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Shri Basavaraj S. Bommai
Hon'ble Chief Minister
Government of Karnataka

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Hon'ble Minister for Higher Education, IT&BT, S&T, Electronics and Skill Development, Livelihood, Government of Karnataka

KARNATAKA SCIENCE AND TECHNOLOGY ACADEMY
DEPARTMENT OF SCIENCE AND TECHNOLOGY, GOVERNMENT OF KARNATAKA

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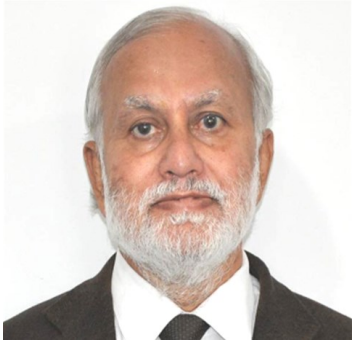
INSIDE THIS ISSUE:

From Chairman's Desk



Prof. S. Ayyappan

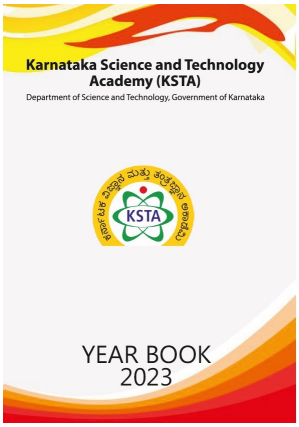
As the year 2022 draws to a close, it has been a year of intense activity in different domains of Science & Technology, interaction and communication. With 177 Fellowship, 100 Associateship, 09 Institutional Membership, 2 Institutional Associateship and 54 MoUs (as on 31.12.2022) with different institutions, the Academy has become a centre of scientific cooperation in the State.

The quarter saw the Annual Nobel Laureate Lecture series, on the Nobel Prize recipients during the year 2022, along with several sponsored and collaborated S&T events, training programmes, both in person and online, associating with both Central and State Institutions. The publications disseminated across the State also included the Year Book, 2023.

The month of December, 2022, was commemorated as the 'Good Governance Month', with Expert Panel Discussion, Special Talks by Eminent Administrators & Academicians and Essay competition on the subject. Looking forward to the New Year, 2023, the guidance and inputs received from the Members are gratefully acknowledged. Greetings for the New Year, 2023.

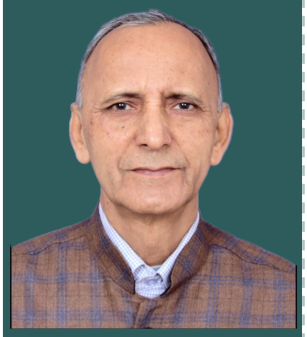
- S. Ayyappan

Year Book 2023



Every year KSTA invites nomination for Fellowship of KSTA (FKSTA). The nominations received were scrutinised by Awards & Fellowship Selection Committee and approved by Executive Committee. 51 Fellowships were awarded for the year 2022 among 12 domains. A Year Book comprising the details of Fellows, Associates, Institutional Members and Institutions having MOU with academy was brought out during third quarter of FY 2022-23. This document consists of details of 177 KSTA Fellows, 08 Institutional Members, 02 Institutional Associates, 94 Associates and 54 organisations having MOU with KSTA (as on November 2022)

J. Craig Venter: A Triumphant Human Genome Researcher



Dr. Mahesh Roy

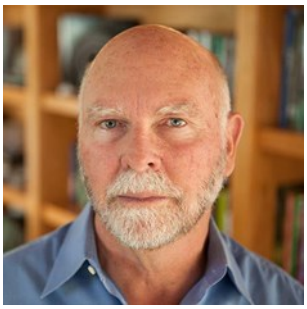
"Autobiography reveals nothing bad about its writer except his memory" and "memory is notoriously malleable"

- Craig Venter

Prologue

The whole array of genes of a species, which are made up of DNA and located on its chromosomes in eukaryotes, is etymologically the genome. Genomic analysis refers to the identification and assessment of genomic features, viz., DNA sequence, structural variation, gene expression, and regulatory and functional element annotation at a genomic scale. The techniques for genomic analysis need high-throughput sequencing or microarray hybridization and bioinformatics tools.

The completion of a high-quality comprehensive sequence of human genome has been a landmark achievement of genomic research. Establishment of increasingly automatable methods for DNA screening and sequencing have helped in sequencing human genomic with utmost rapidity and high accuracy.



Credit: https://www.jcvi.org

The International Human Genome Sequencing Consortium published the first draft of Human genome in 2001 covering 94% of the human genome assembly.

Just one day later, John Craig Venter, an American Biochemist geneticist, Who Launched a human genome sequencing project by CELERA GENOMICS using shot-gun sequencing method, published the whole human genome sequence in Science. No one could miss the excitement in this story of thus term endous task. However , the complete human genome sequencing results of the official Human Genome Project were published in 2003.

In this short communication, sincere attempts have been made to highlight the determined encleavours and valuable contributions of J. Craig Venter in the field of genomic research and historic completion of his team's independent Human Genome deciphering. The article has been drafted in a popular from keeping in view the vast community of generalists. The primary source of inspiration has been Craig Venter's "A Life Decoded- My Genome: My Life". The stimulus for writing this article was received from Prof. J. A. Rajasab, which I wish to duly acknowledge.

Nature of Craig Venter's Genetic Autobiography

In his book Craig Venter argues that traditional "autobiography reveals nothing bad about its writer except his memory" and "memory is notoriously malleable." He further admits that he has "been fortunate enough to take part in one of the greatest most exciting, and, potentially most beneficial scientific adventures of all time". In his own words, this is ..... "the first biography to benefit from having six billion base pairs of the author's genetic code as an essential appendix, new interpretations of Craig Venter, based on my DNA, will continue to be made long after life has left my body. I have no choice but to leave the ultimate interpretation to you and to history".

