



ಸಿ.ಎಸ್.ಐ.ಆರ್.–ಕೇಂದ್ರೀಯ ಆಹಾರ ತಾಂತ್ರಿಕ ಸಂಶೋಧನಾಲಯ, ಮೈಸೂರು–570 020, ಭಾರತ सीएसआईआर-केन्द्रीय खाद्य प्रौद्योगिक अनुसंधान संस्थान, मैसूरु - 570 020- भारत

CSIR-CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE

(A CONSTITUENT LABORATORY OF COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH)

MYSURU - 570 020, INDIA





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# PERFORMANCE REPORT | 2023-24

**CSIR-Central Food Technological Research Institute** 

(A constituent laboratory of Council of Scientific & Industrial Research)

Mysuru - 570 020, India

# Published by : Director CSIR-Central Food Technological Research Institute, Mysuru, India Editorial & Production Team: • Dr. Sreerama YN • Sri. Raghunandanan MV Mrs. Anita CS Mrs. Kusuma K Dr. Seema Kumari

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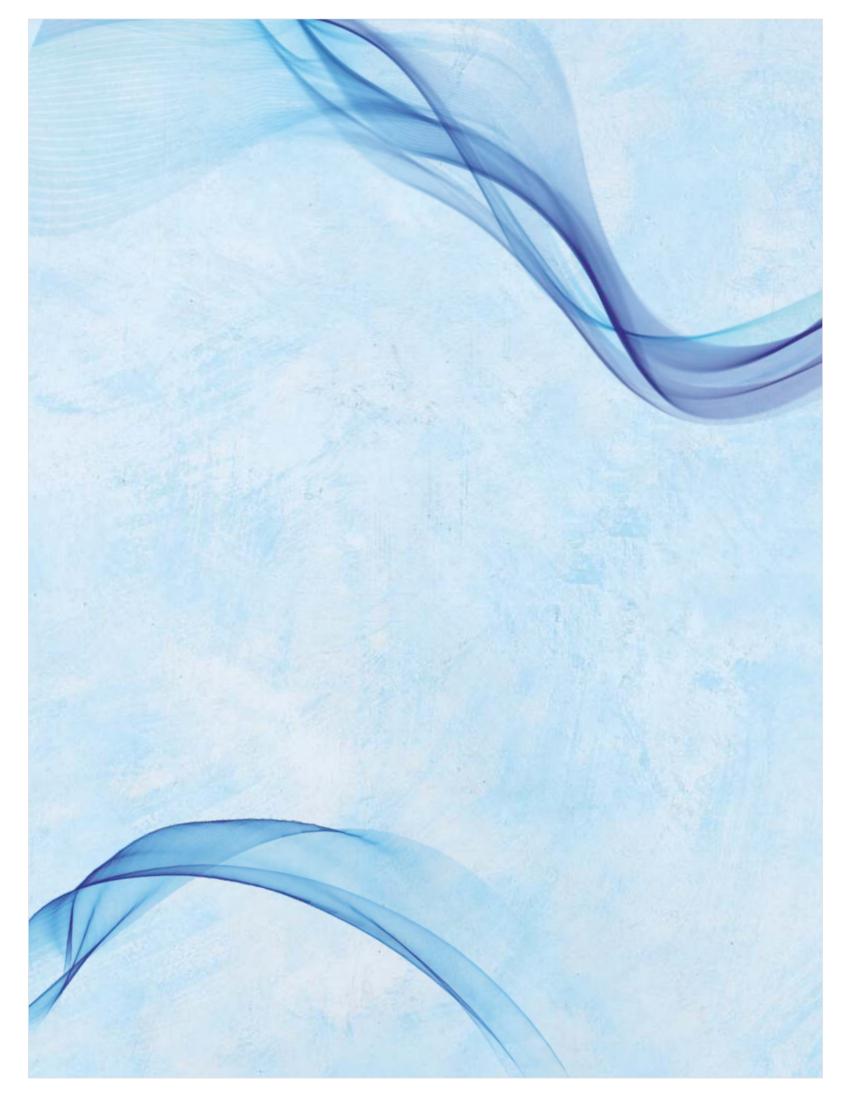
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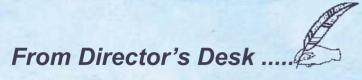
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- **♦** Technology Development
- **♦** Translational Research
- **♦** Food Protection and Safety

CSIR Projects — 116

Staff as on 31.03.2024 — 127

Management Council / Research Council — 134







CSIR-CFTRI is pleased to release its Annual Performance Report for the year 2023-24 and itgives me great pleasure and privilege to share the highlights of the activities of the Institute in R&D as well as societal outreach during the financial year.

The collective efforts of Scientific Staff of the Institute resulted in getting Grant-in Aid projects, CSIR projects and industry projects to extend the tally of about 100 ongoing R & D projects in the Institute. The year witnessed transfer of 69 processes / technologies to 134 parties and 12 nos. of new technologies were developed. Total 163 nos. of publications (including SCI & non-SCI, reviews, book chapters, editorials, books etc.) and 9 MoUs were signed during the year 2023-24. The Institute filed four national & one international patents and also 5 national patents were granted during the year.

After a long gap, we welcomed new faculty to our Institute. 17 Scientists already joined in this year out of 28 selected and the rest will join soon.

The Institute successfully organized the "One Week One Lab (OWOL)" campaign during 3-7th July 2023 at CSIR-CFTRI, Mysuru. This event served as a platform for showcasing our institute's cutting-edge research, technologies, expertise, and facilities in the field of Food

Science & Technology. With a theme of "Celebrating Food Research," the campaign ignited the minds of young innovators, students, start-ups, academia, and industry, encouraging them to explore opportunities through deep tech ventures. The week-long campaign showcased the diversity and depth of CSIR-CFTRI research since 1950 and expertise in the field of Food Science & Technology through a series of sessions, engaging and panel discussions, interactive programs, culinary show, open day, expo and poster presentations. Also, the Institute actively participated in the "World Food India 2023" held during November 3-5, 2023 at Pragati Maidan, New Delhi which was organized by the Ministry of Food Processing Industry.

