Health Organization

estimated that the number of diabetic people have increased from approximately 30 million in 1985 to more than 171 million in 2000. It is further estimated that this number will cross the 366 million mark by 2030 especially in developing countries like India in the age group 45 to 64 years[5]. Despite considerable progress in the treatment of diabetes by oral antidiabetic drugs, search for newer drugs continues because the existing synthetic drugs have several limitations as they have been reported to produce side effects and are cost-effective too. Moreover, medicinal plants are supposed to be gentle, effective and specific in function to organs or systems of the body[38].

The treatment of diabetes with synthetic drugs in the developing countries is expensive due to poverty and lack of access to medicare. Hence, plant-based therapy or 'phytotherapy' has significant role to play in the developing countries as compared to synthetic drugs being safe since plants consist of naturally-occurring compounds (phytoconstituents) viz. polyphenols, flavonoids, terpenoids, tannins, glycosides and alkaloids, etc. with proven antidiabetic activity[39,40], and hence are found to be safe, less expensive and available as a gift of nature[6]. Despite the availability of prevalent antidiabetic drugs in the market, therapy from medicinal plants is being used with success to treat this dreaded disease.

Several traditional plant treatments for diabetes have been used throughout the world. Considering the health services and therapeutic treatments needed to manage diabetes and its complications, better health care resources with greater affordability and negligible health hazards are required to provide adequate diabetes care in the poor and developing countries[5]. Herbal drugs and their formulations are often considered to be less toxic and without any side effects than their synthetic counterparts due to the synergistic effect of natural products associated with several bioactivities[6,7] as bioactive potential of medicinal plants are often attributed to the presence of the so called secondary plant metabolites[41]. On the basis of WHO recommendations, antidiabetic drugs of plant origin used in traditional systems of medicine are gaining greater significance as several traditional antidiabetic plants have been scientifically and systematically validated worldwide[28].

Till date, there is very little available knowledge on the specific mechanism of action of folkloric medicinal plants with antidiabetic activity. Since, most of these medicinal plants have been found to contain secondary metabolites like glycosides, alkaloids, terpenoids and flavonoids, etc. which possess antidiabetic effects therefore, the antidiabetic activity of medicinal plants could be due to the synergy of these plant constituents. The research for alternate therapy based on medicinal plants in the management of diabetes mellitus will continue to gain prominence across the globe as, this disease poses several challenges not only to the physician but also to the researcher[7].

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Table 1: Some traditional Indian Medicinal plants used to treat diabetes

S.No.	Botanical name	Common name	Family name	Parts used
1.	*Abelmoschus moschatus*	Abelmosk	Malvaceae	Seeds
2.	*Acacia arabica*	Indian Gum Arabic tree	Mimosaceae	Seeds & Bark
3.	*Acanthopanax senticosus*	Siberian ginseng	Araliaceae	Stem bark
4.	*Aegle marmelos*	Wood apple	Rutaceae	Root bark, leaves, callus and seeds

S.No.	Botanical name	Common name	Family name	Parts used
5.	*Agrimony eupatoria*	Church Steeples	Rosaceae	Flowers
6.	*Allium cepa*	Onion	Liliaceae	Essential oil
7.	*Allium sativum*	Garlic	Alliaceae	Bulb
8.	*Aloe vera*	Medicine Plant	Asphodelaceae	Leaves
9.	*Annona squamosa*	Custard apple	Annonaceae	Leaves
10.	*Areca catechu*	Betel nut	Arecaceae	Leaves
11.	*Artemisia pallens*	Wormwood	Compositae	Aerial parts
12.	*Azadirachta indica*	Paradise Tree	Meliaceae	Leaves & oil
13.	*Biophytum sensitivum*	Siker pud	Oxaildaceae	Whole plant
14.	*Bougainvillea spectabilis*	Great Bougainvillea	Nyctaginaceae	Leaves
15.	*Brassica nigra*	Black mustard	Cruciferae	Seed oil & leaves
16.	*Bruguirea gymnorrhiza*	Black mangrove	Rhizoporaceae	Roots
17.	*Camellia sinensis*	Green tea	Theaceae	Leaves
18.	*Cassia auriculata*	Spectacular cassia	Fabaceae	Flowers
19.	*Catahranthus roseus*	Rose peri winkle	Apocyanaceae	Leaves
20.	*Cinnamonum zeylanicum*	Cinnamon	Lauraceae	Bark
21.	*Costus speciosus*	Crepe ginger	Costaceae	Rhizome
22.	*Cynodon dactylon*	Doob	Poaceae	Whole plant
23.	*Emblica officinalis*	Indian gooseberry	Euphorbiaceae	Seeds
24.	*Eucalyptus globules*	Blue Gum Tree	Myrtaceae	Leaves
25.	*Ferula asfoetida*	Stinking gum	Apiaceae	Resin
26.	*Ficus benghalensis*	Indian fig	Moraceae	Stem bark & aerial roots
27.	*Ficus glomerata*	Cluster fig tree	Moraceae	Leaves
28.	*Ficus religiosa*	Sacred tree	Moraceae	Bark & leaves
29.	*Guazuma ulmifolia*	Bay cedar	Sterculiaceae	Bark
30.	*Gymnema sylvestre*	Periploca of the woods	Asclepiadaceae	Leaves
31.	*Helicteres isora*	Indian screw tree	Sterculiaceae	Fruits
32.	*Hibiscus rosa sinensis*	Chinese hibiscus	Malvaceae	Aerial parts & flower
33.	*Ichnocarpus frutescens*	Black creeper	Apocyanaceae	Leaves
34.	*Jatropha curcas*	Physic nut	Euphorbiaceae	Leaves
35.	*Mangifera indica*	Mango	Anacardiaceae	Leaves
36.	*Momordica charantia*	Bitter melon	Cucurbitaceae	Fruits
37.	*Murraya koenigii*	Curry leaf tree	Rutaceae	Leaves
38.	*Ocimum sanctum*	Holy basil	Lamiaceae	Leaves
39.	*Phyllanthus reticulates*	Black honey shrub	Phyllanthaceae	Leaves
40.	*Polyalthia longifolia*	Buddha tree	Annonaceae	Bark
41.	*Posidonia oceanic*	Neptune grass	Posidoniaceae	Leaves
42.	*Psidium guajava*	Guava	Myrtaceae	Unripe fruit peels
43.	*Punica granatum*	Pomegranate	Puniacaceae	Peels, leaves & flowers
44.	*Raphanus sativus*	Radish	Brassicaceae	Root

S.No.	Botanical name	Common name	Family name	Parts used
45.	*Rumex patientia*	Garden patience	Polygonaceae	Seeds
46.	*Salvadora oleoides*	Salvadora	Salvadoraceae	Aerial parts
47.	*Selaginella tamariscina*	Resurrection fern	Selaginellaceae	Whole plant
48.	*Senna auriculata*	Tanner's cassia	Fabaceae	Leaves
49.	*Strychonous potatorum*	Clearing nut tree	Loganiaceae	Whole plant
50.	*Syzygium cumini*	Java plum	Myrtaceae	Fruits & leaves
51.	*Terminalia bellerica*	Belliric myrobalan	Combretaceae	Fruits
52.	*Tinospora cordifolia*	Heartleaf moonseed	Menispermaceae	Roots
53.	*Trichosanthes dioica*	Parwal	Cucurbitaceae	Fruits
54.	*Trigonella foenum graecum*	Fenugreek	Fabaceae	Seeds
55.	*Vaccinium bracteatum*	Sea bilberry	Ericaceae	Leaves
56.	*Vitex negundo*	Five leaved chaste tree	Lamiaceae	Leaves
57.	*Withania coagulans*	Indian cheese maker	Solanaceae	Fruits

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EXTREMOPHILES- A CLUE TO ORIGIN OF LIFE AND BIOLOGY OF OTHER PLANETS

Shreerup Goswami[1] and Madhumita Das[2]

It is believed that life in the form of extremophiles may have begun on Earth in hydrothermal vents far under the ocean's surface. The discovery of extremophiles points out the extraordinary adaptability of primitive life-forms and also raises the prospect of finding at least microbial life elsewhere in the Solar System and beyond. Extremophiles living in varied range of extreme environments and their classification with examples are discussed in the present article. As the products obtainable from extremophiles such as proteins, enzymes (extremozymes) and compatible solutes are of great interest to biotechnology; the potential applications of extremophiles in biotechnology are also enumerated.

INTRODUCTION

"Extreme environment" and "biology on Earth or exobiology on other planets" are complimentary to each other. Organisms that live in moderate or normal environments are known as mesophiles or neutrophiles. Extremophiles (from Latin *extremus* meaning "extreme" and Greek *philiā* meaning "love") can be defined as any microbe that can exist in extreme conditions of temperature, pressure, pH, salinity, nutrient concentrations or concentrations of hostile chemicals, and also conditions having high levels of radiation, harmful heavy metals and toxic compounds (organic solvents) etc., which are detrimental to most of the neutrophiles/ mesophiles. Extreme is a relative term, which is viewed, compared to what is normal for human beings. These extremophiles, not only tolerate specific extreme condition(s), but usually require these for survival and growth[1-7]. The range of environmental extremes tolerated by microbes is much broader than other life forms. The limits of growth and reproduction of microbes are, –12° to more than +100°C, pH 0 to 13, hydrostatic pressures up to 1400 atm and salt concentrations of saturated brines. Besides natural extreme environments, there are manmade extreme conditions such as coolhouses, steamheated buildings and acid mine waters[1].

On Earth, extreme environments range from the superheated waters of submarine volcanic vents to the ultra-dry bitter cold of the Antarctic Dry Valleys. Organisms are living in caves dripping with sulfuric acid and others are thriving in intensely alkaline solutions. There are organisms—happily existing in saturated salt solutions, enduring megadoses of ionizing radiation, or deriving their food and energy sources from unpromising inorganic materials like manganese, iron, and sulfur compounds. Some microbes grow in simulated Mars. Some bacteria went to the moon and came back—alive[8-13].

Most known extremophiles are microbes. Many extremophiles belong to the kingdom Archaea, also known as Archaebacteria. In other words, the majority of known extremophiles are varieties of archaeabacteria. There are also extremophiles to be found outside the kingdom Archaea. They are some bacteria and eukaryotic prokaryotes, few species of worm (Pompeii worm), crustacean (Antarctic krill), insects (Grylloblattodea) and water bear[2].

Possibly the most impressive example of an extremophile is a bacterium, *Streptococcus mitis*, which was found, embedded in the camera of the

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lunar probe Surveyor 3 by Apollo 12 astronauts. This bacterium had survived on the surface of the moon for three years.

The Pompeii worm, an extremophile, lives on the floor of the ocean clustered next to hydrothermal vents. Living at temperatures up to 113°C (Thermophiles), these animals are the most heat-tolerant known to science, and they aren't even unicellular.

Thiobacillus, an extremophile will grow in solutions containing 3% sulfuric acid, while other types of bacteria have been found in the saturated brine of the Great Salt Lake in Utah and in an icy pool in Antarctica containing 33% calcium chloride. Some bacteria have survived enormous pressures, up to 10 tons/cm, while low pressures appear to pose no threat to them at all, providing that liquid water is present. However, although some species of bacteria, such as *Deinococcus radiodurans* have been found growing in the radioactive cooling ponds where fuel cans from nuclear reactors are stored, they are tolerant of highly ionizing radiation.

Many extremophiles weren't discovered until the 1970s because they survive in extreme conditions and found in remote areas. Scientists sometimes study extremophiles as potential models of what life might look like or how it would operate on other planets. Extremophiles indicate a definite clue to the nature and behaviour of primordial life on the surface of the Earth. Scientists do believe that life may have begun on Earth in hydrothermal vents far under the ocean's surface. The discovery of extremophiles points out the extraordinary adaptability of primitive life-forms and also raises the prospect of finding at least microbial life elsewhere in the Solar System and beyond. This field of research has also attracted attention because of its impact on the possible existence of life on other planets. The products obtainable from extremophiles such as proteins, enzymes (extremozymes) and compatible solutes are of great interest to biotechnology.