Craig Venter's Childhood and Adolescence: Brief Reflections

John Craig Venter (b. Oct.14,1946), the most vivacious and determined scientist of genomic research in the world during this century, was born to John and Elizabeth Venter at salt Lake City, Utah, US. Venter was a rebellious risk taker very since his childhood. He loved his freedom and kept himself happily busy with lashing some crude scrap materials together relying on his imagination. As he admits, risk- taking was in his blood.

His schooling was neither his interest nor his strength. He hated rote learning and tests and had problems with spelling. But his childhood creativity was obviously amazing.


Credit: Little, Brown Book

Rebellious and disobedient, he was constantly in trouble as a young boy, and several restrictions were imposed on him in the family when he was a High School student. A great change ushered in the life of Venter when he came in contact of Linde, a schoolmate of the orchestra team, and his life could be set in a new direction. This was a turning point in craig Venter's adolescence.

Revelations from Craig Venter's Genetic Autobiography

Each of the one hundred trillion cells (except the sperm and RBC's) of the body which package DNA in 46 chromosomes, the Venter's (and everyone's) genetic autobiography. Along the chromosomes are distributed around 23,000 genes. With a repertoire of only 20 different amino acids, cells can create a bewildering array of combinations to produce innumerable different proteins. Cells are totipotent and can build any organ, but they do not do so. We are in a primitive stage of understanding how stem cells in the embryo end up playing various combinations of genes to produce about 200 types of highly specialized cells found in the human body. But we know for sure that the genetic codes provide a recipe to produce one individual.

"Rebellious and disobedient, he was constantly in trouble as a young boy, and several restrictions were imposed on him in the family when he was a High School student"

Out of at least 23,000 genes in the human body, only 25 genes lie on the Y chromosome of males. But this chromosome confers many peculiarities, from a greater risk of committing suicide, developing cancer, and becoming rich, to having less hair on the scalp.

Some of the prominent revealations from Craig Venter's genome analysis have been summarised in the following Table.

Sl. No.	Trait	Responsible Gene/ enzyme(s) involved	Venter's genome features
1.	Attention Deficit Hyperactivity Disorder (ADHD) in teenage	Ten repeats of a section of a gene called DAT1, the dopamine transporter gene	Venter's genome indeed has these ten repeats; hence, such a complex trait exhibited in his teens
2.	Aggressive sexual urge in adolescence	SRY genes on Y chromosome	Androgen hormones linked to SRY genes led to aggression
3.	Enduring swimming ability	AMPD1 Gene (Adenosine monophosphate deaminase1); Nine mutations in the gene cause AMP deaminase deficiency leading to muscle pain or weakness after prolonged physical activity.	No mutations in Venter's gene for AMPD1 production; Venter has C/C and not a T/T bases required in the gene for AMPD1 production.
4.	Alcoholism history in the family	DRD4 (Dopamine Receptor 4 gene) & DRD 1, 2, 3 & 5	Nothing of peculiar note in Venter's genome
5.	Venter's Asthma	Glutathione S-transferase (GST) family of enzymes [GSTP1, GSTM1 & ile105 variant]	One copy of GSTM1 deleted in the genome and ile105 variant found.
6.	Risk of Heart Attack	E2, E3, E4, TNFSF4, CYBA, CD36, LPL, NOS3	One copy of E3 and one E4 found in Venter's genome; Effect of other genes not worked out as yet
7.	Alzheimer's disease	Apo E4 and Variants of SORL1 gene	Apo E4 and all variants of SORL1 found; great risk of the disease;

J . Craig Venter *Continued.....*

Sl. No.	Trait	Responsible Gene/ enzyme(s) involved	Venter's genome features
8.	Heart Attack due to high consumption of diet coke and coffee	P4501A2 (CYP1A2)	Benign version of the gene lowers the risk
9.	Obesity causing risk of diabetes and heart disease	A variant of FTO gene on chromosome-16	Two copies low risk version of FTO gene; increased risk of diabetes and heart disease
10.	Longevity	A variant of 'Klotho' gene	A blend of 'Klotho' gene variants; lower risk of coronary artery disease and stroke; advantage in longevity
11.	Love for risk	Dopamine receptor 4 gene (DRD4)	Four copies of the repeated section of DRD4; don't like taking risk.
12.	Stress, Impulsivity and thrill seeking	Mono Amine Oxidase (MAO); A gene on the X chromosome	High activity from of the gene; lower risk of antisocial behaviour
13.	Fickle Heart	Matrix metalloproteinase; GNB3 and MMP3 genes	Lower expression version of the gene; more prone to antherosclerosis of plaques in the arterial walls
14.	Diabetes	ENPP1 and CAPN10	A variant of ENPP1 (K121Q found); risk of earlier onset of type 2 diabetes and heart attacks; but no serious complications found as yet
15.	Depression	A short version of Serotonin transporter gene (5-HTTLPR)	Fortunately two copies of long form of the gene and more serotonin have been found; less chance of deep clinical depression
16.	Risk for macular degeneration	Variation in a single letter of CFH gene (rs1061170)	Variation in one copy of CFH gene; risk for macular degeneration
17.	Cancer	Her2, Tp53, PIK3CA & RBL2	Two non-synonymous SNPs found; no known link to Cancer
18.	Longevity	CETP gene	V/V homozygous for I405V; possibility of life up to 90 years and beyond with retention of memory and lucidity

"There is still a vast science left for me to explore"

- Craig Venter

Epilogue:

Towards the end of his genetic autobiography, Craig Venter is found to admit optimistically that there is still a vast science left for him to explore. He is determined to understand fully the software of life by creating true artificial life, and to discover whether a life decoded is truly a life understood.

- Dr. Mahesh Roy
Formerly Professor & Head
Department of Botany (P. G. Centre), R. N. College, Hajipur
[B. R. A. Bihar University], Vaishali, Bihar, India

Climate Conference Resolved to Accelerate Decarbonization

Climate–fuelled disasters were witnessed in many parts of the world since the onset of the monsoon season, wherein the worst floods affected people. It can't be construed as merely an extreme weather event but as an economic disaster. Just costs and scale of devastation may fail to factor in the full impact, especially the emotional and physical toll on affected families in the regions of devastation as well as the effort and courage needed to rebuild the lost properties and livelihood. In sub-Saharan African countries like Somalia, Kenya, and Ethiopia, millions of livestock died and crops were destroyed due to severe drought. Even in the Sahel region of Africa, the temperature spiking has triggered the drying up of water supplies and threatened the food supply to millions of people, thereby prompting migration.