One of the major achievements of the year was the approval of the project -"Millet Sustaining Health through Research and Innovation by Analysis of Nutrients and Nutraceuticals to Achieve global awareness - SHRI ANNA" under mission mode by CSIR in which our Institute is the Nodal and 8 other CSIR Labs are participating. The CSIR Millet mission "SHRI ANNA" aims to promote the nutritional value of millets, develop innovative millet-based food products, enhance their shelf-life, and optimize processing methods to make millets and their products more accessible and beneficial to consumers. Also, various initiatives were

undertaken to raise global awareness of the health benefits of millets. The Institute also contributed to other CSIR Mission projects, viz. Advancing Technological Leads for Assuring Safety of Food (ATLAS), CSIR Floriculture Mission, Seaweed Cultivation & Valorization etc.

To meet the requirements of the entrepreneurs who are working or would like to venture into, we established a Common Incubation Centre (CIC) funded by MoFPI under PMFME scheme with a purpose to provide common facility for production of banana and coffee based products as these commodities are identified as products under One District One Product (ODOP) theme for Mysore and Kodagu districts, respectively.

The Institute continues its supremacy in conducting various Skill Initiatives for the benefit of entrepreneurs, entrepreneurial aspirants, Farmers/FPOs, SHGs, industry professionals and academia. Not only the headquarters but also the resource centres were able to organize various training programmes. CSIR-CFTRI successfully organized a training programme on "Rice Milling and Value Addition to Rice" for

Guyanese Delegation under Indian Technical and Economic Co-operation (ITEC) Programme sponsored by Ministry of External Affairs (MEA), Government of India during 27<sup>th</sup> February to 18th March 2024. This was the first ITEC programme organized by the Institute in which 29 Guyanese Delegates attended.

I would like to acknowledge the support received from CSIR HQ continuously throughout the year which paved the path for new heights for the Institute. I further thank the external funding agencies including State & Central Govt. Departments/agencies, Industries, Academia, Alumni etc. for their support during the journey.

I personally acknowledge the support, encouragement and directions which the Institute received from the Chairperson and the members of the outgoing Research Council (11th) and also welcoming the new Research Council (12th).

Last but not least, I would like to thank each and every staff, students and outsourced personnel for their contributions and putting their sincere efforts as 'Team CFTRI' to meet its mandate and enriching the campus life.

November 22, 2024

Sd/-(Sridevi Annapurna Singh) Director, CSIR-CFTRI



## **Achievements at a Glance**





### **Publications**

Research Papers	11
Reviews	10
Book Chapters	2



#### **Projects**

Grant-in-aid	87
Consultancy	16
Sponsored	25
Technical Service	24
Collaborative Projects	7



## Industrial Development

1	Patents Filed in India	4
1	Patents Filed in abroad	1
	Patents Granted in India	. !
1	Technologies Transferred	69
	New Technologies Developed	12



#### Human Resource Development

M.Sc. (Food Technology)	29
Certificate Course in Flour Milling	19
Ph.D. Awarded	29
Skill Development Programmes	1840





#### 1. Research Publications

#### **SCI Publications**

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#### **Reviews**

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#### **Book Chapters**

- Aravind S., Prakash M. Halami, Metabolic engineering of *Bifidobacterium* sp. using genome editing techniques, In: Genome Editing in Bacteria (Part 1), *Ed.: Prakash M. Halami, Aravind Sundararaman*, Published by: Bentham Science Publishers, Singapore, 2024, 88-105
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## Short Communications / Short notes / Editorial notes

- Anurag Sharma, Manish Mishra, Kunal Sharan, Editorial: Developmental origin of diseases: A special focus on the parental contribution towards offspring's adult health, Frontiers in Endocrinology, 2023, 14, 1196653
- 2. Archana V.R., Vivek Babu C.S., Fumigant and contact toxicities of individual and additive combinations of biorational-essential oils for control of rice weevil (Sitophilus oryzae), Natural Product Res., 2023, 37(16), 2748-2752
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- 4. Puniya A.K., Jain U., Dhillon H.S., Huang J.Y., Rastogi N.K., Tamang B., Editorial: Microbiological food safety: Assessment of processing, storage, and transportation, *Frontiers in Microbiol.*, 2023, **14**, 1184341
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#### **Books Published**

- Engineering Aspects of Food Quality and Safety - Food Engineering Series, Edited by: Umesh Hebbar H., Richa Sharma, Ram Charan Chaurasiya, Shivendu Ranjan, Raghavarao K.S.M.S., Series Editor: Gustavo V. Barbosa-Canovas, Published by: Springer Cham, Switzerland, 2023, 445 pages
- 2. Genome Editing in Bacteria (Part 1), Edited by: Prakash M. Halami, Aravind Sundararaman, Published by: Bentham Science Publishers, Singapore, 2024, 200 pages