CLASSIFICATION

Extremophiles are classified into different classes on the basis of their environmental niche. Accordingly they are classified as thermophiles, hyperthermophiles, psychrophiles, halophiles, acidophiles, alkaliphiles, barophiles, and endoliths etc. Classification and examples of extremophiles are presented in the Table 1. These categories are not mutually exclusive. Some extremophiles may fit into more than one category: for example, some endoliths are also thermophiles. Similarly, organisms living inside hot rocks deep under Earth's surface are both *thermophilic* and *barophilic*. An organism that qualifies as an extremophile under more than one category is known as polyextremophile.

Following are different types of extremophiles (Table -1)[1-3,12-16].

Acidophile: An organism with optimal growth at pH levels of 3 or below are acidophiles. However, the pH level inside the body of the acidophiles stays nearly neutral. Acidophiles are able to survive in the acid habitat, because its cells pump out poisonous hydrogen ions fast enough not to damage the DNA inside the nucleus. If they could not pump out the hydrogen ions, then acidophiles would not be able to survive. However, acidophiles have evolved a variety of specialized mechanisms to maintain their internal cellular pH at a constant level (usually 7.2). These mechanisms include "passive" regulation (not requiring the cell to expend energy) and "active" regulation (requiring energy).

Alkaliphile: Alkaliphile lives in alkaline environments like soda lakes, or alkaline soil. The pH level in these alkaline substances ranges from 9 to 11. Nevertheless, the alkaliphiles keep an alkaline level of about 9 pH inside the cells, but the environment has a higher level of alkalinity. Alkaliphiles can keep the right level by pumping in hydrogen ions at the right rate.

Halophile: An organism requiring at least 0.2 Molar concentrations of salt (NaCl) for growth. Halophiles are aerobic microorganisms that live and grow in high saline/salty environments. The saline content in halophilic environments is usually 10 times the saline/salt content of normal ocean water. Some environments that halophiles live in are the

Table 1. Classification and examples of extremophiles[15,16]

Environmental parameter	Type	Definition	Examples
Temperature	Hyperthermophile Thermophile Mesophile Psychrophile	Growth >80°C Growth 60-80°C 15-60°C <15°C	*Pyrolobus fumarii*, 113°C *Synechococcus lividis* *Homo sapiens* *Psychrobacter*, some insects
Radiation	Radioresistant		*Deinococcus radiodurans*
Pressure	Barophile Piezophile	Weight loving Pressure loving	Unknown For microbe, 130 MPa
Gravity	Hypergravity Hypogravity	>1g <1g	Not known Not known
Vacuum	Vacuumphile	Tolerates vacuum (space devoid of matter)	Tardigrades, insects, microbes, seeds
Desiccation	Xerophiles	Anhydrobiotic	*Artemia salina*; nematodes, microbes, fungi, lichens
Salinity	Halophile	Salt loving (2-5 M NaCl)	*Halobacteriacea, Dunaliella salina*
pH	Alkaliphile Acidophile	pH >9 Low pH loving	*Natronobacterium, Bacillus firmus, Spirulina spp.*(all pH 10.5) *Cyanidium caldarium*, *Ferroplasma sp.* (both pH 0)
Oxygen tension	Anaerobe Microaerophil Aerobe	Cannot tolerate O_2 Tolerates some O_2 Requires O_2	*Methanococcus jannaschii* *Clostridium* *Homo sapiens*
Chemical extremes	Gases Metals	 Can tolerate high concentrations of metal (metalotolerant)	*Cyanidium caldarium* (pure CO_2) *Ferroplasma acidarmanus*(Cu, As, Cd, Zn); *Ralstonia* sp. CH34 (Zn, Co, Cd, Hg, Pb)

Great Salt Lake in Utah, Owens Lake in California and the Dead Sea. These microorganisms use osmotic pressure and chemical substances like sugars, alcohols, amino acids to help control the amount of salt inside the cell. Halophiles are coated with a special protein covering, which is used to allow only certain levels of saline/salt into the cell.

Osmophile: An organism capable of growth in environments with a high sugar concentration is osmophile.

***Endolith*:** An organism that lives in microscopic spaces within rocks (between mineral

grains), such as pores is endolith. These are also known as cryptoendoliths, a term that also includes organisms living in the fissures and faults filled with groundwater in the deep subsurface.

Hypolith: An organism that lives underneath rocks in cold deserts is known as hypolith.

Lithoautotroph: It is an organism (usually bacteria), whose sole source of carbon is carbon dioxide. These organisms are capable of deriving energy from reduced mineral compounds like pyrites, and are active in geochemical cycling and the weathering of parent bedrock to form soil.

Oligotroph: An organism capable of growth in nutritionally limited environments is known as oligotroph.

***Anaerobe*:** An organism that can grow in the absence of oxygen. It cannot grow in the presence of oxygen; the presence of oxygen either inhibits growth or kills the organism.

Piezophile: An organism that lives optimally at high hydrostatic pressure; common in the deep terrestrial subsurface, as well as in oceanic trenches.

Barophiles: Barophiles are microorganisms that can survive under great pressures. They live deep under the surfaces of the earth or water. There are three kinds of these microorganisms: barotolerant, barophilic, and extreme barophiles. Barotolerant extremophiles can survive at up to 400 atmospheres below the water or earth, but grow best in 1 atmosphere. Barophilic extremophiles grow best at higher pressures up to 500-600 atmospheres. Extreme barophiles do best at 700 atmosphere or more, but some survive at 1 atmosphere. One atmosphere in the ocean is equal to 10 feet below the surface of the ocean. That means that barotolerant extremophiles can survive at 4,000 feet, barophilic extremophiles can survive at up to 6,000 feet, and extreme barophiles can survive up to 7,000 feet below the surface of the ocean.

Because of the freezing temperatures that occur at the deepest parts of the earth, barophiles are also considered to be psychrophiles.

Thermophile: It is an organism that can thrive at temperatures between 60–80°C. Thermophiles either live in geothermal habitats, or they live in environments that create heat themselves. A pile of compost and garbage landfills are two examples of environments that produce heat on their own.

Hyperthermophile: Organisms that can thrive at temperatures between 80–122 °C, such as those found in hydrothermal systems are hyperthermophile.

Thermoacidophile: Combination of thermophile and acidophile that prefer temperatures of 70–80°C and pH between 2 and 3 are known as thermoacidophile.

Psychrophile/Cryophile: An organism capable of survival, growth or reproduction at temperatures of -15 °C or lower for extended periods; common in cold soils, permafrost, polar ice, cold ocean water, and in or under alpine snowpack. They live and grow better in temperatures that are about -10 to 20°C. Psychrophiles are found mostly in the Arctic and Antarctic oceans, which remains frozen most of the year. The food that is needed by psychrophiles is inside the frozen glaciers and seawater, but flows in tiny streams in between cracks and layers of ice.

Xerophile: Organisms that can grow in extremely dry, desiccating conditions; this type is exemplified by the soil microbes of the Atacama Desert. Xerophiles are responsible for spoiling food, even the dry foods. Since xerophiles are able to live in extremely dry environments, they reproduce and create enzymes, which will break down foods stored in dry conditions.

Radioresistant: Organisms resistant to high levels of ionizing radiation, most commonly ultraviolet radiation and nuclear radiation are known as radio-resistant.

***Toxitolerant*:** Organisms able to withstand high levels of toxic elements (e.g., pools of benzene) are toxitolerant.

Metallotolerant: Organisms capable of tolerating high levels of dissolved heavy metals in solution, such as copper, cadmium, arsenic and zinc belong to metallotolerant. *Ferroplasma sp.* and *Ralstonia metallidurans* are few examples of metallotolerant.

APPLICATIONS

Extremophiles have evolved several structural and chemical adaptations, which allow them to survive and grow in extreme environments. The enzymes of these microbes, functioning in extreme environments (extremozymes), have several biotechnological applications. Antibiotics, compatible solutes and other compounds obtainable from these microbes are also finding a variety of uses[1].

The thermoalkaliphilic catalyst, which initiates the breakdown of hydrogen peroxide into oxygen and water, was isolated from an organism, *Thermus brockianus*. The catalyst operates over a temperature range from 30°C to over 94°C and a pH range from 6-10. This catalyst is extremely stable compared to other catalysts at high temperatures and pH. The catalyst have applications for removal of hydrogen peroxide in industrial processes such as pulp and paper bleaching, textile bleaching, food pasteurization, and surface decontamination of food packaging[1,3].

Research is going for ways that the special proteins inside extremophiles can be used to fight infectious diseases and genetic diseases. Enzymes are proteins and are sometimes used as biological catalysts. Protein catalysts cause chemical reactions in extremophiles that allow them to survive in deadly environments. Before extremophiles were discovered, regular proteins had to be protected from breaking down and becoming useless. Scientists hope that the proteins in extremophiles will not need special treatment like regular proteins. Many different industries would like to use these enzymes in making products like artificial sweeteners, stonewashing blue jeans, and in identifying the make up of the genes of criminals. It is expected that the enzymes inside extremophiles will replace regular enzymes used in enzyme based industries[1,3,4].

Acidophiles are used to recover metallic minerals lost during the mining of coal. It is also used to reduce sulfur levels in coal. Some acidophiles are used as organic acids or solvents. *Lactobacillus*, an acidophile is important in producing lactic acid commercially. It is also found in the human body in the mouth and intestines. Alkaliphiles are used to remove gel surfaces from x-ray film, take the hair off of animal hides, to make food, medicines, treatment of wastes, recovering spilled oil, and as anitibiotics[1,4].

Thermus aquaticus and *Thermococcus litoralis* are two thermophiles that are used as an enzyme used in DNA fingerprinting in criminal cases or in identification of parents or siblings[1]. *Bacillus stearothermophilus* is another thermophile used as an enzyme in biological detergents. Thermophiles in self-heating environments must have a supply of organic matter like food scraps in order to grow. These kinds of thermophiles turn this organic matter into a rich source of nutrients for living microorganisms and plants to use as food[1,3].

A halotolerant, *Marinobacter hydrocarbonoclasticus* can degrade a variety of aliphatic and aromatic hydrocarbons[5]. Recently, Nicholson and Fathepure[6] developed a highly enriched halophilic culture that was able to degrade benzene, toluene, ethylbenzene and xylene within a fortnight. There is a possibility of developing cost-effective methods for remediation of brine impacted soil and aquifers[1,6].

Extremozymes that are now commercially used include—alkaline proteases in detergents. It is a huge market, with 30% of the total worldwide production for detergents. DNA polymerases have been obtained from *Thermococcus littoralis*, *Thermus aquaticus*, *Thermotoga maritime*, *Pyrococcus woesii* and *P. furiosus* for application in polymerase chain reaction (PCR). Development of an ideal starch saccharification process involves use of thermostable enzymes such as *a*-amylase that does not require Ca^{2+} for its activity/stability, amylopullulanase, glucoamylase and glucose isomerase that are active in a narrow pH range for the cost-effective starch hydrolysis and these can now be obtained from Extremophiles[1,7]. Alkali and thermostable xylanases are useful in pre-bleaching of pulps in order to reduce chlorine requirement in pulp bleaching[8,9].

Scientists are studying the genes of halophiles so that they can find a way to reclaim soil that is

ruined by overuse, flooding, and too much irrigation. Over time, these soils are making too saline/salty to grow crops, but the genes inside halophiles might demonstrate— how to fix the ruined land by blending the genes of the halophiles with the genes of the crops. That would hopefully make the crops able to grow in soil with above average saline/salt content[1,14].

Genetically engineered extremophilic microbes are now used in bioremediation of waste sites contaminated with a variety of organopollutants, radionuclides and heavy metals[1,3]. The uses and applications of extremophiles are enumerated in Table 2[1,3].