The global temperature rise of under 1.1 degree Celsius has caused devastating impacts on vulnerable communities around the globe, while the World is expected to warm far more than this magnitude with business as usual scenario. The vulnerable communities who have contributed the least to the problem endure loss and damage disproportionally. Although climate impacts are occurring across the world, it is only the rich countries that have the resources to weather out the impacts due to insurance coverage and governmental support. Hence, cutting down greenhouse gas emissions, giving impetus for the use of renewable/green energy, building mass transport and sustainable use of natural resources are some of the measures to mitigate climate impacts as well as to avoid significant losses and damages in many vulnerable countries.

United Nations Framework Convention on Climate Change (UNFCCC)

UNFCCC treaty was formed in 1992 as a result of a global commitment by countries to cooperatively find solutions to limit global average temperature increase. UNFCCC entered into force on 21 March 1994 and laid out the basic legal framework and principles for international climate change cooperation for stabilizing atmospheric concentrations of greenhouse gases (GHGs) to avoid dangerous anthropogenic interference with the climate system. In order to enhance the effectiveness of the UNFCCC, the Kyoto Protocol was adopted in December 1997. The Conference of Parties (COP) is the apex decision-making body of the UNFCCC responsible for monitoring and reviewing the implementation of GHG emissions reduction measures that are decided in the meetings. The first COP meeting was held in Berlin, Germany in March 1995. Today, 198 countries have ratified the Convention and are called Parties to the Convention.

Paris Agreement (COP 21)

The UNFCCC Paris Agreement adopted in COP 21 on 12 December 2015 in Paris marks the latest step in the evolution of the UN climate change regime and builds on the work undertaken in the Convention. The Paris Agreement drew a new course of action in the global effort to combat climate change by fast-tracking and intensifying the actions and investments that are required for a sustainable low-carbon future. The agreement's main objective was to strengthen the global response to the threat of climate change by keeping a global temperature rise well below 2 degree Celsius above pre-industrial levels by the end of this century and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. The Agreement also aimed at strengthening the ability of countries to deal with the impacts of climate change.

Conference of Parties – 27 (COP 27)

The UNFCCC COP27 hosted in the green city of Sharm El-Sheikh in Egypt during 6-20 November 2022 was of significance in reaching a consensus on accelerating decarbonization. In fact, the conference marks the 30th anniversary of the adoption of the UNFCCC. In the conference, countries across the world came together to act towards achieving the collective climate goals as agreed upon in the Paris Agreement (COP 21) held in 2015.

COP27
SHARM EL-SHEIKH
EGYPT 2022

The COP27 ended on 20th November 2022 reaffirmed their commitment to limit global temperature rise to 1.5 degrees Celsius above pre-industrial levels and reinforced action by countries to cut GHG emissions and adapt to the unavoidable impacts of climate change and enhance the support of finance, technology and capacity building that are needed by developing countries to tackle the impact of climate change.

A breakthrough was achieved to provide "loss and damage" funding for vulnerable countries, wherein lives and livelihoods were ruined by the worst climate disasters. The countries also agreed to establish a transitional committee to recommend how to operationalize both the new funding arrangements and the fund to be proposed at COP28, which is scheduled for next year in the United Arab Emirates.

In COP 27, the developed countries made new pledges to the tune of more than USD 230 million to the Adaptation Fund. The proposed fund will help several vulnerable communities to adapt to climate change through concrete adaptation solutions that would enhance their resilience by 2030.

A new five-year work program to promote climate technology solutions in developing countries was initiated at COP27. Further, a mitigation work program was also launched to immediately scale up mitigation ambition and implementation following COP27 and continue until 2026. Thereafter, an extension of the program will be considered after reviewing the work done till then. That apart, countries were requested to revisit and strengthen the 2030 targets in their national climate plans by the end of 2023. It was also recognized that the unprecedented global energy crisis underlines the urgency to rapidly transform energy systems to be more secure, reliable, and resilient, by accelerating transitions to renewable energy during this critical decade of action.

Another important progress in the COP 27 was a decision on forest protection with the launch of the Forest and Climate Leaders' Partnership which aimed to unite action by governments, businesses, and community leaders to halt forest loss and land degradation by 2030.

More than 45,000 participants got together at the COP27 to network, share ideas and solutions, and build partnerships and coalitions to tackle climate change. Indigenous peoples, local communities, cities, and civil society, including youth and children, showcased how they are addressing climate change and shared how it impacts their lives. Finally, the conference urged countries to deliver bold climate action and encourage all businesses to accelerate the low-carbon technologies to give a fillip to the Net Zero transition by setting science-based targets, disclosing emissions, catalyzing decarbonization, and partnerships across global value chains.

- Dr. A. M. Ramesh
Chief Executive Officer, KSTA
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Recent advancements in plant-based protein processing and their applications

Abstract : Protein as a naturally available biopolymeric material has a wide range of functions to play in different life forms including human health, growth and development. From the very beginning of life, proteins have played various important roles. Human-recommended dietary allowance is considered incomplete and a nutrition deficit if a sufficient proportion of protein is not found available. Recently there has been a shift towards plant-based diets and an increase in plant-based protein demand, keeping in mind sustainability, environmentally friendly, awareness and the healthier nature of the plant-based diet. There has been an increasing demand for plant-based proteins as well. Researchers have been working on the extraction of proteins from different sources, studying their functional properties and modification of properties to find different applications including food and pharmaceutical sectors. This paper reviews the recent developments in plant-based protein processing from the aspect of extraction and their application in the food and pharmaceutical industries.