#### 2. Patents Filed / Granted in India

#### Filed:

SI. No	Title	Inventors	Filing Date	Application No.	Country
1.	A flavoured sugar composition with natural essential oil and food colourant and process for preparation thereof	Subban Nagarajan Linganna Shivakumar Krishnegowda Anil Kumar	11-May-2023	202311033470	India
2.	Eco-friendly oxygen scavenger containing food grade catalyst and process for preparation of the same	Rajeshwar Shantayya Matche Sachin Rama Chaudhari, Subhash Vishwanath Pawde	16-Aug-2023	202311057427	India
3.	A method for production of enzyme mix for preparation of no-added sugar bread	Sarma MVRK, Prabhasankar P, Gnanesh Kumar Belur Shivappa Ashwath Kumar Kathalsar Punil Kumar HN Ashok Sadhu Abel Anbarasan Philip Teja Sree Hamasavathu	28-Nov-2023	202311081141	India
4.	Aptamer for detection of SARS-CoV-2 virus	Praveena Bhatt Mudliar Pravin Savata Gade Abhigna Nagaraj Sarma MVRK Mukesh Kapoor Dinesh Kumar Saini Manjunath Shivasangappa Devaraman	12-Mar-2024	202411017997	India
5.	Dihydrofolate for hypoglycemic activity	Vikas Singh Chauhan Bijesh Puthusseri Ajana Pathikkal Ulaganathan Mabalirajan Atmaja Karmakar Divya Peethambaran	31-May-2023	18/326450	USA



#### **Granted:**

SI. No	Title	Inventors	Filing Date	Application No.	Country
1.	A method of separation of whole wheat germ in a roller flour milling system	Sourav Kumar Bhagyalakshmi Neelawarne	459588	17-Oct-2023	In-force
2.	A device useful for continuous cooking and discharging of ragi mudde and other similar kind of dumpling products	Nagaraju V.D. Girish K Ghiwari Raju Ezhil Murugan Krishnamurthy Sheshanarayana	514315	22-Feb-2024	In-force
3.	A paper based time temperature indicator for monitoring the freshness/spoilage of the perishable products	Rajeshwar S Matche Jaydeep Dave	493549	03-Jan-2024	In-force
4.	A process for preparation of manno-oligosaccharides from galactoamannan using immobilized recombinant endo-betamannanase (manb-1601)	Kapoor Mukesh Panwar Deepesh Kaira Gaurav Singh	499748	16-Jan-2024	In-force
5.	Vacuum frying system	Sukumar Debnath Praneeth Juvvi A. Chakkaravarthi	513066	21-Feb-2024	In-force

## 3. Processes / Technologies transferred for commercial exploitation

The following 69 processes / technologies were released to 134 parties.

- Bottling of sugarcane juice
- Chicken wafers
- Chikki/nutra chikki
- Chocolate rich in healthy polyphenols
- Coffee concentrate

- Convenience flour from ragi suitable for stiff porridge
- Chocolate rich in healthy polyphenols
- Decortication of ragi



Coffee concentrate



- Doly mix
- Eggless cake premix
- Instant cake mix
- Egg wafers
- Fermented and dehydrated ready mixes for idli/dosa batter
- Finger millet semolina
- Fish wafers
- Fortified mango bar
- Fruit dehydration: Banana
- Fruit bar: Mango
- Fruit jams & jellies
- Coffee concentrate
- Fruits & vegetables dehydration: Grapes, banana
- Fruit syrups and squashes
- Garlic paste
- Ginger paste
- Ginger beverage
- Green pepper in brine
- High performance advanced oxidation process for STP's grey water and industrial waste water (food and non food)
- Instant coffee cubes
- Instant gravy mixes (dehydrated) Madras kurma, multi purpose gravy, biryani mix
- Instant finger millet halwa mix

- Instant finger millet khichdi mix
- Instant finger millet rava idli mix
- Instant finger millet upma mix
- Foxtail millet puttu podi
- Instant halva mix from millets and multimillets semolina
- Instant rava idli mix from millets and multimillets semolina
- Instant upma mix from millets and multimillets semolina
- Instant products from moringa leaves
- Instant traditional food: Sambar
- Layered parotta (South Indian)
- Meat wafers
- Millet based cookie
- Millet and multimillet puttu podi mix
- Multigrain nutri cookies
- Online fortification of atta (whole wheat flour)/maida (refined wheat flour)
- Ready to eat shelf stable egg crunchy bite
- Osmo-air dried: Mango
- Paan flavoured water
- Pickles and chutneys
- Pork wafers
- Prawn wafers
- Preparation of protein, vitamin and mineral fortified chikki



Chocolate rich in healthy polyphenols



Ready to eat shelf stable egg crunchy bite



Foxtail millet puttu podi



- Banana dehydration
- Preparation of ready-to-cook multigrain whole mix for drink/porridge
- Preparation of ready to eat shelf stable egg crunchy bite
- Preparation of shelf stable biriyani paste
- Preparation of shelf stable roti from no wheat cereal and millet (ragi, rice, maize, jowar, bajra)
- Process for nutri fruit bars with immune boosters
- Process for production of millet and multimillet semolina
- Pulse based papads
- Ready mix: Upma
- Ready mix: Vada
- Ready-to-use multigrain idli and dosa batter in retail packs
- Roasted and flavoured cashew kernels
- Roller milling process for semolina (sooji/rava) from millets and preparation of multimillets semolina
- RTS fruit juices and beverages
- Shelf stable jowar flour
- Shelf stable chapati
- Spirulina choco bar and cereal bar
- Tamarind juice concentrate
- Tamarind powder
- Decortification of ragi



Banana dehydration



Decortification of ragi

- Tamarind candy
- Tomato products
- Tutti fruity (papaya/carrot)

## 4. New processes ready for commercial exploitation

Twelve new processes / technologies were developed for commercial exploitation as detailed below:

- Ragi based malt hydrolysate
- Malted ragi based ready-to-eat weaning food
- Finger millet semolina
- Instant finger millet (ragi) rava idli mix
- Instant finger millet halwa mix
- Malted ragi based ready to eat weaning food
- Instant finger millet khichdi mix
- Instant finger millet upma mix
- Millet and multimillet puttu podu mix
- Cleaner process for biotechnological production of spirulina