Table 2. Applications of extremophiles in biotechnology[1,3.]

Thermophiles	
DNA polymerase	DNA amplification by PCR
DNA ligase	Ligase chain reaction (LCR)
Alkaline phosphatase	Diagnostics
Proteases and lipases	Dairy products
Lipases, pullulanase, amylopullulanase, and proteases	Baking and brewing and amino acid production from keratin
Amylases, glucoamylase, *a* - glucosidase, pullulanase, amylopullulanase and xylose/glucose isomerases	Starch processing, and glucose and fructose for sweeteners
Alcohol dehydrogenase	Chemical synthesis
Xylanases	Paper bleaching
Antibiotics	Pharmaceutical
layer proteins and lipids	Molecular sieves
Oil degrading microorganisms	Surfactants for oil recovery
Sulphur oxidizing microorganisms	Bioleaching, coal, and waste gas desulfurization
Thermophilic consortia	Waste treatment and methane production
Psychrophiles	
Alkaline phosphatase	Molecular biology
Proteases, lipases, cellulases, and amylases	Detergents
Lipases and proteases	Cheese manufacture
Proteases	Contact-lens cleaning solutions, meat tenderizing
Polyunsaturated fatty acids	Food additives, dietary supplements
Various enzymes	Modifying flavours
Galactosidase	Lactose hydrolysis in milk products
Ice nucleating proteins	Artificial snow, ice cream, other freezing applications in the food industry
Ice minus microorganisms	Frost protectants for sensitive plants
Various enzymes (e.g. dehydrogenases)	Biotransformations
Various enzymes (e.g. oxidases)	Bioremediation, environmental biosensors
Methanogens	Methane production
Halophiles	
Bacteriorhodopsin	Optical switches and photocurrent generators in bioelectronics
Polyhydroxyalkanoates	Medical plastics
Rheological polymers	Oil recovery
Eukaryotic homologues (e.g. *myc* oncogene product)	Cancer detection, screening antitumour drugs
Lipids	Liposomes for drug delivery and cosmetic packaging
Lipids	Heating oil
Compatible solutes	Protein and cell protectants in a variety of industrial uses (e.g. freezing, heating)
Various enzymes (e.g. nucleases, amylases, proteases)	Various industrial uses (e.g. flavouring agents)
Linoleic acid, β -carotene and cell extracts and feedstock	Health foods, dietary supplements, food colouring,

(e.g. *Spirulina* and *Dunaliella*) Microorganisms and flavours Microorganisms Membranes	 Fermenting fish sauces and modifying food textures Waste transformation and degradation (e.g. hypersaline waste brines contaminated with a wide range or organics) Surfactants for pharmaceuticals
Alkaliphiles Proteases, cellulases, xylanases, lipases and pullulanases Proteases Elastases, keritinases Cyclodextrins Xylanases and proteases Pectinases Alkaliphilic halophiles Various microorganisms	 Detergents Gelatin removal on X-ray film Hide dehairing Foodstuffs, chemicals, and pharmaceuticals Pulp bleaching Fine papers, waste treatment, and degumming Oil recovery Antibiotics
Acidophiles Sulphur-oxidizing microorganisms Microorganisms	 Recovery of metals and desulfurication of coal Organic acids and solvents
Organic solvent tolerant microbes	Bioconversion of water insoluble compounds (e.g. sterols), bioremediation, biosurfactants
Radiation-resistant microbes	Degradation of organopollutants in radioactive mixed-waste environments
Oligotrophs/oligophiles	Bioassay of assimilable organic carbon in drinking water
Barophiles	Microbially enhanced oil recovery process

DISADVANTAGE

Extremophiles causes acid mine drainage. *Ferroplasma* was found growing at pH 0 in acid mine drainage in Iron Mountain in California. Acidophiles such as some gastrointestinal pathogens are acid-resistant and can survive in low pH in our own stomachs and cause disease. Two such microbes are *Escherichia coli*, a well-known gastrointestinal pathogen, and *Helicobacter pylori*, which causes stomach ulcers.

DISCUSSION

It can be firmly said that extremophiles would be living in conditions that are the norm for their biology and not extreme at all for them, however, it is extreme environment for mesophiles or neutrophiles.

The intensified search for life in harsh and difficult environments on Earth has been one important benefit of our interest in the possibilities of life elsewhere in the universe. In turn, the accelerated pace at which scientists uncover ever greater limits to life on Earth has inspired them to speculate more realistically on the forms and constraints that such extraterrestrial life may take on other planets. It is evident that understanding extreme environments is important to understanding biology and evolution in general. It is also critical in helping search for life on other planets.

Astrobiology is the field concerned with forming theories, such as panspermia, about the distribution, nature, and future of life in the universe. Astrobiologists are particularly interested in studying extremophiles, as many organisms of this type are capable of surviving in environments similar to those known to exist on other planets. Thus, scientists study extremophiles as potential models of what life might look like or how it would operate on

other worlds. We know that there are a number of environments that mimic some features of the dry, cold surface of Mars. The Antarctic Dry Valleys and their permanently ice-covered lakes may represent one stage of Mars' past development[11]. It is somehow evident that mars may have regions in its deep subsurface permafrost that could harbor endolith communities. There is possible existence of the counterparts of the deep subsurface microbial inhabitants of Earth in the deep surface of Mars. The Europa (Jupiter's moon) and perhaps Callisto (?) may harbor life, especially at hypothesized hydrothermal vents at the ocean floor like our Earth[11].

Geological and geochemical evidence indicates that earth remained hot for several hundred million years, due to frequent meteorite impacts that were capable of heating oceans and the atmosphere up to 100°C. Hyperthermophiles could have been either the first living organisms or the only survivors following such sterilizing events[12]. We know that such extreme environments on Earth have persisted for millions of years. Indeed, there are many suggestions that the origins of life on this planet occurred in a hot, sulfurous, and non-oxygen environment (i.e. in hydrothermal vents) that it is now called very extreme. Extremophiles have played their best part in the early development of our biosphere, when conditions were much different from present. Bacteria that used iron for food are still very much alive. Such weird bacteria were essential to form the atmosphere that enabled the development of other life forms[12, 13].

Life is common in the universe, as life can ostensibly survive almost anywhere there is liquid water. It is suggested here that while environments capable of supporting life may be common, this does not in itself support the notion that life is common in the universe. Given that interplanetary transfer of life may be unlikely, however, the actual origin of life may require specific environmental and geological conditions that may be much less common than the mere existence of liquid water[13, 14].

Understanding the subject extremophiles will make us to understand origin of life and biology of other planets. Yet, very little is known about the ecology, taxonomy, evolutionary history, physiological and behavioural strategies of extremophiles especially in Indian subcontinent. Hence, scientific programmes must be launched, especially in India to learn more about this least known branch of science. Distributional and ecological work of extremophiles should be encouraged in the developing country like India. An inventory of biodiversity of such organisms must be prepared by a group of biologists and earth scientist. Ministry of Science and Technology and Ministry of Environment and Forest, Government of India, different autonomous research institutions, Botanical Survey of India, Zoological Survey of India, International bodies must encourage and provide financial support for collaborative, multi-scale research projects in this infant branch of science.

ACKNOWLEDGEMENT

The authors are greatly indebted to Dr. T. Satyanarayana; Dr. C. Raghukumar, Dr. S. Shivaji; Dr. S. Narang, Dr. A. Archana, R. Cavicchioli and T. Thomas as their praiseworthy research and publications encouraged us to write this popular science article to make aware the general scientific community about extremophiles. The authors are also thankful to Prof. B.C. Guru, Professor, Department of Zoology, Utkal University for critically going through the manuscript.

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BIOGAS GENERATION FROM WATER HYACINTH – ALTERNATIVE OPTION FOR RURAL ENERGY DEMAND

J. N. Mishra and P. L. Pradhan

Presently biogas is produced mainly from cow dung, producing methane under anaerobic fermentation. But cow dung is gradually becoming scarce to feed all the biogas plants regularly. As a result many biogas plants are found defunct. There are many wastes such as paddy/wheat straw, water hyacinth, rice husk etc. which can be utilized to generate biogas. Water hyacinth has already proved itself as a potential source for energy generation. It is one of the most successful colonizers in water, which has established itself as a persistent aquatic weed. Most of the proven methods of control have proved ineffective. Almost all rural sectors have large supply of this weed and cow dung. From experiments it is seen that, it has a good potentiality for biogas production. If this can be used for biogas production, there is an estimate that it can meet 90% of the present rural energy need.

INTRODUCTION

Biogas is a clean, unpolluting, smoke and soot free fuel for cooking, lighting and running of engines. It contains 50– 65% methane, which is inflammable, and 35-45% carbon dioxide, along with hydrogen, hydrogen sulphide and ammonia as trace amount. Biogas is produced from cattle dung, human excreta and other organic matters in Biogas plant commonly known as Gobar gas plant through a process called anaerobic digestion. One cubic meter biogas can keep one biogas lamp of luminosity equivalent to 60 watt electric lighting for 6-7 hours. Biogas is also a superior fuel for producing power. One cubic meter can keep one hp engine working for two hours roughly equivalent to 0.6 lit of diesel. The use of energy of one cubic meter biogas can save 3.5 kg of wood or 1.6kg of coal or 4.7 Kw of electricity

Table 1. Gas productivity and methane content from agricultural waste[2]

Material	Gas produced/tonne of dried material(m^3)	Methane content (%)
General stable manure from live stock	260 – 280	50 – 60
Rice husk	615	70
Fresh grass	630	59
Hemp	359	59
Straw	342	59
Leaves from trees	210 – 294	58
Sun flower leaves and stalks	300	58
Sludge	640	50
Water hyacinths	**300 – 350**	**78**

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Advantages of biogas are given below:

1. Domestic fuel
2. Manure for agriculture
3. Sanitation
4. Health
5. Motive power

Presently biogas is produced mainly from cow dung, producing methane under anaerobic fermentation. But cow dung is gradually becoming scarce to feed all the biogas plants regularly. As a result many biogas plants are found defunct. There are many wastes such as paddy/wheat straw, water hyacinth, rice husk etc. which can be utilized to generate biogas. The gas productivity and methane content from commonly used agricultural waste are given in Table 1. From Table 1 it can be seen that water hyacinth is a very good potential source for generation of biogas. It is abundantly present in almost all the districts of Orissa and causing water pollution problems. Water hyacinth (*Eichhornia crassipes*) is presently considered a noxious weed blocking water ways, fish ponds and reservoirs and is available in plenty. The growth of this water weed is very fast. It can reproduce from 10 plants to 6,00,000 plants in a span of 8 months. The annual productivity is about 1050 tones per hectare of water surface.

RURAL ENERGY NEED

The energy required in rural areas is mostly utilized for household, agriculture, lighting and transport purposes (Table 2)[5]. From Table 2, it is clear that most of the energy consumed in rural sectors is for household 64% and for agriculture 22%. The resource wise break up of house hold energy needs is presented in Table 3. Energy requirement of the household sector for cooking, lighting, space heating, domestic water supply etc. is met through commercial energy (13.7%) like coal, oil and electricity as well as non-commercial energy (86.3%) like firewood, agricultural wastes and dung cakes. From Table 2 it is clear that, firewood constitutes 71% of the rural household energy needs. If water hyacinth can be exploited for generation of biogas as an alternative to fire wood, then this can solve 90% problem of rural energy demand and consequently check the environmental degradation.