Introduction:

Proteins are basically the polymers of amino acids connected by peptide bonds, and for these reasons, proteins are also referred to as polypeptides. Protein is essential to life and plays important roles in living systems, i.e., proteins are responsible for different

works at the cellular level, synthesis, maintenance, receiving signals etc (Potter and Hotchkiss, 1997; Frazier, 2009). Proteins are naturally available in different plant and animal sources, including microbial protein or single-cell protein (SCP) (Matassa *et al.*, 2016). Keeping in mind, consumer preferences and the present market scenario, more emphasis was given to plant-based proteins although other sources of proteins also exist. Different plant-based sources are available which are considered good sources of protein, i.e., seeds, legumes, oil cakes etc. Several under-utilized legumes and de-oiled cakes obtained after the mechanical extraction of oils from oil seeds are good sources of under-utilized protein. Proteins can be extracted from above mentioned under-utilized sources and can be utilized for different applications (Kamal et al., 2021).

Protein extraction strategy:

Based on protein content, the extract is characterized as protein flour (protein content: 65% or less), protein concentrate (protein content: 65-90%) and protein isolate (protein content: 90% or higher) (Kumar et al., 2021). The choice of protein extraction method depends on the particular end usage. The protein extraction process may be categorised as chemical and physical methods, which are explained below.

Chemical methods: Chemical methods of protein extraction may be classified based on the type of solvents used, i.e., water, alkali, acid etc. For protein extraction, the sample may be defatted followed by protein extraction. The alkali extraction method is conventionally used for the extraction of protein from plant-based protein-rich sources, where sodium hydroxide (NaOH) and potassium hydroxide (KOH) are commonly used as alkali. Various factors play role in the efficiency of protein extraction, like temperature, solvent-to-feed ratio, extraction duration etc. By the alkali extraction method, high protein recovery is possible, but this method affects the protein digestibility and overall protein quality. For preventing this, a balance between the alkali strength and protein extraction yield needs to be done. Enzymes can also be used for superior-quality protein extraction from different sources including non-conventional protein sources, i.e., algae, fungi, food wastes etc. Enzyme-assisted protein extraction destroys the cell wall integrity (by damaging hemicellulose, cellulose, pectin etc.) via enzyme action. Various proteolytic enzymes can be used, i.e., alcalase and protamex, papain enzymes to enzymatic hydrolysis. Extraction can be done by using single or multiple enzymes for enzyme-assisted protein extraction processes. (Kumar et al., 2021).

Physical methods: Conventional wet methods of protein extraction use chemicals and also needs drying, which makes the process energy intensive, expensive and also alters the native protein structures. For overcoming this drawback, dry fractionation of raw materials to separate out protein -rich parts from carbohydrate and fibre-rich parts can be done by air classification and electrostatic separation methods. However, these dry separation methods are not suitable for the production of high protein content isolates, like wet chemical methods (Assatory et al., 2019).

Besides the dry or physical method of protein extraction, other physical methods can be used to assist or enhance the wet/chemical methods of protein extraction. Ultrasound-assisted extraction helps in the extraction of valuable components from plant cells. During the application of ultrasound treatment, there is a production of acoustic cavitation and also hot spot generation for high pressure and temperature, which enhances the extraction of protein. Hildebrand et al. (2020) reported the application of ultrasound for enhancing the protein extraction from *Chlorella vulgaris*, a green microalga, by alkali extraction method. The ultrasound method has been reported as a rapid, economical method of extraction for protein. Electrical energy-assisted extraction has been used as a novel non-thermal method for protein extraction, i.e., pulsed electric field and high voltage electric discharges. Roselló-Soto et al. (2014) reported their work on the application of high-voltage electrical discharge, pulsed electric field and ultrasound-assisted extraction of protein from the olive kernel and stated that out of the three treatments, high-voltage electric discharge helped in maximum protein recovery (Roselló-Soto et al., 2014; Kumar et al., 2021).

Application of plant-based protein

Plant-based proteins find their wide applications in different domains of food and pharmaceutical sectors which are explained below.

Food applications: Proteins are an essential part of the daily human diet and protein-rich extracts act as dietary supplements providing additional nutrition. As discussed earlier, proteins are considered an important part of the diet, as consumed protein plays important roles in the human body. Extracted proteins

can be used for the development of protein-rich food products like bakery products, beverages, health drinks etc. (Banerjee et al., 2022; Kumar et al., 2022). Due to the over-usage of natural resources, the rise in global population and seek for sustainable, environment-friendly food sources, plant-based proteins like soy protein, pea proteins etc., have been explored for mimicking fibre like textured meat, using high moisture extrusion or shear cell technologies. Plant-based textured artificial meat products are known as meat analogues, mock meat or meat substitute (Joshi and Kumar, 2015; Schreuders et al., 2019; Zhang et al., 2022). Besides meat alternatives, plant-based proteins can also find other food applications, i.e., as a fat replacer, a filler in manufacturing healthier foods, foaming agents, stabilizer, emulsifier, functional ingredients for nutrient delivery in foods etc. (Roger, 2001; Kumar et al., 2021).

Packaging and coating applications: Proteins as biopolymeric materials can be used for manufacturing environmentally sustainable and biodegradable films, which can be used as biodegradable and/or edible packaging materials as a smart alternative to conventional non-biodegradable packaging materials. The functional properties of the developed protein-based films can be altered by the addition of different additives (Assad et al., 2020; Hadidi et al., 2022). Similar to films, proteins can also find their applications as coating materials for different food applications (Chen et al., 2019; Lim, 2022; Kumar et al., 2022).