Malted ragi based ready to eat weaning food



Ragi kichidi mix



Multigrain pizza base



Multigrain waffle



- Ready-to-use multi-grain idli and dosa batter in retail packs
- A process for the production of multigrain waffle
- A process for the production of multigrain pizza base

#### 5. Consultancy / Sponsored / Grant-in-Aid / Technical Service / Collaborative Projects

SI. No.	Type of project	No. of projects as on 31.3.2024	No. of projects completed during 2023-24	No. of new projects initiated during 2023-24
1.	Sponsored	18	7	11
2.	Consultancy	5	-	-
3.	Grant-in-Aid	64	23	12
4.	Technical Service	24	-	3
5.	Collaborative	6	1 1	-
	Projects			

## 6. M.Sc. / ISMT / Skill Development Programmes

SI. No.	Type of project	Degree / Certificate Awarded
1. 2. 3.	M.Sc. (Food Technology) Certificate Course in Milling Skill Development Programmes	29 19 1840

## 7. Symposia, conferences and events organised / sponsored by CSIR-CFTRI

#### National Workshop (April 12-13, 2023)

Two-day National workshop on "Gerobiotics supplementation through millet beverage and fermented millet curd" was organised by the

department of Microbiology & Fermentation Technology and sponsored by Probiotic Association of India (PAi) held during 12-13<sup>th</sup> April 2023. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI inaugurated the event and various eminent speakers delivered talks.



#### National Technology Day (May 11, 2023)

National Technology Day celebration was held on May 11, 2023. Shri D. Sudhanva, Co-Founder and CEO, Excel Soft Technologies Pvt. Ltd., Mysuru was the Chief Guest and delivered the National Technology Day lecture. He distributed mementoes and certificates to entrepreneurs and released FoodPro, quarterly newsletter of CSIR-CFTRI (Jan-March 2023 issue). Dr. N.K. Rastogi, Chief Scientist and Director-in-Charge presided over the function.





#### World Environment Day (June 5, 2023)

As part of World Environment Day celebration, tree planting ceremony was held on June 5, 2023 in CSIR-CFTRI campus. Shri Suresh Heblikar, Founder of Eco-Watch, Environmentalist, Film maker, Director & Actor was the Chief Guest and delivered Environment Day lecture. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the function.



#### • World Food Safety Day (June 7, 2023)

World Food Safety day 2023 was observed at CSIR-CFTRI on June 7, 2023. Students from various colleges in large numbers visited the Institute and interacted with scientific staff of Food Safety and Analytical Quality Control Department. (FSAQCL). Chemical, physical and biological hazards on foods were demonstrated.



#### Curtain Raiser of One Week One Lab (OWOL) (June 20, 2023)

The Curtain Raiser of One Week One Lab (OWOL) event was held at CSIR-CFTRI on June 20, 2023. Dr. N. Kalaiselvi, Director General, CSIR & Secretary, DSIR unveiled the OWOL logo and released the brochure. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI welcomed the gathering and spoke about OWOL. The Chief Guest and dignitaries launched the Recruitment Software developed by CSIR-CFTRI. Director General, CSIR also visited various facilities, venue of posters and products display and interacted with scientists.



In her address, the DG stated that CFTRI has developed and transferred more than 700 technologies over the years. She also stated that the CFTRI-developed idli and dosa batter technology is not getting its due recognition though appreciated by the people. She also stated that the "One Week One Lab" initiative has been planned in such a way that the CFTRI's research achievements can be effectively highlighted.

#### International Yoga Day (June 21, 2023)

International Yoga Day 2023 with theme "Yoga for Vasudhaiva Kutumbakam" was celebrated



on June 21, 2023 at the campus. Director, CSIR-CFTRI, staff and students participated in the event.



#### Rashtriya Boudhik Sampada Mahotsav (July 2023)

As part of Rashtriya Boudhik Sampada Mahotsav, IP Awareness Programmes were conducted by CSIR-CFTRI at:

- GSSS Institute of Engineering &Technology on 14<sup>th</sup> July, 2023 with participation of 400 students
- JSS Arts and Science College on 21<sup>st</sup> July, 2023 for 150 post-graduate students
- JSS Medical College on 24<sup>th</sup> July, 2023 for 100 Medical post-graduate students
- CSIR-CFTRI campus on 24<sup>th</sup> July, 2023 for 200 students from Davangere and Bangalore degree colleges

IP Awareness Programme was organised as part of Rashtriya Boudhik Sampada Mahotsav as on online workshop on IPR for Academia, Researchers & Industry on 18th September, 2023 conducted by CSIR-CFTRI under CSIR Integrated Skill Initiative. Various talks were delivered by Resource persons and Scientific staff. Nearly 280 participants attended the training programme through hybrid mode.

#### Indian Pulp & Paper Technical Association (IPPTA) Zonal Seminar (August 4, 2023)

Indian Pulp & Paper Technical Association (IPPTA) Zonal Seminar 2023 was held at CSIR-CFTRI during August 3-4, 2023. Director, CSIR-CFTRI and other dignitaries inaugurated the event and released the IPPTA journal. About 380 delegates participated in the seminar. Valedictory function was held on August 04, 2023. His Highness Shri Yaduveer Krishnadatta Chamaraja Wadiyar was the Chief Guest of the function and the Best paper Awards were distributed.



## Independence Day Celebration (August 15, 2023)

As part of 77<sup>th</sup> Independence day celebrations, Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI hoisted the National Flag in front of Main Mansion and also addressed staff and students, highlighting the achievements of CSIR-CFTRI and path forward.

## Birth Anniversary Celebration of Dr. B.R. Ambedkar (August 30, 2023)

132<sup>nd</sup> Birth Anniversary of Bharath Ratna Dr. B.R. Ambedkar was held on August 30, 2023 at CSIR-CFTRI. Justice H.N. Naga Mohan Das, Former Judge, High Court of Karnataka inaugurated



the event and Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided. Sri Basvalingaiah, Former Director, Rangayana, Mrs. B.T. Lalitha Nayak, Former Minister for Kannada Culture, Women and Child Welfare, Govt. of Karnataka were the Chief guests and delivered the special address.