Table 2. Utilisation pattern of rural energy use

Household energy	64%
Agriculture	22%
Non agriculture work	7%
Lighting	4%
Transportation	3%
TOTAL	**100%**

Table 3. Resouces used for meeting household energy needs

Fired wood	71.0%
Coal, oil and electricity	13.7%
Agricultural waste	8.0%
Dung cakes	7.3%
TOTAL:	**100%**

Table 4, Physico chemcial characterstics of water hyacinth

Physical Characteristics	**Percentage**
(i) Moisture	92.87
(ii) Total solids	7.13
a) Volatile solids	5.82
b) Residue	1.31
Chemical characteristics	
i) Carbon	32.51
ii) Hydrogen	4.22
iii) Nitrogen	1.78
iv) Cellulose	25.00
v) Lignin	10.99
vi) Carbon to nitrogen ratio	18.26
vii) Specific gravity	0.25

PHYSICO CHEMCIAL CHARACTERISTICS OF WATER HYACINTH

The physical and chemical characteristics of water hyacinth are presented in Table 4 [6]. From this table, it is seen that water hyacinth has a very high content of moisture and 83% of its total solids are volatile. Its carbon to nitrogen ratio is 18.26 and cellulose content is 25%, which shows that it has a good potentiality for biogas production.

BIOGAS GENERATION

The results of experiments[2] on water hyacinth for biogas production is given below:

i)	Biogas production per kg of wet water hyacinth	53.50 liters
ii)	Biogas production per kg of dried water hyacinth	750.61 liters
iii)	Biogas production per kg of volatile solids of water hyacinth	919.24 liters
iv)	Methane contents of the biogas generated from water hyacinth	78%

From the above result it is seen that, 1 kg of wet water hyacinth produced 53.5 liter of biogas with 78% methane content. Retention period of 30 days were observed.

BIOGAS PLANT USING WATER HYACINTH

Need to change the traditional plant

Behavior of water hyacinth under biodegradation is different from that of cattle dung. Cattle dung has a specific gravity almost equal to water and remains wherever it has been fed into the digester while water hyacinth floats over water surface when fresh and as digestion proceeds, partially and fully decomposed material settles down at the bottom. So, traditional biogas plants based on cattle dung as feed material could not be used for water hyacinth. It is also observed that deliberate efforts are required to bring an intimate contact of microbes with fresh and floating material for decomposition. The final decomposed material obtained is in powder form.

Domestic biogas plant for water hyacinth

A domestic biogas plant of 0.4 m^3 capacity was developed and fabricated at Vallabh Vidyanagar, Gujarat, which could be placed inside the kitchen and save 50% LPG requirement of a family. This plant uses water hyacinth. The line diagram of this plant is given in Fig.1. The main design modifications done in traditional biogas plant working on cattle dung are:

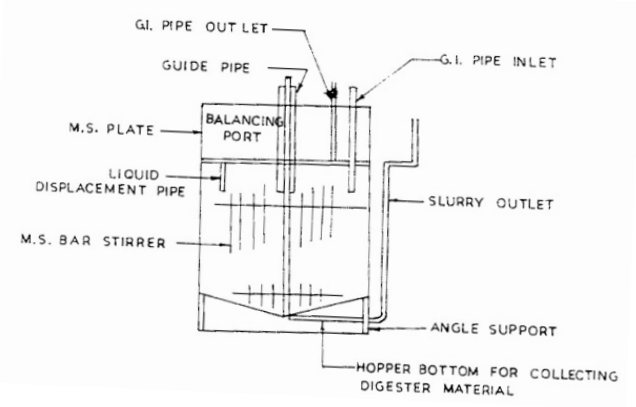

Fig. 1 Domestic Biogas Plant for Water Hyacinth

I) The inlet is provided near the top of the digester with proper sealing arrangement.

ii) The slurry outlet is provided from the bottom of the digester. The bottom should be hopper to facilitate the discharge of digested slurry.

iii) There is a stirring (mixing) arrangement for intimate contact of microbes with substrate.

In this plant, 550 gms of chopped dried water hyacinth is to be fed daily with 20 liters of water. Daily 400 liters of biogas (with 78% methane content) is generated. Chopped wet water hyacinth initially mixed with digested slurry, brought from another biogas plant. It is clear from this plant that, this domestic biogas plant based on dried water hyacinth would be very useful for substituting the conventional fuels for cooking.

Kachra biogas plant

A family size biogas plant (2 –3 m^3 biogas capacity per day) was designed and tested at Gujarat

Agricultural University, Ananad, Gujarat[2]. This plant was named as Kachra gas plant. The line diagram of this plant is shown in Fig. 2. The water hyacinth must be copped to few cm sized pieces. Stirring is the most important operation, since the material floats in a thick layer (30 – 40 cm).

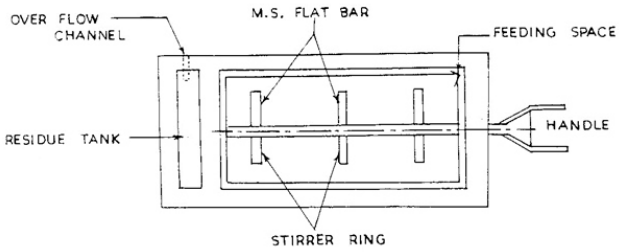

Fig. 2 Plan of a Kachara Bio Gas Plant

The stirring should be so designed that, it should be able to submerge the floating material. In this plant, the horizontal stirrer is provided and is mounted on a 4cm diameter water pipe shaft. The plant is initially filled with water in which few buckets of cow dung or well rotten compost are added. Initially 1 kg of urea may be added to the digester and the evolved gas should be let out into air for a week. During this period the gas should never be tested for burning due to possible danger of its explosion and accident.

CONCLUSION

Water hyacinth has already proved itself as a potential source for energy generation. It is one of the most successful colonizers in water, which has established itself as a persistent aquatic weed. Most of the proven methods of control have proved ineffective. Almost all rural sectors have large supply of this weed and cow dung. From experiments it is seen that, it has a good potentiality for biogas production. If this can be used for biogas production, there is an estimate that it can meet 90% of the present rural energy need.

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WORST OFFENDERS ADDED IN FOOD ITEMS

B. Suresh[1] and G. Chelladurai [2]

We don't just want our food to taste good these days. It also has to look good. As a result, food producers use any of laboratory-made additives to make appear fresher, more attractive and last longer on the shelf. The Food Safety and Standards Authority of India (FSSAI), Quality Assurance Division, (A Statutory Authority established under the Food Safety and Standards Act, 2006) provides the clear idea about the permissible limit of the additives added in food items. International Numbering System [INS] gives the Number to the Food additives. INS is only for identifying the INS No. of these food additives or their synonyms as per Codex. The manufacturers use additives. While some additives are harmless, others cause everything from hives and asthma to nausea and headaches in some people. List of the top 12 chemical additives and their possible side effects will help to decipher ingredient lists at supermarket.

INTRODUCTION

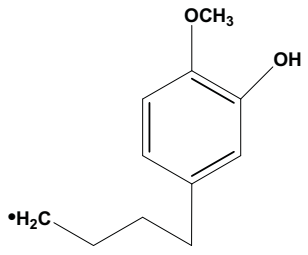
Modern food-production methods have opened major avenues of exposure to environmental carcinogens and endocrine-disrupting compounds meaning it can interfere with humans' hormones. Pesticides sprayed on crops, antibiotics used on poultry, and hormones given to cattle expose consumers to involuntarily contaminants that become part of the body. Some of these exposures may increase till breast cancer risk [1,2].

BHA (BUTYLATED HYDROXYANISOLE) AND BHT (BUTYLATED HYDROXYTOLUENE)

Butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are antioxidants and also delay rancidity in fats, oils, and foods that contain oils, such as cereals, sausages, dried meats, chewing gum, vegetable oil, and potato chips. Since they can easily be replaced by safer alternatives like vitamin E or packing under nitrogen instead of air, or even be completely left out, there is no reason to take the chance; these chemicals to be avoided as much as possible.

1. BUTYLATED HYDROXYANISOLE (BHA)

BHA is used to preserve some cereals, chewing gum and potato chips, according to the centers. It is also used in rubber and petroleum products. According to the National Institutes of Health and the World Health Organization's International Agency for Research on Cancer considers Butylated hydroxyanisole is "reasonably anticipated to be a human carcinogen, because on animal studies that have shown that their chemical composition can cause tumors in rats' and hamsters' fore stomachs (something humans don't have) and fish livers [3,4]. FSSAI suggested that the permissible limit of BHA in food items is 200 p.p.m. and the INS No. is 320.



$C_{11}H_{15}O_2^{\bullet}$
Exact Mass: 179.11
Mol. Wt.: 179.24
m/e: 179.11 (100.0%), 180.11 (12.1%), 181.11 (1.1%)
C, 73.71; H, 8.44; O, 17.85

BUTYLATED HYDROXY ANISOLE (B.H.A)

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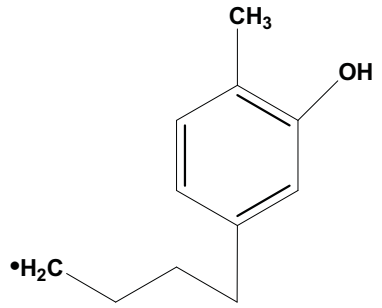
2. BUTYLATED HYDROXYTOLUENE (BHT)

BHT the common additive used to prevent oxidation in a wide variety of foods and cosmetics is listed by the National Toxicology Program (NTP) in 2005 as "reasonably anticipated to be a human carcinogen" on the basis of experimental findings in animals. It is also used in jet fuels, rubber, petroleum products, transformer oil and embalming fluid. BHT should not be allowed to enter the environment, can cause liver damage, and is harmful to aquatic organisms. FSSAI suggested that the permissible limit of BHT in food items is 50 p.p.m. and the INS No. is 321.

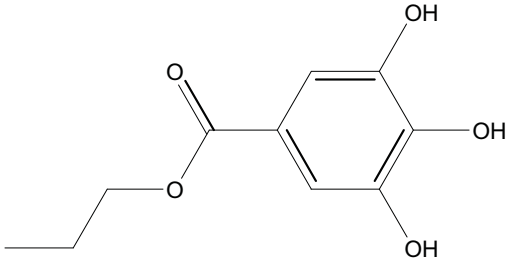


$C_{11}H_{15}O^{\bullet}$
Exact Mass: 163.11
Mol. Wt.: 163.24
m/e: 163.11 (100.0%), 164.12 (12.1%)
C, 80.94; H, 9.26; O, 9.80

BUTYLATED HYDROXY TOLUENE (B.H.T)

3. PROPYL GALLATE

Propyl gallate is often used in conjunction with BHA and BHT. These antioxidant preservatives protect oily products from oxidation, which prolongs the life of fats and oils which would otherwise cause them to go bad. Propyl gallate can be found in mayonnaise, vegetable oil, chewing gum, meat products, and chicken soup base dried meats, as well as hair-grooming products and adhesives. Some scientists believe that propyl gallate is an "endocrine disruptor ". Endocrine disruptors can lead to developmental, reproduction and/or neurological problems, according to the National Institutes of Health, including fertility issues and an increased risk of some cancers[5]. FSSAI suggested that the permissible limit of Propyl Gallate in food items is 90 mg/kg and the INS No. is 310.

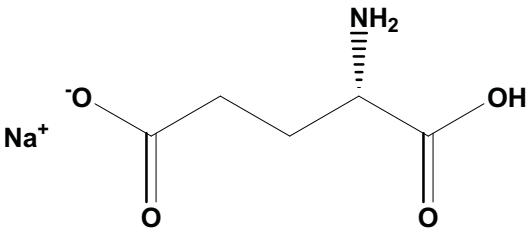


$C_{10}H_{12}O_5$
Exact Mass: 212.07
Mol. Wt.: 212.2
m/e: 212.07 (100.0%), 213.07 (11.1%), 214.07 (1.0%)
C, 56.60; H, 5.70; O, 37.70

PROPYL GALLATE

There was much hue and cry years ago when the public learned Chinese restaurants commonly added MSG to Chinese foods as a flavor enhancer. It was also learned MSG could be found in many other processed products, such as Noodles, salad dressings, condiments, seasonings, bouillons and snack chips. Some reports indicate MSG causes tightening in the chest, headaches and a burning sensation in the neck and forearms. While MSG is made of components found in our bodies' water, sodium and glutamate (a common amino acid) ingesting it is an entirely different matter [6]. FSSAI suggested that the permissible limit of MSG in food items is 5 mg/kg and the INS No. is 621.