Pharmaceutical applications: Various plant-based bioactive peptides have shown evidence of therapeutic properties, e.g., bioactive peptides extracted from soybean and buckwheat show hypocholesterolaemic and hypolipidemic activities (Kumar et al., 2022). Plant -based proteins can also be used for other pharmaceutical applications, particularly for targeted drug delivery, with enhanced bioavailability, efficiency and efficacy. The pharmacokinetics of the drugs can be controlled by varying the composition, dimension, and structure of the colloidal delivery systems. Micro or nano-sized particles, spheres or capsules can also be used for drug delivery, using plant-based proteins. This ensures the release of the encapsulated drugs or other substances of interest over the targeted tissue or organ. Besides micro/nano-particle form, hydrogels can also be developed from plant protein-based materials. Hydrogels are three-dimensional networking of crossed -linked hydrophilic polymers, which can be developed from proteins or other polymeric compounds using both physical and chemical approaches. Specific hydrogels have the ability to respond to external surrounding stimuli like heat, ionic strength, pH etc., change structural morphology and have controlled release profiles, are referred to as smart hydrogels. Smart hydrogels find their suitable applications in the controlled release of drugs by responding to external stimuli like heat, pH etc. For hydrogels, proteins are preferred over other polymeric materials, due to the presence of both acidic and basic groups in protein, enabling protein-based hydrogels to be suitable for pH-sensitive drug delivery systems. Plant proteins like zein, soy protein, gluten etc., also have been reported for their application in the development of films and three-dimensional scaffolds for tissue engineering and controlled drug release mechanisms (Reddy and Yang, 2011; Jao et al., 2017; Mohammadi et al., 2022, Kumar et al., 2022).

Conclusion:

Plant-based proteins can be extracted from different protein-rich plant-based sources by different approaches. Plant-based proteins are safe, sustainable and more environmentally friendly than animal-based proteins or other synthetic polymeric materials. Biomaterials developed from plant-based proteins lack desirable mechanical and other properties, hence desirable chemical modifications are essential with or without the addition of suitable additives to achieve desirable properties, for their applications in food, pharmaceutical and allied sectors. Controlled drug or bioactive compound release for efficient and targeted drug delivery can also be achieved using plant-based proteins. Since less work has been achieved with different unexplored and under-utilized plant-based protein sources, further research in exploring the potential of plant-based proteins and their different applications can be helpful to promote alternate proteins and their varied applications.

- Dr. Soumitra Banerjee

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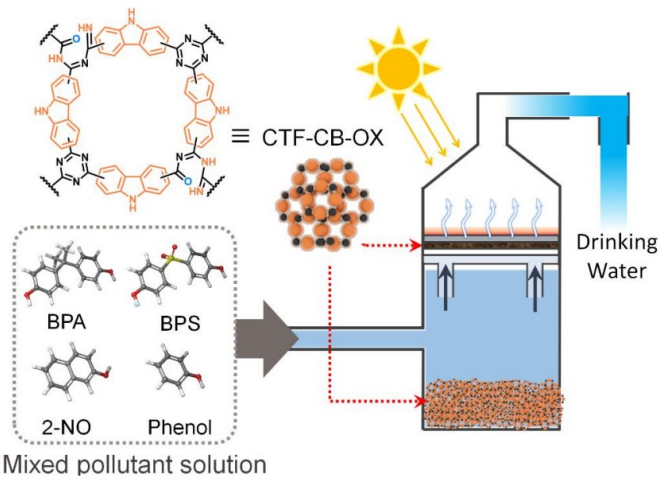
Latest in Science and Technology Research

New method for rapid adsorption of micro-pollutants

Industrialization and rapid urbanization have led to the production of enormous amount of waste that finds their way into land and water bodies causing surface and ground water contamination. Chemical industry being one of the largest industries in the world, produces a huge range of products, many of which support industries viz., pesticides, acids, lubricants, cleaning agents, cosmetics and pharmaceuticals and plastics. Among pollutants volatile organic compounds (VOCs) and other micropollutants are matter of concern in any treatment process. These contaminants can easily get into drinking water sources and pose a serious threat to human health. An effective removal of micropollutants from wastewater is an important issue. Choosing the right method for removing of VOCs and other micropollutants from water and air is complicated due to the diversity of their structures and low concentrations.

Existing treatment methods using carbon-based porous materials have limitations in terms of adsorption rate and requirement of high thermal energy for recycling. Constant efforts are being made to develop materials with are effectively recyclable, highly efficient, economical and have industrial potentials.

Researchers led by Professor Chiyoung Park at Department of Energy Science and Engineering, Daegu Gyeongbuk Institute of Science and Technology, South Korea have reported the development of a highly efficient molecularly engineered covalent triazine framework (CTF) for rapid adsorption of micropollutants and VOCs using solar distillation



Schematic illustration of rapid adsorption and photothermal molecular sieving of organic pollutants. Source: https://doi.org/10.1002/adma.202206982

process. According to their study, this material can efficiently remove not only microplastics, but also small-sized VOCs with 99.9% efficiency within the short period of 10 seconds. This process does not require high thermal energy for recycling and can be used multiple times without loss of performance. Further, they opined that, this process can be commercialized easily as it involves low-cost raw material and can purify contaminated water even in areas where there is no power supply.

- Dr. Anand R

Senior Scientific Officer, KSTA

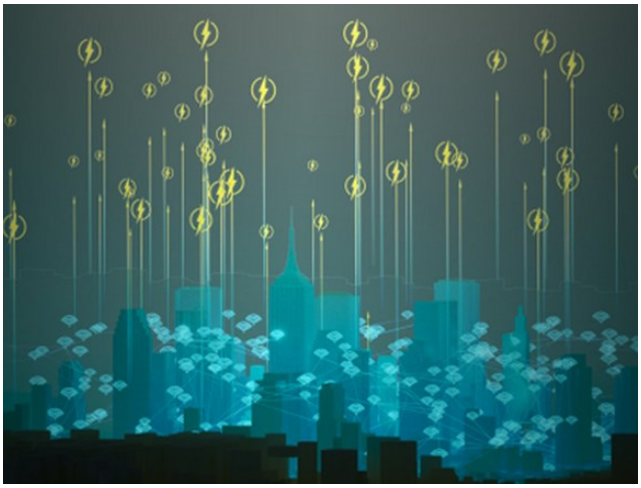
Reference:

Cho, Wansu & Lee, Dongjun & Choi, Gyeonghyeon & Kim, Jihyo & Acquah, Ebenezer & Park, Chiyoung. (2022). Supramolecular Engineering of Amorphous Porous Polymers for Rapid Adsorption of Micro-pollutants and Solar-Powered Volatile Organic Compounds Management. Advanced Materials. 34. 10.1002/adma.202206982.