#### National Nutrition Week Celebrations (September 1-7, 2023)

Nutrition awareness lectures and various competitions were organized during National Nutrition Week held from September 1-7, 2023. The concluding programme was held on September 8, 2023. Prizes were distributed during the concluding session by Chief Guest Dr. Praveen Kulkarni, Associate Dean, JSS AHER and Dr. P. Vijayanand, Chief Scientist presided.



## Hindi Fortnight Celebration (September 1-14, 2023)

Hindi Fortnight was celebrated from September 1-14, 2023. Competitions in Hindi were conducted for the employees and research students of the Institute during the fortnight. Prizes were distributed by Dr. Sridevi Annapurna Singh, Director CSIR-CFTRI during the valedictory function held on October 5, 2023.



## Curtain Raiser for 9th IFCON (September 11, 2023)

Curtain Raiser event of 9<sup>th</sup> International Food Convention (IFCoN) scheduled to be held at CSIR-CFTRI during December 7-10, 2023 organized by AFST(I) and co-organised by CSIR-CFTRI, DRDO-DFRL and CSIR-IITR was held on September 11, 2023. IFCoN App was also launched on this occasion.





## Engineer's Day Celebrations (September 15, 2023)

55<sup>th</sup> Engineer's Day celebrations was held on September 15, 2023 on the occasion of 162<sup>nd</sup> Birthday of Bharat Ratna Sir M. Visvesvaraya. Prof. Rekha Singhal Chairperson, CSIR-CFTRI Research Council, other members of RC along with Director garlanded the photo of Sir M. Visvesvaraya. Dr. Rekha Singhal delivered a talk on this occasion.



### Birth Anniversary Celebrations of Dr. V. Subramanyan, Founder Director, CSIR-CFTRI (September 22, 2023)

Birth Anniversary celebrations of Dr. V. Subramanyan, Founder Director, CSIR-CFTRI, was held on September 22, 2023. The Chief Guest, Dr. N Krishnamurthy, Chief Scientist (Retd.) & Former Head, PPSFT Dept., delivered a talk on "Dr. V. Subrahmanyan - A Pioneering



Techno Food Scientist". Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the function.

#### • Open Day (September 26, 2023)

On the occasion of CSIR Foundation Day 2023, Open Day was organised at CSIR-CFTRI on September 26, 2023 with the theme "A day with Food Technologists". Nearly 650 students from various schools and colleges visited the Institute and its facilities. Technologies, machineries and analyser techniques were demonstrated on this occasion.



#### • Gandhi Jayanthi (October 2, 2023)

Gandhi Jayanthi was celebrated on October 2, 2023 at the campus. As part of Swachhata Shramdan, Swachhata Hi Seva campaign with theme "Garbage Free India" event was undertaken by students and staff of CSIR-CFTRI.





#### World Food Day (October 16, 2023)

World Food Day 2023 with the theme "Water is Life, Water is Food - Leave no one behind" was held on October 16, 2023. Dr. N.G. Malleshi, Chief Scientist (Retd.) & Former Head, GST Department was the Chief guest and delivered the Chief Guest of the function and delivered a lecture entitled "Mainstreaming Millets for Food and Nutritional Security". Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided.



#### National Quiz Contest on Food Security Mission (October 16, 2023)

National guiz contest on "Food Security Mission" was held on the occasion of World Food Day, organized by CSIR-CFTRI in association with UPL Ltd., Mumbai. The event was inaugurated by Dr. Sridevi Annapurna Singh, Director of CSIR-CFTRI, who spoke about the importance of food security in the country. Ujjawal Kumar, Business Head of UPL Ltd., also addressed the event, followed by Chief guests Dr. Devinder Dhingra from ICAR and Dr. S. Rajendran from UPL Ltd., who emphasized the message that "Food is too good to waste" and stressed the importance of valuing and preserving food. Dr. Prakash M Halami, Head of FPIC, was the organizing secretary of the event. The first round of the national quiz contest took place on July 27, 2023, with 19 teams participating from across the country. The final round was conducted on October 16, 2023, with 5 teams competing.



## • CSIR Foundation Day (October 21, 2023)

82<sup>nd</sup> CSIR Foundation Day was combined with CSIR-CFTRI Foundation Day and was celebrated on 21<sup>st</sup> October, 2023 wherein Prof. Rishikesha T. Krishnan, Director, Professor in Innovation & Leadership, Indian Institute of Management, Bangalore (IIM-B) was the Chief guest and addressed the gathering on the topic "Can India become Innovation powerhouse". Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided the event. The dignitaries distributed prizes to meritorious students and school children who won in various competitions. Mementoes were also distributed to retirees and staff.





## • CSIR-CFTRI Foundation Day (October 21, 2023)

74<sup>th</sup> Foundation day of CSIR-CFTRI was held on 21<sup>st</sup> October, 2023 wherein Prof. M. Pushpavathi, Director, All India Institute of Speech and Hearing (AIISH), Mysore was the Chief Guest and delivered the Foundation Day Address entitled "Ahaara and Aarogya in specially abled: A step ahead to POSHAN Programme". Ms. Shilpi Agarwal, Divisional Railway Manager, Mysuru Division, South Western Railway was Guest of Honour and Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided the event.



## Kannada Rajyotsava (November 1, 2023)

Kannada Rajyotsava celebrations was held on November 1, 2023. Dr. M.S. Sekhar, Kannada writer and critic and former Director of Gandhi Bhavan, University of Mysore was the Chief



Guest and he addressed the gathering. On this occasion Director, CSIR-CFTRI and Chief Guest hoisted the Flag.