Loaded with "unbound" fructose and glucose molecules, studies have shown that the reactive carbonyl molecules can cause tissue damage that may lead to obesity, diabetes, and also heart disease. So much for this "Strong Heart Antioxidants" cereal recipe! HFCS is made from genetically modified corn and processed with genetically modified enzymes. To make matters worse, studies have recently revealed that nearly half of tested samples of



$C_5H_8NNaO_4$
Exact Mass: 169.04
Mol. Wt.: 169.11
m/e: 169.04 (100.0%), 170.04 (5.7%)
C, 35.51; H, 4.77; N, 8.28; Na, 13.59; O, 37.84

MONO SODIUM GLUDAMATE (MSG)

HFCS contained mercury[7]. This ubiquitous sweetener, helps maintain moisture while preserving freshness. The consumption of large quantities has been fingered as a causative factor in heart disease. It raises blood levels of cholesterol and triglyceride fats, while making blood cells more prone to clotting and accelerating the aging process. FSSAI suggested that the permissible limit of HFCS in food items is 450 ppm.

6. PROPYLENE GLYCOL ALGINATE (E405) (PGA-E405)

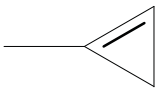
PGA – E405 is a food thickener, stabilizer, and emulsifiers are derived from alginic acid esterified and combined with propylene glycol. Even though propylene glycol is used as a food additive, it has many industrial uses including automotive antifreezes and airport runway de-icers. FSSAI suggested that the permissible limit of PGA in food items is 5 g/kg and the INS No. is 405.

7. POLYSORBATE 60

It is short for polyoxyethylene-(20) - Sorbitan mono stearate. This emulsifier is widely used in the food industry. Made of corn, palm oil and petroleum. This gooey mix can't spoil, so it often replaces dairy products in baked goods and other liquid products [8]. FSSAI suggested that the permissible limit of Polysorbate in food items is 3000 mg/kg and the INS No. is 432.

8. 1-METHYLCYCLOPROPENE

This gas is pumped into crates of apples to stop them from producing ethylene, the natural hormone that ripens fruit. Commonly known as Smart Fresh, this chemical preserves applies for up to a year and bananas up to a month. Sulfur dioxide serves the same purpose when sprayed on grapes.



C_4H_6
Exact Mass: 54.05
Mol. Wt.: 54.09
m/e: 54.05 (100.0%), 55.05 (4.4%)
C, 88.82; H, 11.18

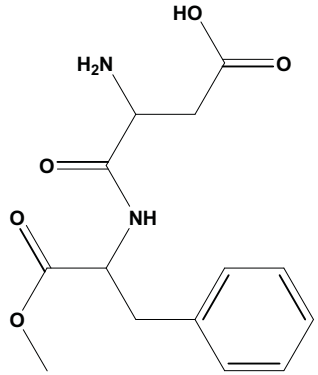
1-METHYLCYCLOPROPENE

9. ASPARTAME

Aspartame is found in the name brands Equal and NutraSweet and was hailed as a savior for dieters unhappy with a saccharine unpleasant after taste. It is composed of methanol and two amino acids. Although originally believed to be the perfect artificial sweetener, it caused brain tumors in rats in certain studies conducted in the 1970s. There was much pressure from different groups for further studies to explore the potential dangers of aspartame; it wasn't until 2005 that a new study was released. It was found that even small doses of the sweetener increased the occurrence of lymphoma and leukemia, and occasionally caused brain tumors in rats. Unfortunately, one out of 20,000 babies is born without the ability to metabolize phenylalanine, one of the two amino acids in Aspartame. As a result, it's not recommended for pregnant women or infants [9]. FSSAI suggested that the permissible limit of Aspartame in food items is 2200 mg/kg and the INS No. is 951.

10. BENZOIC ACID AND SODIUM BENZOATE

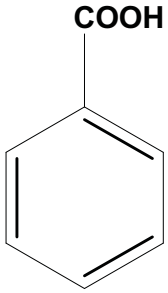
Often added to milk and meat products, these



$C_{14}H_{18}N_2O_5$
Exact Mass: 294.12
Mol. Wt.: 294.3
m/e: 294.12 (100.0%), 295.12 (15.9%), 296.13 (2.2%)
C, 57.13; H, 6.16; N, 9.52; O, 27.18

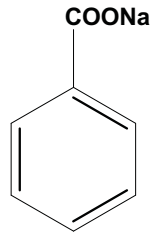
ASPARTAME

preservatives are used in many foods, including drinks, low-sugar products, cereals and meats. Both temporarily inhibit the proper functioning of digestive enzymes and cause headaches, stomach upset, asthma attacks and hyperactivity in children [10]. FSSAI suggested that the permissible limit of Benzoic acid and Sodium benzoate in food items is 50 - 1500 mg/kg. The INS No. of benzoic acid is 210 and the INS No. of sodium benzoate is 211.



$C_7H_6O_2$
Exact Mass: 122.04
Mol. Wt.: 122.12
m/e: 122.04 (100.0%), 123.04 (7.7%)
C, 68.85; H, 4.95; O, 26.20

BENZOIC ACID



$C_7H_5NaO_2$
Exact Mass: 144.02
Mol. Wt.: 144.1
m/e: 144.02 (100.0%), 145.02 (7.6%)
C, 58.34; H, 3.50; Na, 15.95; O, 22.21

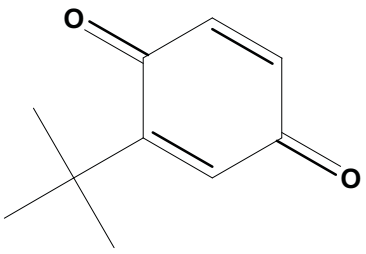
SODIUM BENZOATE

11. CANTHAXANTHIN

Egg yolk don't always come out golden yellow, so producers use this pigment to make them more palatable. Although the amounts used are very small, tests have shown greater quantities of canthaxanthin can cause retinal damage[11]. FSSAI suggested that the permissible limit of Canthaxanthin in food items is 200 mg/kg and the INS No. is 161 g.

12. TERT-BUTYL HYDRO QUINONE (TBHQ)

This chemical preservative is a form of butane that is used in crackers, potato chips and some fast food. It can also be found in varnish, lacquer and resin. It helps prolong the shelf life of food and, if it's consumed at low levels, is considered safe. In higher doses of TBHQ has been found to cause "nausea,



$C_{10}H_{12}O_2$
Exact Mass: 164.08
Mol. Wt.: 164.2
m/e: 164.08 (100.0%), 165.09 (11.0%)
C, 73.15; H, 7.37; O, 19.49

BUTYL HYDRO QUINONE

vomiting, ringing in the ears, delirium, a sense of suffocation, and collapse," according to "A Consumer's Dictionary of Food Additives." It may also cause restlessness and vision problems[12]. FSSAI suggested that the permissible limit of TBHQ in food items is 200 mg / kg and the INS No. is 319.

CONCLUSION

Most of these chemicals that enter our environment are manufactured by the chemical industry and added to the thousands of items in daily commercial that support our modern lifestyle. Under our current system, thousands of toxic chemicals have been "grandfathered" in without adequate health and safety testing. Government is handcuffed with undue burden to prove harm before any precautionary actions can be taken to prevent chemical exposure. If this system works, we would not find hazardous chemicals in people's bodies. Furthermore, we should know the FSSAI Rules and Regulations[13] about the food additives added in the food products. From the help of FSSAI we should identify the permissible limit of the food additives. From that we can choose our food products in a pure and natural way neglecting the Worst Offenders added in food items.

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A TREATISE ON THREE INDIAN WOMEN AS SCIENTIST ENTREPRENEURS IN FOOD TECHNOLOGY

Sayantani Dutta, Sayani Pal and Paramita Bhattacharjee*

This is a short treatise of three pioneering women scientist-cum-social workers. Their contributions to science and society in India are legendary. They can be considered as hallmarks of 'science-social work' bridges. They are the true scientist entrepreneurs of our country. This short journey through their lives may light many other lives.

INTRODUCTION

"Women are not only the deities of the household fire, but the flame of the soul itself" - Rabindranath Tagore. Women empowerment is the strong foundation of a peace loving prospective society.

We present to readers three brilliant Indian women personalities, who pioneered in the field of scientific research. Their scientific contribution has not been limited to research publications; they have forayed into social fields and are remarkable hallmarks of "science-social work" bridges. This short treatise would certainly boost every Indian woman scientist.

We have from the pre-independence era of our country- Dr. Kamala Sohonie who could be considered literally today as lead food scientist-technologist whose work has transcended the boundaries of food and pharmaceutical sciences.

LATE PROFESSOR (MRS.) KAMALA SOHONIE

Professor Kamala Sohonie (Fig. 1), born in 1912[1], was the first Indian woman to be awarded Ph.D. degree. She got this award in Biochemistry from Cambridge University. She was highly inspired by her father Narayanrao Bhagwat and brother Madhavrao, who were distinguished Chemists[2].

She accomplished her graduation in Chemistry from Bombay Presidency College, where she stood first and took admission in Indian Institute of Science (IISc), Bangalore for further studies.

Fig. 1. Late Professor (Mrs.) Kamala Sohonie

Sir C. V. Raman, was the then head of the institute and refused her admission on the ground that she was a woman. However, this decision did not refrain Kamala from taking admission at IISc.

Being a firm follower of the principles of Mahatma Gandhi, she decided to continue Satyagraha in Raman's office, until she convinced Sir Raman to grant her admission.[3]

At IISc, she worked under Shri Sreenivasayya on proteins in milk, pulses and legumes, which had and continue to have significant nutritional implications in India. In 1936, Kamala was the only graduate student perhaps in the world, working on pulse proteins[3]. She worked very diligently and submitted her research to Bombay University and received M.Sc. degree. Her devotion and hard work convinced Sir Raman that a woman is also capable

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for research work and thereafter he allowed women students into IISc.[2]

Later, Kamala went to Cambridge University and worked under the guidance of Dr. Derik Richter and Dr. Robin Hill on potatoes[3] (Fig. 2). She discovered that every cell of plant tissue to Cambridge University for her Ph.D. degree.She took less than 16 months to accomplish her research work along with thesis writing. She became thefirst Indian woman ''on whom the title of Ph.D. degree was conferred''[2]

Fig. 2. Kamala Sohonie at Cambridge University

Dr. Kamala Sohonie then returned to India and worked for various institutions such as Lady Hardinge College, New Delhi in 1939 as Professor and Head of the newly opened Department of Biochemistry; then as Assistant Director of the Nutrition Research Lab, Coonoor and later as Professor of Biochemistry in the newly opened Biochemistry Department at (Royal) Institute of Science, Bombay[3].

During her tenure at the Institute of Science, she worked with her students on nutritional aspects of Neera (sweet toddy or palm nectar supplemented with vitamins A and C and Fe), pulse and legume proteins as well as dhan (paddy) atta. Her work on Neera was initiated with a suggestion from the then president Dr. Rajendra Prasad[2]. The drink has high nutritive value, delicious taste and agreeable flavor. It is rich in carbohydrates and protein and contains several minerals and salts. This novel product development laid the groundwork for using jaggery and molasses as inexpensive dietary supplements. Even today, Neera is often used to help tribal malnourished adolescent children and pregnant women in recovering their strength and improving overall health.

Although the concept of nutraceuticals and functional foods are quite recent as defined by Dr. Stephen de Felice in 1989, Kamala Sohonie in those times propounded the concept of food and dietary supplement. Her work had mitigated boundaries between food and pharmaceutical sciences.