Sustainable and eco-friendly IoT by wirelessly powered sensors

Internet of Things (IoT) has changed the way we work and live. The entire world is like a small village where things are not only connected but also communicate with each other. IoT technology employs sensors, software, and the internet to establish a network between all our physical devices and gadgets. Our smartphone, laptop, car and home appliances could interact and share information with one another all the time and thus makes our life more comfortable. Real-time monitoring applications such as e-healthcare, home automation, environmental monitoring, transportation autonomy and industry automation, etc. are reality now. IoT technologies are becoming smarter day by day, capable of processing data intelligently and make communication more effectively and efficiently. A forecast by International Data Corporation (IDC) estimates that there will be 41.6 billion IoT devices in 2025, capable of generating 79.4 zettabytes (ZB) of data. However, operation of sensors and processing of enormous amount of data consumes large amount of energy. This will pose a new stress on society and environment. At present, sensor nodes rely on battery technology, but, batteries need regular replacement, which is costly and environmentally harmful over time. Also, the current global production of Lithium for battery materials may not keep up with the increasing energy demand from ever increasing number of sensors.

An international research team comprising of Luis Portilla, Kalaivanan Loganathan, Hendrik Faber and others at King Abdullah University of Science and Technology (KAUST) in Saudi Arabia have studied the possibility of wireless-powered electronics that promise to meet the energy demands of IoT networks in a sustainable and eco-friendly manner. Wirelessly powered sensor nodes could help to achieve a sustainable IoT by drawing energy from the environment using photovoltaic cells and radio-frequency (RF) energy harvesters. The team says, a



new thin-film device technology that use alternative semiconductor materials, such as printable organics, nanocarbon allotropes, and metal oxides, could help make the IoT more economically and environmentally sustainable. Significant progress in solution-based technologies made it possible to print circuits on flexible, large-area substrates.

The team has developed a range of RF electronic components, including metal-oxide and organic polymer based semiconductor devices known as Schottky diodes and scalable methods for manufacturing RF diodes to harvest energy reaching the 5G/6G frequency range. The team says that this technology provides the needed building blocks toward a more sustainable way to power the billions of sensor nodes in the near future.

- Dr. Anand R

Senior Scientific Officer, KSTA

Reference:

Portilla, L., Loganathan, K., Faber, H. et al. Wirelessly powered large-area electronics for the Internet of Things. Nat Electron (2022). https://doi.org/10.1038/s41928-022-00898-5

Salient Outcome of VGST Funded Research Projects

Development of bladeless wind turbine

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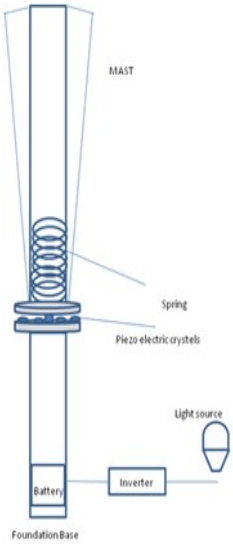
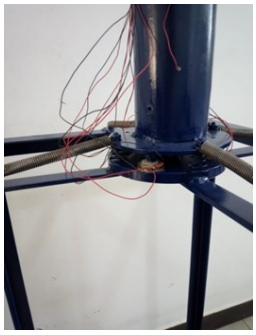
Abstract : The use of alternate source of energy can reduce the power demand during severe shortages. The bladeless turbine is energy efficient and reduces the physical damages in conventional power generating units. It uses the transducers to convert mechanical motion to electrical energy known as piezometric power generation and they are used in interchangeable energy production. In the study bladeless turbine is developed to generate power through wind energy. The mast receives the wind force and converts it to electrical energy. Even when the velocity of wind is very minimal, turbine was able to generate the power. The generated power is cumulative and 3v to 6v was achieved in the laboratory scale.

Introduction: Wind power is a renewable source of energy, and its reliable use in complimenting the electrical supply is essential. Bladeless turbines are efficient in generating electricity with lesser cost in maintenance when compared with conventional wind turbines. The bladeless turbine uses the movement of the built mast or body to convert mechanical energy to electrical energy.



Methodology: The mast is built by fibrous material with lower density. It is connected with electromagnet inside and spring balance at the bottom. Later it is connected with alternator and volt meter.



Results: The result shows that continues movement of the mast contributes for generation of power upto 3-6 volts, when observed through voltmeter. The setup must be installed at plane field or higher altitudes for power generation. From the results it was observed that it can be used for generation of power for volts less than 12v, which can be used for mobile charging or glowing led lights.

Molecular Screening of Polycystic Ovary Syndrome (PCOS) in Dakshina Kannada District.

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In the present study, a total of 400 women in and around Dakshina Kannada district in Karnataka were screened. Out of which 200 women were diagnosed with polycystic ovary syndrome and 200 women were treated as healthy controls. Majority of the women were of the age group between 25 to 32 years and were belonging to the urban region. We estimated the prevalence, anthropometric, biochemical, serum hormone concentrations and fatty acid levels followed by genotyping by advanced molecular techniques. Genes like CYP19 which is very essential in female ovarian steroidogenesis, FADS1 and FADS2 genes involved in fatty acid metabolism, and Vitamin D receptor genes were analyzed for all the patients with the help of this project. We observed that majority of the women with PCOS were having health issues, mainly with hormonal imbalance which likely resulted in many women having gone through obesity. As a result, genotyping of the molecular genes gave varying results which we believe were due to lifestyle modifications or environmental factors. We believe that with the help of this study, we will be able to help a lot of women undergoing treatments related to PCOS and the analysis of these polymorphisms could

aid in the diagnosis of both patients as well as asymptomatic women. Further studies are being carried out to explore the vast molecular mechanisms associated with respect to genetic aetiologies in the south canara region of Karnataka.