#### • Ayurveda Day (November 2, 2023)

Ayurveda day programme was held on November 2, 2023 where in Dr. Tejaswi Kiran and Dr. C.V. Sindhu, CARI, Bengaluru delivered talks on "Ayurveda: A Distinctive Approach to Metabolic Syndrome & Ayurveda: A Panacea for Global Health Concerns", respectively. Also as part of this programme free health check-up for staff and students was conducted and free medicines were distributed.



#### • World Food India (November 3-5, 2023)

World Food India 2023 was held from November 3-5, 2023 at Pragati Maidan, New Delhi which was organized by the Ministry of Food Processing Industry. The event was inaugurated by the Prime Minister Shri Narendra Modi on November 3, 2023. Council of Scientific and Industrial Research (CSIR) Pavilion at World Food India 2023 Expo was inaugurated by Dr. N. Kalaiselvi, Director General, CSIR & Secretary, DSIR, New Delhi on November 3, 2023 in presence of Directors of three CSIR Constituent Laboratories, namely, Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI, Mysuru; Dr. Sudesh Kumar Yadav,



Director, CSIR-IHBT, Palampur, HP; and Dr. C. Anandharamakrishnan, Director, CSIR-NIIST, Thiruvananthapuram, Kerala and Scientists from CSIR Hgrs. The design and setting up of CSIR-Pavilion was coordinated by CSIR-CFTRI. During the event, Dr. Kalaiselvi released three products one each from 3 labs. The product launched from CSIR-CFTRI Technology was "Ragi Power Punch" (Instant beverage mix from malted ragi) of M/s Ram Gold. Director General visited CSIR Pavilion and interacted with Directors and Scientific staff. CSIR-CFTRI displayed food machinery, millet and other products and innovative technologies developed by CSIR-CFTRI. Officials from Central and State Governments Ministries and Boards, Industrialists, Entrepreneurs, Exhibitors, Academia, Research persons from Institutes and Universities visited the CFTRI stall in CSIR - Pavilion on all three days and interacted with Director and Scientific staff.

## 'Aarambh' Roadshow (November 20, 2023)

CSIR-CFTRI organized "Aarambh" a roadshow event to connect Startups, Scientists, Students, and Investors on November 20, 2023. The roadshow was held at CSIR-CFTRI as ecosystem partner to Biotechnology Industry Research Assistance Council (BIRAC) and Global Bio India (GBI 2023). The event was inaugurated by Shri. Sudhanva Dhananjaya, Founder and CEO of Excelsoft Technologies, Mysuru in presence of Dr. Debanjana Dey, Sr. Program Manager, BIRAC, New Delhi. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the inaugural function. The dignitaries also launched the new website of the upcoming BioNEST (Bioincubators Nurturing Entrepreneurship for Scaling Technologies) bio- incubation facility at the Institute with the support of BIRAC.







## ISMT Course Award Ceremony (November 21, 2023)

The award ceremony and valedictory function of 42<sup>st</sup> ISMT course was held on November 21, 2023. Dr. K. Leelavathi, Former Senior Principal Scientist, CSIR-CFTRI, the Chief Guest of the function addressed the students

and participants. The occasion was presided over by Dr. Umesh Hebbar H, Chief Scientist & Head, Department of Food Engineering and medals were presented to meritorious students.



# Jan Jatiya Gaurav Divas (November 23, 2023)

Jan Jatiya Gaurav Divas was celebrated on November 23, 2023 at CSIR-CFTRI. As part of celebration, the dignitaries inaugurated the programme by lighting the lamp and paying homage to Bhagawan Birsa Munda. The invited talk was delivered by Dr. N. Muni Raju, Director and Planning Coordinator, Tribal Development Commission, Govt. of Karnataka, Mysuru. Mr. Motta Somanna, renowned Social Worker and Rajyothsava awardee was felicitated during the function. Dr. Sridevi Annapurna Singh, Director,



CSIR-CFTRI presided over the function. A workshop on "Opportunities in Food Processing for Tribal Empowerment" was conducted for the tribal women on November 24, 2023. Dr. Ravi



U.M, Researcher and Resource person, Janapada Loka, Ramanagara inaugurated the workshop and delivered a talk on lifestyle and food habits of tribals in Karnataka. Pickle making, Papad making and Ginger candy making were demonstrated. A talk on nutritional aspects of food and the importance of value addition of food for tribal women empowerment was explained to the 13 tribal women from the different tribal areas of Mysuru district who participated in the programme. Participation certificates were distributed on the concluding session.

On culmination of Janjatiya Gaurav Divas celebrations, Prof. Promode Kumar Misra, Leading Social Anthropologist and Former National Fellow, Indian Council of Social Science Research delivered a talk on November 29, 2023 on the topic "Tribes in India" with emphasis on bio cultural aspects of Scheduled Tribes in all parts of the country having a well-defined society, culture, identity and rules of behaviour.



#### • Constitution Day (November 26, 2023)

Constitution Day was celebrated on November 26, 2023 at the Institute. Dr. M. Umapathi, Former Chairman, Dept. of Political Science, University of Mysore was the Chief Guest and

delivered the special address on "Indian Constitution and its relevance to society". Dr. N.K. Rastogi, In-Charge Director and Chief Scientist, presided over the function. The participants read the Preamble of the Constitution on this occasion.



## Millet Showcase Inauguration (December 7, 2023)

CSIR-CFTRI Millet Showcase was inaugurated on December 7, 2023 by Shri S. Somanath, Chairman, Space Commission & Secretary, DoS, ISRO, Bengaluru and addressed the students and staff of the Institute.