Kamala Sohonie received the Rashtrapati Award for her work on 'Neera'[3]. All the subjects of her research are till today of extreme relevance to Indian societal needs. Kamala Sohonie was the founder member of Consumer Guidance Society of India (CGSI)[1], the earliest consumer's organization in India, founded by nine women in 1966, and became the first to conduct formal product testing in 1977[2]. She was also a very popular science writer. She published a decent number of books in Marathi for young students.

In 1998, Kamala Sohonie was invited by Dr. Satyavati, the then Chairperson of Indian Council of Medical Research (the first woman DG of ICMR), to felicitate her in a remarkable ceremony in New Delhi[1]. Fatefully, at this ceremony, Kamala Sohonie collapsed leaving behind her work and substance. The 86 year's long journey came to an end[4] and India lost an outstanding contributor.

This legacy of marriage of science with social work has been continued by several women in post-independent India, among whom authors think contributions of Dr. R. Pankaja Reddy and Dr. Puspha Srivastava are noteworthy.

DR. R. PANKAJA REDDY

Dr. R. Pankaja Reddy (Fig. 3) was born on May 13, 1935 in a small village of Telangana State. She was a brilliant student and her interest in Botany was reflected from childhood. She obtained B.Sc. degree in Botany in 1952 from Andhra Pradesh Agricultural University, Hyderabad and did her M.Sc.

(Agriculture) at Indian Agriculture Research Institute, New Delhi. She also received Rockefeller Foundation Fellowship during her M.Sc. She was the first woman in India to bag this prestigious fellowship[5].

Fig. 3. Dr. R. Pankaja Reddy

She moved as a Fulbright scholar to Kansas State University, USA to pursue doctoral degree. Her area of research included monosomic analysis in wheat under the guidance of Dr. H. B. Hiney. After completion of Ph.D. in 1969, she undertook post-doctoral research in Ornamental Plant Breeding at Ohio (USA).

After returning to India, she had an opportunity to work under Dr. N. G. P. Rao, "Father of Indian Sorghum", and under Dr. M. S. Swaminathan, the "Indian Father of Green Revolution". Later she worked on the screening of wheat lines in the fields of the Indian Agricultural Research Institute (IARI)[5].

Dr. Reddy served as a scientist under Indian Council of Agricultural Research (ICAR) during 1975-95. During this period, she developed six high yielding varieties of pigeon pea with short, medium and long duration, suitable for different irrigation regimes. She also succeeded in developing six varieties of groundnut (Spanish types) with high yields. She was the initiator of forage breeding program at Indian Institute of Millets Research (the then National Research Centre for Sorghum), Hyderabad, and identified five promising varieties in fodder sorghum. The major objective of this breeding research was to fulfill the national and regional varietal requirements and thereby develop many high yielding varieties of sorghum.

Dr. Reddy believes that plant breeding is an art as well as science. During her service, she visited the agriculture field every day and noted the observations. This systematic work attitude of Dr. Reddy is an inspiration not only to women scientists but to all pursuers of science and technology. A simple living and high thinking woman, Dr. Reddy belonged to an agricultural family from a small village, worked with world class scientists and served Indian dry-land agriculture for several decades. She is regarded as one of the leading dry land agriculturalists.

After her retirement, she preferred to stay in her native place. Currently, she is living in a small village of Telangana State spending time with farming community[5]. This noble attempt of her for the upliftment of society is admirable and an inspiration to every scientist, that research is not all about developing high-end technology in the laboratory scale, but also application of science at the grass root level.

Further work on cultivation to yield value added food products from algae has been furthered by the magnanimous efforts of another outstanding personality, Dr. Pushpa Srivastava.

DR. (MRS.) PUSHPA SRIVASTAVA

Dr. Pushpa Srivastava (Fig. 4) was born on 11th of October, 1940. She did M.Sc. in Botany (1962) from Osmania University, Hyderabad and was awarded Ph.D. degree in 1968 from the same institute on the topic entitled 'Studies on the experimental cultures of certain Chlorococcales', in the field of algeal biotechnology.

She started her academic career as a Lecturer in the Department of Botany, Osmania University in 1966. Thereafter, she joined the Department of Botany, University of Rajasthan, Jaipur, in 1971 as an Assistant Professor and continued there until her retirement in 2002. She engaged herself in both teaching and research activities. She has worked on several research projects sponsored by UGC, CSIR, DST, DNES (Department of Non-conventional Energy Sources), and DBT and published 151

Fig. 4. Dr. (Mrs.) Pushpa Srivastava

research papers in national and international journals of repute. She was also the author of a book on "Spirulina cultivation using rural technology". She also visited many countries such as UK, USA, Australia, France, Japan and China to participate in scientific activities and enrich herself in science.[6]

She is the winner of three gold medals- YSRK Sarma Memorial Gold Medal (1994) for her contributions in the field of algal biotechnology; International Women Scientist Gold Medal award (2010); and life time achievement award Medal (2014) (Fig. 5). She is the first woman scientist from Rajasthan University who had been awarded Emeritus Fellowship of UGC (2011).

Fig. 5. Dr. Pushpa Srivastava receiving Life Time achievement award from Dr. G. Subramanian and Prof. V. Krishnamurthy

She is also the receiver of "Galantary Award" (2012), "Honorary Fellowship Award" (2013) and "Women Recognition Award" as Erudite (2014)[6].

After superannuation, she dedicated herself to the upliftment of rural women. The villages are her work fields for mass cultivation of Spirulina. According to her, Spirulina algae are the richest source of protein available in the world. It also contains high levels of iron, and therefore, can redress malnutrition and anaemia in children as well as in women (especially pregnant women).[7]

It can be safely used as a food supplement and acts as a health promoter. More than any other achievement, she is known for developing a simplified technology for commercial cultivation of Spirulina, for generating income for the illiterate and uneducated less privileged component of society – the ST/SC women in the two states of Rajasthan and Gujarat. This "laboratory to land" technology has successfully been transferred to the rural villages of Burthal and Kanadwas in challenging semi-dry environment of Jaipur. She by herself trained 85 women of below poverty line for large scale production of Spirulina. This unit of women uses Spirulina for preparation and marketing of various food items such as biscuits, papad, snacks, noodles, squash and capsules. The women are able to produce about 25-30 kg Spirulina per month and earn Rs. 1000-3000/month by working just for 3 hours a day. This humble attempt of her not only spearheaded production of spirulina in a large scale, but also aided many women to become economically self-dependent.

With this brilliant idea of generating income for rural women of Rajasthan, Department of Biotechnology - Govt. of India (Delhi) offered yet another similar project to her for generating income to earthquake affected victims of Gujarat in 2001. Govt. of Gujarat sanctioned 4000 sq. m land in the village - Halvad, Surendra Nagar, Saurashtra, where Dr. Srivastava built a large scale commercial unit and involved the women (affected by earthquake) in work for the mass cultivation of Spirulina. 286 women have been skilled and production from 630 sq. m land was ensured. Initially, she used to feed Spirulina itself to the target population i.e., to the malnourished children and anaemic mothers. Later,

nutraceutical Spirulina was introduced in the field of pharmaceuticals. A systematic study on Spirulina administration to patients of both genders in the age group of 40-70 years, who were suffering from hypoglycemia, anaemia and arthritis, was also carried out by her in collaboration with medical doctors. This study resulted in an improved level of sugar, lipids (LDL and VLDL), cholesterol, triglycerides and erythrocyte sedimentation rate in the blood serum of the treated patients.

Lately at the age of 74, she is writing a book on Spirulina for rural India and is still actively involved in working for the prosperity of rural women of Rajasthan pioneering a group of about 20 women. In one of her articles "Algae, a source of employment for rural women" published in the Times of India, Jaipur, she expresses her concern regarding this welfare project, "The biggest question that concerns me today is after me who will take over this work. I often think of closing down the project, but every time I look at the village women, I feel I cannot leave them in the middle of a sea," she concludes.[6]

CONCLUSION

These pioneering women have "covered the paths of their creation in a mash of varied wiles" (Rabindranath Tagore) from research and applications in Biochemistry, Engineering of food and natural products, Biopharmaceuticals and in research leading to Social welfare. We salute the contribution of the three scientist entrepreneurs of our country.

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KNOW THY INSTITUTIONS

RAJENDRA MEMORIAL RESEARCH INSTITUTE OF MEDICAL SCIENCES, PATNA

OVERVIEW

Rajendra Memorial Research Institute of Medical Sciences (RMRIMS), Patna was established in the memory of the First President of Republic of India Deshratna Dr. Rajendra Prasad in the year 1963 with Asthma as its mandate. It was taken over by Indian Council of Medical Research, New Delhi on 1st April, 1984 under Ministry of Health and Family Welfare, Govt. of India and thereafter the main thrust area is Visceral Leishmaniasis (Kala-azar).

EXISTING FACILITIES

This Institute has well equipped departments viz. Clinical medicine with OPD and 50-bedded Indoor facility, Pathology, Biochemistry, Microbiology, Immunology, Molecular biology, Epidemiology, Animal house, Social science, Biostatistics, Bioinformatics and Library. Some of the modern equipment are: Fully automated clinical chemistry analyzer, semi-auto analyzer, Flow cytometer, PCR, Gel-documentation system, Microarray, DNA sequencer, RT-PCR, 2D gel electrophoresis system, HPLC, FPLC, Cell–counter, Ion-selective analyzer etc besides the other routine instruments for the research purpose.

Our modern library and information system is featured with online bibliographic access through various online database search tools like ProQuest, ERMSS, J-Gate, JCCC etc. We also have guest house as well as International hostel to provide accommodation to our guests and scholars.

COLLABORATION

The institute is well recognized by the national and International agencies viz. World Health Organization (WHO/TDR), Institute for OneWorld Health, GlaxoSmithKline, DNDi, MSF, Bharat Serum and Vaccine Ltd. for clinical drug trials. We have collaborated with Department of Biotechnology, European Commission, WHO/TDR etc. for advance basic and epidemiological research. The institute has been identified by WHO as

reference centre for Leishmania parasite and Sera Bank; and we serve as one of the WHO centers for RDT evaluation networking.

EXTENDED FACILITIES

A tropical disease research centre cum hospital with a 150-bedded indoor facility is coming up in the Institute premises along with all the latest diagnostic and management facilities. Other facilities include ICTC for HIV counseling and testing, ART centre for AIDS treatment, Virology lab with H1N1 testing facility and IRL Tuberculosis laboratory for diagnosis, management and research purpose. We are the mentor institute for National Institute of Pharmaceutical Education and Research (NIPER), Hajipur.

OBJECTIVES

The broad objective of the Institute is to undertake research on clinical, basic and applied aspects of kala-azar.

MAJOR ACHIEVEMENTS

Successful application of PCR as better diagnostic test for Kala-azar as compared to conventional microscopy of bone marrow/ splenic aspirate, and similarly also in PKDL cases, especially with macular lesion, where sensitivity of conventional microscopy of slit kin/ biopsy is very poor is a remarkable achievement. The Institute has undertaken various clinical drug trials for VL and PKDL to assess safety and efficacy of new molecules as well as combination therapies of the existing drugs, out of which miltefosine, the first ever oral drug, have been introduced in Kala-azar elimination programme and paromomycin has been registered by Govt. of India. Apart from the other clinical trials, dose-finding study of miltefosine for treatment of PKDL cases is of great importance.

It has been experimentally demonstrated that plants' extract may be used as replacement of costly animal products for in-vitro propagation of Leishmania promastigotes and some the plants that exhibit lethal effort may be further explored for its potentiality as anti-VL drug in future. Twenty two different isolates of Leishmania and 119 sera samples of various categories of Kala Azar patients have been archived in the Leishmaina repository and sera bank.

A genomic DNA microarray library from Indian strain has been constructed to study differential gene expression related to development and regulatory pathogenicity in the different developmental stages and drug resistant and susceptible strains of *L. donovani*.