As a part of the project, 4 PhD research candidates were recruited. Two of them worked on molecular gene mechanism, while one worked on toxic chemicals and heavy metals and the other on the effect of gut microbiome and short chain fatty acids on PCOS. We have published 4 research articles with many more still under communication and 1 thesis has also been submitted. Through the funds made available by VGST, we were able to procure 4 major instruments viz., 1. Flow cytometer (BD ACCURI), 2. Fluorescent microplate reader (Spark Tecan), 3. Probe Sonicator 4. - 80ºC Deep freezer. The addition of flow cytometer setup was an important addition to our laboratory which has benefitted clinicians as well as scholars in providing important reports regarding treatment of malignancies and cancer. We were also able to conduct several CME's and hands on workshop on flow cytometers and molecular techniques. With the help of this project, several students from other universities have also had an opportunity to work as interns and carry out projects.

Effect of dietary Nano Zinc and Nano Selenium supplementation on Ram Semen Characteristics

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Recent advances in nanotechnology have tremendously expanded its possible applications as feed supplements in farm animal reproduction. Kendall et al. (2000) and Kumar et al. (2014) have demonstrated that the supplementation of Zinc and Selenium has improved the semen quality significantly by decreasing the oxidative stress on the spermatozoa. Many of the researchers have opined that the bioavailability of the Zn and Se in organic and inorganic forms is less; hence, an alternative to conventional Zinc, Zinc oxide and Selenium nano-particles have been studied and have shown to have higher bioavailability. In this context, the present work was designed to know the effect of Nano-Zn and Nano-Se supplementation on Ram semen parameters. Twelve Rams were randomly divided into two equal groups, given the basal diet as control (C) or supplemented with the combination of Nano Zn (100 mg/kg) and Nano Se (0.3 mg/kg) for 90 experimental days. Ejaculates of 12 rams were collected and diluted in a TRIS extender at monthly intervals and assessed for motility, concentration, abnormalities, viability and plasma membrane integrity. Motility in per cent (74.83 ± 0.55, 75.32 ± 1.50 and 77.66± 0.25), viability in per cent (72.02 ± 1.33, 76.33 ± 1.50 and 78.56± 1.63), sperm concentration in 106/ml (2428±2.86, 2547±3.05 and 2610±5.16) and membrane integrity in per cent (77.21 ± 0.55, 82.82 ± 1.68 and 87.22± 0.23) were significantly ($P<0.05$) higher in ZnNPS and SeNPS supplemented groups compared with the control group. The sperm morphological abnormalities in per cent reduced significantly in treated groups beyond 60 days (5.98 ± 0.53, 2.72 ± 0.50 and 1.56± 0.63) compared with the control group (6.42± 0.25, 6.50± 0.11 and 6.20±0.32; $P <0.05$). The results showed that the supplementation of Nano Zn and Nano Se in combination was found to be more beneficial in increasing the sperm concentration, progressive motility, percent live and dead spermatozoa, acrosomal integrity and hypo osmotic reacted spermatozoa, while it was well documented that the percent of abnormal spermatozoa significantly decreased when compared to control Group. Finally, it can be concluded that supplementation of ZnNps and SeNps in combination for 60 days and beyond improves Ram semen quality and minimises the effect of abiotic stress in Rams. The results suggested that supplementation of ZnNPs and SeNPS in combination improves the qualitative and quantitative properties of sperm.

Join hand with KSTA

MOU and Collaborations

In order to promote science and technology and to popularise science in the State, the KSTA is collaborating with Institutions (public/ corporate/private) having similar interests and programmes. As on December 31, 2022, Fifty-five institutions have collaborated with KSTA. Interested institutions may send expression of interest and after approvals from KSTA, a Memorandum of Understanding (MoU) in the prescribed format (available in the KSTA website) will be signed on mutually accepted terms and conditions, also legally vetted, for specific activities involving manpower, finance, etc. with the following purpose and scope:

- Inculcating scientific temper across civil society through science communication
- Facilitating technology dissemination through Academia-Farm-Industry interface, with a focus on rural areas
- Fostering innovations and entrepreneurship for societal benefits
- Organising conferences & outreach programmes
- Capacity building in frontier areas of Science & Technology
- Any other aspects with mutual consent

Institutional Membership

Nine institutions have obtained Institutional Membership as on December 31, 2022. Institutions who are desirous of seeking paid Institutional Membership of KSTA, may do so by paying a fee of Rs. 1,00,000/- (Rupees One lakh only), and submitting a letter of interest throughout the year. This is valid for a tenure of 10 years. Visit KSTA website for further details.

Individual Associates

Hundred individuals have been admitted as Associates of KSTA as on December 31, 2022. Individuals who are desirous of seeking paid Associate Membership of KSTA may do so by paying a fee of Rs. 1,000/- (Rupees One thousand only), and submitting a duly filled application throughout the year. This is valid for a tenure of 5 years. Visit KSTA website for further details and Application form.

Programs carried out during Third Quarter (October - December 2022) of FY 2022-'23

During the period from October – December 2022, the following programs related to frontier areas of science and technology were conducted through both Video Conference (VC) and Physical modes by KSTA and also in association with research institutes/ science forum/ educational organizations.

Physical Mode

Sl. No.	Date	Topic	Association
1	October 06-12, 2022	Skill Vigyan in Biotechnology	KITS &Department of Biotechnology, Govt. of India
3	October 08, 2022	'Vijnana Sanje' (Resource expert: Dr. Na Someshwara)	Kutuhali, Vijnan Prasar, New Delhi
2	October 18-19, 2022	Science and Technology Content Translation	Kutuhali, Vijnan Prasar, New Delhi
4	November 12, 2022	Vijnana Sanje' Resource expert: Prof. VijayaRaghavan	Kutuhali, Vijnan Prasar, New Delhi
6	December 10, 2022	Vijnana Sanje'	Kutuhali, Vijnan Prasar, New Delhi
7	December 13-17, 2022	Research Methodology and Data Analysis	VTU, Belagavi
8	December 22, 2022	Vijnana Vismaya 2022	Sri Sai Science & Commerce College, Darawada