#### 9<sup>th</sup> IFCON (December 7-10, 2023)

The 9<sup>th</sup> edition of the International Food Convention (IFCoN), organized by the Association of Food Scientists & Technologists (India) and co-organized by CSIR-CFTRI, DRDO-DFRL and CSIR-IITR was held from

December 7-10, 2023 at the Institute. The conference was centered around the theme "TRIMSAFE – Technology Re-engineering for Innovation and Mitigating Risk for a Safe, Sustainable, Affordable & Secure Food Ecosystem." This emphasized the pivotal role of technological advancements in safeguarding the safety, sustainability, affordability, and security of the food ecosystem worldwide.



The inaugural event had the presence of esteemed luminaries like Dr. N Kalaiselvi. Secretary of DSIR (Department of Scientific and Industrial Research) and Director General of CSIR; Shri S Somanath, Chairman of the Indian Space Research Organisation (ISRO), Secretary, DoS; Her Highness Smt. Pramoda Devi Wadiyar; Dr. N. Bhaskar, President of AFST(I) and Organizing Chairman of the 9<sup>th</sup> IFCoN; Dr. Anil Semwal, Director, DFRL, Mysuru; Dr. Sridevi Annapurna Singh, Director of CSIR-CFTRI, Mysuru. As prelude to "Prof. M.S. Swaminathan Padma Shri Award Lecture" Series: Convention Talk on "Sci-toons" was delivered by Dr. Pradeep Kumar Srivastava. former Deputy Director (Senior Principal Scientist) at CSIR-CDRI, Lucknow. The "Prof. M.S. Swaminathan Padma Shri Award Lecture"

series started with talk by Padma Shri Prof. (Dr.) Shanshank R. Joshi, Consultant Endocrinologist at Lilavati Hospitals & Joshi Clinic. The conference garnered an enthusiastic response with 2600 registered delegates, hosted around 24 technical sessions spanning over four days, covering 90 distinguished speakers who are globally and nationally renowned in the fields of research, academia and industry. The poster sessions in IFCoN-2023 received overwhelming response especially from the young researchers from different parts of the country. A standout feature of the convention, the Mega Food Expo. had participation from more than 75 industry/research organisations. One noteworthy highlight was the dedicated Millet Pavilion, featuring an exclusive section for showcasing millet technologies and products. The conference's comprehensive agenda extended to include the Start-Up Conclave which was exclusively designed to nurture food startups, fostering an environment of collaboration and innovation. In the valedictory session, the distinguished Chief Guest, Prof. S. Ayyappan, a Padma Shri Awardee and Chairman of NABL, Gurugram, delivered an enlightening address. Poster presentation awards were distributed on this occasion.





# Indian Botanical Society Foundation Day Lecture (December 28, 2023)

Indian Botanical Society Foundation Day Lecture was held on December 28, 2023, wherein Prof. Manoj Kumar Dhar, Director, AcSIR, Ghaziabad, UP delivered a talk on "Exploring the beauty and benefits of Saffron: The Golden Spice"



#### • Republic Day (January 26, 2024)

As part of the 75<sup>th</sup> Republic Day celebrations, Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI unfurled the National Flag and delivered the Republic Day address. Rangoli competition and T-6 cricket tournament were held on 18<sup>th</sup> and 23<sup>rd</sup> January 2024, respectively and also photography competition was held on 18<sup>th</sup> January 2024. Director distributed cash prizes, medals and certificates to winners of the competitions.

## Phenome India-CSIR Health Cohort Knowledgebase (February 22-27, 2024)

Comprehensive health checkup and screening camp under Phenome India-CSIR Health Cohort Knowledgebase (PI-CHeCK) was held during February 22-27, 2024 at CFTRI campus for staff and retirees. This camp was inaugurated by Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI on February 22, 2024. Nearly 310 participants were screened during the camp.

#### National Science Day (March 1, 2024)

National Science Day-2024 programme with the theme "Indigenous Technologies for Viksit Bharat" was held on March 1, 2024 at the Institute. Prof. S.R. Niranjana, Vice-Chairman, Karnataka State Higher Education Council and former Vice-chancellor of Gulbarga University



Dr. Sridevi Annapurna Singh, Director CSIR-CFTRI at the inauguration of Phenome India-CSIR Health Cohort Knowledgebase



was the Chief Guest and delivered a lecture on "Development of Science and Technology in India". Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the event.



# International Women's Day (March 8, 2024)

International Women's Day "Indian Women-Excellence in Science" was celebrated on March 8, 2024. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the event and delivered International Women's day message. Various women scientists from CSIR-CFTRI & Guyanese delegates participated in the event and shared their experiences



### 8. MoU(s) Signed

 International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad

- 2. Indian Institute of Technology, Delhi (IITD)
- 3. Jan Swasthya Sahyog (JSS), Bilaspur, Chhattisgarh
- 4. JSS College of Arts, Commerce & Science, Mysuru
- Adikavi Nannaya University, Rajamahendravaram
- Ramaiah University of Applied Sciences (RUAS), Bengaluru
- 7. UPL Limited, Mumbai
- Milltec Machinery Private Limited, Bengaluru Signing of MoU between CSIR-CFTRI and Ramaiah University of Applied Sciences (RUAS), Bengaluru
- 9. BAIF Development Research Foundation, Pune



Signing of MoU between CSIR-CFTRI and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad



Signing of MoU between CSIR-CFTRI and Ramaiah University of Applied Sciences (RUAS), Bengaluru