Through operational research, tremendous work has been done for effective vector management for VL elimination. In collaboration with WHO/TDR, monitoring and evaluation toolkit for IRS has been developed and training was imparted for its implementation at the ground level. Software using remote sense and GIS developed in collaboration with RRSC, Kharagpur for predicting vector density and endemicity.

THRUST AREAS

The following are the thrust areas of RMRIMS

- PCR based diagnosis
- Studies on VL-HIV co-infection
- Clinical trials
- Cost effective integrated vector management
- Leishmania repository
- Role of cytokines in responsive and unresponsive patients
- Immuno-pathology of PKDL patients
- Innate immunity in malnutrition
- Database design of leishmania parasite
- Routine Biochemical and Hematological Diagnosis and Treatment of VL/PKDL/HIV
- HLA Typing of VL Patients Studies on Drug Resistance Mechanism in Genomic and Proteomic Level

HUMAN RESOURCE DEVELOPMENT

HRD includes training to P.G. students of Life

Sciences; training to M.O.s, DMOs, KTS, VBD Consultants etc. involved in Kala-azar elimination programme. We are affiliated with T.M. Bhagalpur University and Calcutta University for Ph.D. degree programme.

Contact:

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Ph : 091-2612-2631565, 2636651, 2631561.
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- Inelastic Neutron Scattering
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- Multimodal imaging
- Hyperspectral Imaging
- Vibrational optical activity
- Vibrational circular dichroism
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Internet Technologies

- Web Search & Mining
- Information Retrieval
- Multi-media Systems
- Semantic Web
- QoS Analysis
- Web Services
- Business Processing
- Bidding, Pricing and Negotiation
- Reputation and Trust
- Recommender Systems
- Internet of Things
- Bigdata Scalable Algorithms

Societal Applications

- Social Networking
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CDM 2017 : 19th International Conference on Diabetes and Metabolism, February 7 - 8, 2017, Mumbai.

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- Regulatory and Economical Aspects in Diabetes Research

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4th International Congress of Society for Ethnopharmacology (SFEC 2017) on "Healthcare in 21st century: Perspectives of Ethnopharmacology & Medicinal Plant Research" , February 23-25, 2017, Bardoli, Gujarat.

Topics :

- Dissemination of knowledge on education and research for promotion of medicinal plant and Ethnopharmacology
- Evidence based documentation and evaluation of safety, efficacy and quality of medicinal plant products in India systems of medicine (Ayurveda, Siddha, Unani, Homeopathy) - Globalization of traditional medicine
- Scientific documentation and validation of traditional knowledge
- Ethnopharmacology in drug discovery and development – global scenario
- Development of analytical techniques for quality control, and standardization of herbal medicine
- Phytochemical, pharmacological, microbiological screening of medicinal plants
- Bioprospecting of natural products – an approach towards drug discovery
- Integrative approach in healtheare – Role of medicinal plants
- Development of evaluation of herbal formulation from medicinal plant through industry institute partnership
- IP rights, patents and regulatory affairs of medicinal and aromatic plants
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Contact :
Prof. Dr. R. Krishnamurthy , Director, C.G. Bhakta Institute of Biotechnology, Uka Tarsadia University, Surat Dist, Bardoli-394 350, Gujarat, Mobile: +91 9825349279, Email: krishnashanti@gmail.com krishnamurthy@utu.ac.in

2nd International Conference on Pollution Control & Sustainable Environment, March 6-8, 2017 Dubai, UAE.

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9th International Conference on Geomorphology, November 6-11, 2017, New Delhi.

Theme - Geomorphology and Society.

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9th ICG Secretariat, Prof. Sunil Kumar De, *Convener*, 9th ICG, Department of Geography, North Eastern Hill University, Shillong 793022,Meghalaya, Contact: (mobile) +91 9862009202 / +91 9433902268; (office) +91 364 2723205, Email:desunil@yahoo.com desunil@gmail.com

2nd Indian Cancer Congress, 08 - 12 November, 2017, Bengaluru.

Contact :
Prof. Ramesh S. Bilimagga, CIMGlobal India Pvt. Ltd., #2, NG Complex, 2nd Floor, 30th Cross, Bannerghatta Road Layout, Jayanagar 4th T Block, Bangalore - 560041, +91 76 76 11 2017, F: +91 80 2608 0702

S & T ACROSS THE WORLD

SCIENTISTS DEVELOP A LIGHT-DRIVEN THREE-DIMENSIONAL PLASMONIC NANOSYSTEM

Scientists at the Max Planck Institute for Intelligent Systems have developed a nanoplasmonic system in the form of a pair of scissors that they can open using UV light.

Nanomachines could take over a variety of tasks in future. Some day they may be able to perform medical precision work in the human body or help analyze pathogens and pollutants in mobile laboratories. Scientists at the Max Planck Institute for Intelligent Systems in Stuttgart have now presented a possible component which could be used to specifically move and control such a machine. They have developed a nanoplasmonic system in the form of a pair of scissors that they can open using UV light. As soon as they irradiate the nanostructure with visible instead of UV light, it closes again. The researchers can observe the structural changes with the aid of gold particles which they excite with the light.

Animal and plant cells, as well as bacteria store the information about their complete structure and all vital processes in their DNA. In nanotechnology, it is not the ability of DNA to carry the genetic make-up which scientists use, but its elastic structure. This allows them to build components of small machines, such as motors and other tools.

In order to be able to design complete nanomachines, however, scientists must design and further develop possible subunits of a machine step by step. Researchers from the Max Planck Institute for Intelligent Systems together with colleagues from Japan and the USA have now developed a structure made out of DNA that could serve as moving components of a nano-motor or nano-gearbox. Like the two blades of a scissors, they have two DNA bundles connected by a type of hinge. Each bundle is only 80 nanometres long and each consists of 14 strands of coiled up DNA lying parallel to each other. Initially, the motion of the scissor-like nanostructure is blocked by a type of chemical padlock made of azobenzenes, which can be opened by UV light.

The nanoplasmonic system consists of DNA and is closed via visible light. The two DNA bundles (grey) are held together by a small molecular padlock which consists of two protruding DNA ends (red). Embedded in it are azobenzenes which change their structure when excited by UV light (purple). This causes the two DNA bundles to separate from each other and the angle between the two DNA strands opens up. Researchers can detect this structural change using spectra obtained from so-called circular dichroism (CD) spectroscopy (top right), in which changes to the plasmons on the small gold rods (yellow) leave characteristic traces. When the researchers switch off the UV light with the system in the open state and switch on visible light (vis), the azobenzene changes its structure and the two DNA ends link up again.

THE CHEMICAL PADLOCK IS OPENED BY LIGHT

The azobenzene components are each connected with a DNA thread that protrudes from each bundle. In visible light, the azobenzene residues assume a structure which allows the protruding DNA strands of the two bundles to link up with each other – the two bundles lie very close to each other. However, as soon as the researchers excite the DNA-azobenzene complex with UV light, the azobenzene changes its structure. This leads to the two loose DNA ends separating and the hinge snapping open within only a few minutes. The light therefore acts, in a sense, like a lubricant for the motion. As soon as the UV light is switched off, the azobenzene changes its structure again, and the two DNA ends link up once more: the nanosystem closes. "When we want to develop a machine, it has to work not only in one direction, it has to be reversible," says Laura Na Liu,

who leads a Research Group at the Max Planck Institute in Stuttgart. The DNA bundles here do not move because the light changes or because the azobenzene changes its structure, but only because of the Brownian molecular motion.

The researchers can observe live how the nanostructure opens and closes. To this end, they have linked up the DNA nanotechnology with so-called nanoplasmonics: a research field that deals with the oscillations of electrons – so-called plasmons – at a metal surface. The plasmons can arise when light impinges on a metal particle, and leave behind a characteristic signature in suitable light.

TINY GOLD RODS PROVIDE INFORMATION ON THE OPENING STATE

The Research Group led by Laura Na Liu has generated these plasmons on two tiny gold rods, each sitting on one of the two bundles of DNA. Using the analogy of the scissors, these two gold particles each lie on the outer side of a scissor blade and cross over like the DNA bundles at the hinge of the scissors. The light excitation causes not only the molecular padlock fixing the two DNA bundles together to spring open, plasmons on the gold particles also start to oscillate. When the scissor-like structure opens, the angle between the two gold rods changes as well, which has an effect on the plasmons. The researchers can observe these changes spectroscopically by irradiating the nanosystem with light with suitable properties and measuring how it changes. They can thus even determine the angle between the DNA bundles.

"We have succeeded for the first time in controlling a nanoplasmonic system with light. And this was precisely our motivation," says Laura Na Liu. The researcher and her colleagues had previously worked on nanosystems that can be chemically controlled. However, the chemical controls are not as clean and leave residues in the system.

Laura Na Liu already has an application in mind for the light-controlled scissor design. The system could serve as a tool to control the arrangement of nanoparticles. "As the angle between the two DNA bundles can be controlled, it offers the possibility to change the relative position of nanoparticles in space," says Laura Na Liu. Moreover, the scientists consider the current work as a step towards a nanomachine. The nanoplasmonic system could be part of such a machine.

(Source : *Anton Kuzyk, et al.,Nature Communications 7, Article number: 10591; doi:10.1038/ncomms10591)*

STUDY TAKES SINGULARITY OUT OF BLACK HOLES

In a newly published study, physicists take singularity out of black holes, suggesting that black holes could serve as portals.

LSU physicist and Center for Computation and Technology researcher Jorge Pullin and his colleague Rodolfo Gambini of the University of the Republic in Montevideo, Uruguay, have published a study applying Loop Quantum Gravity to an individual black hole, showing that singularities – or the infinite strengthening of the gravitational field that occurs deep within a black hole, insuring the annihilation of anything entering – may not be encountered. Instead, their model shows that gravity would eventually change, suggesting that the "other end" of a black hole might take one to another location within our own universe.

Apply a quantum theory of gravity to black holes and the all-crushing singularity at their core disappears.

In its place is something that looks a lot like an entry point to another universe. Most immediately, that could help resolve the nagging information loss paradox that dogs black holes.

Though no human is likely to fall into a black hole anytime soon, imagining what would happen if they did is a great way to probe some of the biggest mysteries in the universe. Most recently this has led to something known as the black hole firewall paradox – but black holes have long been a source of cosmic puzzles.

According to Albert Einstein's theory of general relativity, if a black hole swallows you, your chances of survival are nil. You'll first be torn apart by the black hole's tidal forces, a process whimsically named spaghettification.

Eventually, you'll reach the singularity, where the gravitational field is infinitely strong. At that point, you'll be crushed to an infinite density. Unfortunately, general relativity provides no basis for working out what happens next. "When you reach the singularity in general relativity, physics just stops, the equations break down," says Abhay Ashtekar of Pennsylvania State University.

The same problem crops up when trying to explain the big bang, which is thought to have started with a singularity. So in 2006, Ashtekar and colleagues applied loop quantum gravity to the birth of the universe. LQG combines general relativity with quantum mechanics and defines space-time as a web of indivisible chunks of about 10-35 meters in size. The team found that as they rewound time in an LQG universe, they reached the big bang, but no singularity – instead they crossed a "quantum bridge" into another older universe. This is the basis for the "big bounce" theory of our universe's origins.

Now Jorge Pullin and Rodolfo Gambini have applied LQG on a much smaller scale – to an individual black hole – in the hope of removing that singularity too. To simplify things, the pair applied the equations of LQG to a model of a spherically symmetrical, non-rotating "Schwarzschild" black hole.

In this new model, the gravitational field still increases as you near the black hole's core. But unlike previous models, this doesn't end in a singularity. Instead gravity eventually reduces, as if you've come out the other end of the black hole and landed either in another region of our universe, or another universe altogether. Despite only holding for a simple model of a black hole, the researchers – and Ashtekar – believe the theory may banish singularities from real black holes too.