Video Conference (VC) mode

Sl. No.	Date	Topic	Association
1	October 01-14, 2022	Science Talent Search Program (Oct: 1, 6, 7, 10, 11, 14)	KSTePS, Bengaluru
2	November 01-30, 2022	Science Talent Search Program (Nov: 3,5,7,8,14,15,23,25,29,30)	KSTePS, Bengaluru
3	November 21-23, 2022	Nobel Prize Lecture Series 2022	-
4	November 21, 2022	Re-Search'22	SRN Adarsh College, Bengaluru
5	December 12-14, 2022	Agripreneurship Development	Manage, Hyderabad
6	December 17, 2022	Panel Discussion on Good Governance: Panel comprising of KSTA Fellows	
7	December 22, 2022	Special Talk on Good Governance: Shri M N Vidyashankar IAS and Prof. Gopal Naik	-
8	December 01-31,	Science Talent Search Program (Dec: 1,2,5,7,21,22,26,27,28,29,30,31)	KSTePS, Bengaluru

Koti Kanta Gayana

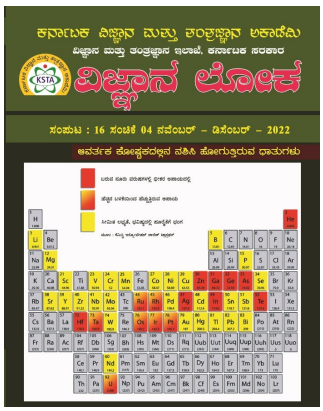
In order to commemorate 67th Karnataka Rajyostava *Koti Kanta Gayana* program was conducted on November 28, 2022 as per the Government guidelines. As a part of the program, songs depicting *Kannada Nadu Nudi* were sung as suggested by the Government. All the staff of KSTA participated in the program.

Celebration of Good Governance Month (December 2022)

December 2022 was celebrated as Good Governance Month as declared by Government of Karnataka in memory of late former Prime Minister Atal Bihari Vajpayee. This is to create awareness among citizens about accountability in Government. KSTA celebrated Good Governance Month by organizing special talks by eminent administrators and educationists as well as an essay competition for UG & PG students both in English & Kannada

Vijnana Loka — Bimonthly Magazine

Brought out Sep-Oct2022 and Nov-Dec2022 issues of *Vijnanal Loka* and sent to subscribers including pre-university and science degree colleges, science centres, libraries and other organizations across the state. Interested may fill the prescribed application form available on the website and send the same along with payment details to our email: vijnanaloka@gmail.com



Subscription details are as follows:

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Branch: Vidyaranyapura

UPI ID: KSTABANGALORE@SBI

Subscription	Individual	Institution
Each	Rs. 50/-	-
Annual	Rs. 300/-	Rs. 500/-
3 years	Rs. 875/-	Rs. 1500/-

SCAN & PAY

Digital Content Generation

Digital learning contents are being developed for the high school students in Physics, Chemistry, Mathematics and Biology as per the Karnataka Secondary Education Examination Board (KSEEB) syllabus in Kannada and are distributed to selected 380 Government High Schools in backward taluks across the State during October - December 2022. This Program is supported by KSTePS.

Science Talent Search Program for Pre-University Students

KSTA, in association with KSTePS, has organized Science Talent Search Program for Pre-University Students. During October - December 2022, 28 online talks by eminent scientists in physics, chemistry, biology, engineering, and agricultural sciences were organized and around 5350 students are benefited by this program.

Upcoming programs/publications

Innovation Award for UG, PG and General Public

Exemplary innovations / solutions emanating from Science & Technology that have helped transform the lives of people, particularly in rural areas or have enabled enterprises and employment would be recognised and awarded. The Award carry a cash prize of Rs 10,000 and a certificate. The selected innovators for the FY 2022-23 will be announced in the month of January 2023.

Policy/Strategy/Status Paper

A Strategy Paper entitled "National Capital Accounting and Validation of Lentic Aquatic Ecosystem Services" is being developed by an expert group of eminent scientists led by Prof. T.V. Ramachandra, Coordinator, Energy and Wetlands Research Group, Centre for Ecological Sciences [CES], IISc and will be brought out in the month of January 2023.

Vijnana Loka — Bimonthly Magazine

January -February 2023 and March-April 2023 issues of *Vijnanal Loka* will be published during last quarter of FY 2022-23

Celebration of National and International Days

National Science Day (NSD) will be organized to commemorate the remarkable discovery "Raman Effect" by one of the great icons of Indian Science Sir C.V. Raman on 28th February as well as to spread the message of importance of science and its applications among students.

Best Book Award in Science, Agriculture, Technology & Medicine

In order to encourage publication of Kannada books in the field of agriculture, science, technology and medicine, KSTA has been providing best book award for the selected books once in two years. Best book for the year 2021-22 will be awarded on February 28, 2022.

IP in Academics: Patents

KSTA in association with Karnataka State Council for Science and Technology (KSCST) organizing one day workshop on IP in Academics: Patents on January 30, 2023. Visit KSTA website for more details.

Other Programs

Workshop/training on Geoinformatics, Research Methodology and Statistical Data Analysis Using R-software will be conducted for UG, PG and Research Scholars during last quarter of FY 2022-23.

KSTA, a unit of the Department of Science and Technology, Government of Karnataka, established on 5th September, 2005, has been mandated for science promotion and popularisation in the State. KSTA has the Vision of 'Nurturing and Enabling Science & Technology for All' and Mission of 'Playing a pivotal role in Science promotion, Technology dissemination and fostering Innovations for Societal welfare'. The Objectives of the KSTA are to inculcate scientific temper across the civil society through science communication, particularly in Kannada; facilitate technology dissemination through Academia-Farm-Industry interface, with a focus on rural areas; foster Innovations & Entrepreneurship for Societal benefits; recognise talents and contributions through Awards; organise Conferences & Outreach programs; serve as Resource Centre for Capacity building in frontier areas of Science & Technology; and act as a Science, Technology & Innovation Policy (STI) Advisory Body for the State.

Scan to view Program Videos

Science & Technology for All

Contact

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'Vijnana belesi -Tantrajnana balasi'