That would mean that black holes can serve as portals to other universes. While other theories, not to mention some works of science fiction, have suggested this, the trouble was that nothing could pass through the portal because of the singularity. The removal of the singularity is unlikely to be of immediate practical use, but it could help with at least one of the paradoxes surrounding black holes, the information loss problem.

A black hole soaks up information along with the matter it swallows, but black holes are also supposed to evaporate over time. That would cause the information to disappear forever, defying quantum theory. But if a black hole has no singularity, then the information needn't be lost – it may just tunnel its way through to another universe. "Information doesn't disappear, it leaks out," says Pullin.

(Source : *Rodolfo Gambini and Jorge Pullin, Phys. Rev. Lett. 110, 211301 (2013); DOI: 10.1103/PhysRevLett.110.211301)*

SCIENTISTS REVEAL CHEMICAL CODE FOR NITROGEN FIXATION

A team of scientist from Yale University reveal part of the chemical code that allows nature to transform nitrogen from the air into usable nitrogen compounds.

The process is called nitrogen fixation, and it occurs in microorganisms on the roots of plants. This is how nature makes its own fertilizers to feed plants, which feed us.

The enzyme responsible for natural nitrogen fixation is called nitrogenase. Yale chemistry professor Patrick Holland and his team designed a new chemical compound with key properties that help to explain nitrogenase. The findings are described in the September 23 online edition of the journal Nature.

"Nitrogenase reacts with nitrogen at a cluster of iron and sulfur atoms, which is strange because other iron-sulfur compounds typically don't react with nitrogen, either in other enzymes or in the thousands of known iron-sulfur compounds synthesized by chemists," Holland said.

Keeping that in mind, Holland and his team

designed a new compound with two distinct properties found in nitrogenase: large shielding groups of atoms that prevented undesired reactions, and a weak iron-sulfur bond that could break easily upon the addition of electrons. The design proved successful because the compound binds nitrogen from the atmosphere, just as nitrogenase does.

With this insight into how nature fixes nitrogen, Holland and his colleagues hope to design synthetic catalysts that turn nitrogen into ammonia, the main fertilizer produced in the natural system. "Natural systems are much friendlier than the current industrial process for making ammonia, which uses very high temperature and pressure," Holland said.

By making ammonia synthesis easier, it could be possible to make fertilizers on-site at farms, reducing transportation and production costs. "This work shows that carefully designed chemical compounds can help us figure out how natural systems use plentiful raw materials like the nitrogen in our atmosphere," Holland said.

(Source : *Ilija Čorić, et al., Nature (2015); doi:10.1038/nature15246)*

YALE ENGINEERS DEVELOP A NEW TOOL TO FIGHT DUST

Micrometric and sub-micrometric contaminant particles — what most of us call "dust" — can cause big problems for art conservators, the electronics industry, aerospace engineers, and others. These nanoparticles can prevent a cellphone from working or rob the vitality of a painting's colors.

Drawing from the forces of static cling and the science behind gecko feet, the lab of Yale School of Engineering & Applied Science Dean T. Kyle Vanderlick has developed a promising tool in the war on dust. The results appear in the journal ACS Applied Materials and Interfaces. Hadi Izadi, a postdoctoral associate, is the paper's lead author.

Vanderlick's lab, which focuses on thin films and surface properties, took on the dust problem shortly after Yale established art conservation labs at its Institute for the Preservation of Cultural Heritage (IPCH) at the Yale West Campus. Vanderlick said the project is particularly characteristic of Yale, where collaborations between disciplines are strongly encouraged.

"This wouldn't have happened without the art scientists and conservators at the IPCH working with the researchers in our lab," she said.

The lab worked with a number of Yale art conservators in developing the technology. Cindy Schwarz, assistant conservator of painting at the Yale University Art Gallery, said dust is particularly a problem for her when it comes to modern paintings that feature acrylic paint.

"Acrylic paints are incredibly porous, so anything you're putting on the surface could get into the pores, and then work from the insides of the pores to soften the paints," Schwarz said, adding that the new technology has the potential to solve this long-standing problem.

If dust particles are bigger than 10 micrometers, removing them can be achieved with minimal fuss, usually with an air jet or nitrogen jet. It's a whole other world of trouble for particles less than 10 micrometers. There are plenty of methods of removal, but each has its drawbacks. Wet cleaning is limited in its ability to remove particles, and can possibly damage the object being cleaned. In recent years, the electronics industry and art conservators have turned to dry cleaning techniques, such as lasers, micro-abrasive particles, and carbon dioxide snow jets. They remove dust well, but can be just as damaging to artwork as wet cleaning methods.

The Yale researchers' solution is deceptively simple. In the lab, Izadi holds up what looks like an ordinary plastic sheet. It's actually an elastic and non-sticky polymer, polydimethylsiloxane (PDMS). Put it under a microscope, and you can see millions of tiny columns. Depending on the size of dust particles you're removing, the pillars range from 2 to 50 micrometers in diameter — bigger particles require bigger pillars.

Izadi is very familiar with fibrillar structures and micropillars. His previous research explored the mystery of how geckos effortlessly stick to walls. It turns out that a lot of it has to do with electrostatic

charges and the microscopic pillars on the pads on their feet. Applying some of this science to cleaning microparticles made sense, he said. "When you're talking about dust, you're talking about electrostatic charges."

The micropillar structures used for dust cleaning, however, differ from those of geckos in that they're designed specifically not to stick. The PDMS polymer has minimal interaction with the substrate — whether it's an iPhone or a sculpture — but it produces enough electrostatic charge to detach the dust particles.

Once you match up a sheet with the appropriately sized pillars, cleaning is simply a matter of tapping the polymer on the surface. Particles absorbed by the polymer go around the pillars. Tests on various surfaces in the lab have shown total cleaning of silica dust particles and no damage to the surface.

Although her lab is new to art preservation, Vanderlick noted, there's much to engage researchers in her field.

"Dust is something at the nanometer level," she said. "And there's a lot of interesting thin film, surface, and interfacial physics associated with the preservation of art."

(Source : *Hadi Izadi, et al., ACS Appl. Mater. Interfaces; DOI: 10.1021/acsami.5b09154)*

THE INDIAN SCIENCE CONGRESS ASSOCIATION

14, DR. BIRESH GUHA STREET, KOLKATA - 700017

ISCA Best Poster Awards Programme : 2016-2017

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

1. Applications are invited from members (Life, Annual & Student) of the Association who have paid their subscription on or before **July 15, 2016**.
2. Four copies of full length paper along with four copies of the abstract (not exceeding 100 words) must reach the office of the General Secretary (Membership Affairs) not later than **September 15, 2016**. At the top of each copy of the paper and its abstract, the name of the Section under which the paper is to be considered should be indicated. For details of Sections see http://www.sciencecongress.nic.in
3. Along with the Four copies of paper, Four copies of the Application Form (to be downloaded from ISCA website http://www.sciencecongress.nic.in) with brief bio-data of the candidate (not exceeding 2 pages), full length paper, abstract in the form of a CD must also be sent simultaneously along with the hard copies.
4. The number of authors of each poster submitted for the award shall be limited to two only. **The first author of the poster shall be the presenting author**. **Both the authors should be the members of the Association and have paid their subscription on or before 15th July, 2016.**
5. The research work should have been carried out in India and this has to be certified by the Head of the Institution from where the candidate is applying.
6. The candidate should give an undertaking that the paper being submitted has not been published in any journal or presented in any other Conference / Seminar / Symposium or submitted for consideration of any award.
7. A scientist shall submit only one poster in any one Section (and not a second poster on the same or any other topic in any other Section) for consideration for poster presentation award.
8. A person who has already received ISCA Best Poster Award in any section once will not be eligible to apply for the above Award in the same or any other section.
9. Incomplete Applications will not be considered.
10. Full length papers will be evaluated by experts and twenty posters in each section will be selected for presentation during 104th Indian Science Congress.
11. The final selection for the Awards will be made by a duly constituted committee and the awards will be given during the Valedictory Session of 104th Indian Science Congress session.
12. Applications submitted for the above award will not be returned.
13. The last date for receiving applications for the above award at ISCA Headquarters is **September 15, 2016**.

All correspondences should be made to: The General Secretary (Membership Affairs),The Indian Science Congress Association ,14, Dr. Biresh Guha St.,, Kolkata-700017, Tel. Nos. (033) 2287-4530/2281-5323, Fax No. 91-33-2287-2551, E-mail:iscacal@vsnl.net, Website: http: //www.sciencecongress.nic.in

घोषणा

हिन्दी निबन्ध प्रतियोगिता
104 वाँ भारतीय विज्ञान कांग्रेस के मूल विषय
पर
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ON

THE FOCAL THEME OF THE 104TH INDIAN SCIENCE CONGRESS

"SCIENCE AND TECHNOLOGY FOR NATIONAL DEVELOPMENT "

All ISCA Chapters will organise Hindi Essay Competition on the focal theme of the 104th Indian Science Congress and will give four names (two from each category) for the final competition to be organized by the Host University at SRM University, Chennai.

Eligibility criteria:

Category- I)	:	Students of Class VIII to XII .
Category- II)	:	Undergraduate / Postgraduate students.
Time duration of Written test	:	Half an Hour (30 min.)
Words limit	:	Within 1000 words.
Last date	:	October 15, 2016.

Note: Sleeper Class Train Fare and Local Hospitality will be provided by the Host University to the candidate (along with his / her mother or father or guardian) and the names of winner candidates (First and Second) of the final competition will be published in the "Everyman's Science".

The candidates may send their write up directly to the respective ISCA Chapter Conveners.
Details available in: http://www.sciencecongress.nic.in/ html/isca_chapters.php

INFOSYS FOUNDATION -ISCA TRAVEL AWARD

With a donation from Infosys Foundation, Bangalore and the amount accrued from interest of selling of the special volume on "Shaping of lndian Science" published by ISCA on the occasion of the 90th Indian Science Congress,The Indian Science Congress Association has instituted the award namely, "Infosys Foundation – ISCA Travel Award" from 2004-2005 to be given annually to **ten** students (upto Class XII) during the Annual Session of the Indian Science Congress Association. Among ten, **First Five** awardees will be given a Plaque during the annual session of Indian Science Congress . All ten students along with one guardian will be given T.A. (AC III – tire/Chair Car Train Fare), local hospitality, for attending the 104thIndian Science Congress to be held in the S.R.M.University, Chennai, during January, 2017.

The selection of the awardee will be made by a committee constituted by the host university on the basis of the write-up on – "*What developments in Science during the last two years have influenced him/her and why?"*

Interested students (upto Class XII) are requested to submit an application with the above write up and brief bio-data (name, address, school, date of birth, class, phone/e-mail, extracurricular activities etc.)The application should be forwarded by the School Principal/Headmaster. Application must reach the on or before November 15, 2016.

Communication Address:

Prof.N.Sethuraman, Local Secretary, 104th Indian Science Congress, Registrar, SRM University, Kattankulathur-603 203; Mobile : 09940036008; E-mail : registrar@srmuniv.ac.in

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ई-मेल/E-mail : iscacal@vsnl.net
es.sciencecongress@nic.in

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

भारतीय विज्ञान कांग्रेस संस्था

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

THE INDIAN SCIENCE CONGRESS ASSOCIATION

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

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

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

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

स्टैम्प आकार का फोटो / Stamp Size Photograph

महोदय/Dear Sir,

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

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

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

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

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

विभाग/Sections

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

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

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

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

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

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

शैक्षणिक योग्यता/Academic Qualifications :

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

पदनाम/Designation

सम्पर्क का पता/Address of communication :

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

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

स्थायी पता/Permanent Address :

टिप्पणी (अगर कोई)/Comments (if any)

दिनांक/Date : भवदीय/Yours Faithfully

हस्ताक्षर/Signature

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

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

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

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

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

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

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

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

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

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

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

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

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

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