# 9. Awards and Recognitions

# Ph.D. Degree awarded

# a) AcSIR

SI. No.	Name of the Student	Title of the Thesis	Guide
1	Aisha Siddiq	Studies on selected molecules of dietary origin as potential modulators of proprotein convertase subtilisin / kexin 9	Dr. Asha Martin
2	Ajana P	Modulators of glucose metabolism from <i>Spirulina</i> and elucidation of their mechanism of action	Dr. Vikas Singh Chauhan Dr. Sudha Rudrappa (Co-guide)
3	Anjali P	Genetic transformation of <i>Linum usitatissimum</i> (flax) with Delta-6- desaturase from <i>Buglossoides arvensis</i>	Dr. Sreedhar RV
4	Anusree L	Biochemical characterisation of Flavin Adenine Dinucleotide Synthetase (FADS) involved in riboflavin metabolism from Staphylococcus aureus	Dr. Ravi Kumar
5	Arya Devi KP	Molecular insights related to the propensity of dietary molecules to modulate Sirtuins (SIRT1)	Dr. Asha Martin
6	Chandra G	Studies on the osteogenic potential of glycosaminoglycans isolated from fish waste	Dr. Nandini CD
7	Deepak TS	Functional food ingredients from selected maize ( <i>Zea mays L.</i> ) wet milling by-products	Dr. Jayadeep A
8	Devika R Nair	Understanding the modulatory potentials of probiotic actobacillus fermentum MCC2760 on the lipidemic effects of saturated and omega-6 fats in experimental rats	Dr. Ramaprasad TR



SI. No.	Name of the Student	Title of the Thesis	Guide
9	Duppeti Haritha	Characterization of flavor compounds from the shrimp <i>Litopenaeus vannamei</i>	Dr. Bettadaiah BK
10	Gopika S Kumar	Enriching bioactives from curcumin- removed-turmeric-oleoresin fractions by anofiltration	Dr. Navin K Rastogi
11	Jyoti Lavania	Solvent resistant nanofiltration membranes for processing rice bran oil	Dr. Navin K Rastogi Dr. R. Subramanian (Co-guide)
12	Jyoti Semwal	Prolamin and resistant starch of sorghum as functional ngredients: Effect of processing	Dr. Meera S
13	Kalpana Patel	Understanding the molecular basis of osteoanabolic activity of potential plant bioactives	Dr. Kunal Sharan
14	Kanwate Balaji Wamanrao	Studies on preparation, haracterization and applications of gelatin hydrolysate from <i>Labeo rohita</i> swim bladder	Dr. Tanaji G Kudre
15	Meena Kumari	Bio-efficacy of <i>Lactobacillus fermentum</i> MCC2760 based probiotic formulation for hypercholesterolemia and gut microbiome	Dr. Muthukumar SP
16	Mehar Jitendra Gajanan	Spirulina platensis cultivation using automated open raceway pond with Co2-fed pH control: Metabolite profiling and microbial population dynamics investigation	Dr. Sandeep N Mudliar Dr. Azam Sheikh (Co-guide)
17	Monica P	Molecular engineering of native and chimeric forms of GH26 endomannanase (ManB-1601): Towards understanding / improvement in stability and catalysis for industrial applications	Dr. Mukesh Kapoor
18	Moumita Das	Effect of ergosterol extract from white button mushroom ( <i>Agaricus bisporus</i> ) in modulating obesity related complications	Dr. Suresh Kumar G



SI. No.	Name of the Student	Title of the Thesis	Guide
19	Neenu Ravikumar	Amelioration of vitamin B12 and micronutrient deficiency through Spirulina supplementation	Dr. Vikas Singh Chauhan Dr. R Sarada (Co-guide)
20	Nivedha K	Development of hypoglycaemic food Dr. Prabhasankar enriched with Sesbania grandiflora bioactives and its biological validation	
21	Pinchu Elizabath Thomas	Structuring of virgin coconut oil based oleogel and its application in bakery products	Dr. Prabhasankar P
22	Pramila Epparti	Evaluation of structural and functional properties of subtilin-like lantibiotics produced by <i>Bacillus</i> species	Dr. Prakash M Halami Dr. A P Sattur (Co-guide)
23	Priyanka Rose Mary	Understanding the utilization of β-mannan/β-manno-oligosaccharides by probiotic and commensal gut bacteria	Dr. Mukesh Kapoor
24	Raj Kumar	Non-thermal processing of tender coconut water using UV-C light emission diodes	Dr. Sudheer Kumar Yannam
25	Raja N	Identification and functional characterization of Alpha Beta Hydrolase Domain (ABHD) containing protein 16B	Dr. Usharani D Dr. Ram Rajasekharan (Co-guide)
26	Ravi Mangu SVVS	Understanding the effect of maternal hypercholesterolemia on the offspring's bone developmental programming pathways in mice models and its correlation in human subjects	Dr. Kunal Sharan
27	Rohini B	Photocatalytic assisted valorization of corn cob biomass Dr. Umesh Hebbar H	
28	Seema Mudhol	Development of nanoformulations for in situ delivery of phytochemicals to efficiently convert white to brown adipose tissue	Dr. Muthukumar SP



SI. No.	Name of the Student	Title of the Thesis	Guide
29	Seemashree MH	Studies on effect of culture conditions on the modulation of lipids in select microalgae	Dr. Vikas Singh Chauhan Dr. R Sarada (Co-guide)
30	Siddhi S Patil	Anti-obesity potential of coffee leaf extract using mice model	Dr. Pushpa S Murthy
31	Sowmya GV	Effect of maternal omega-3 LC-PUFA exposure in the programming of offspring's skeletal metabolism	Dr. Kunal Sharan
32	Tehreem Maradagi	Elucidation of molecular mechanism underlying the inhibitory potential of lutein/zeaxanthin on high glucose-induced proliferation of human hepatocellular carcinoma (HepG2) cells	Dr. Ganesan P Dr. Ravi Kumar (Co-guide
33	Trishitman Das	Development of forward osmosis process for pomegranate and beetroot juice concentrates	Dr. Navin K Rastogi
34	Uma Maheshwari	Improved method for extraction of bioactives from fenugreek seed fractions: Characterization of 4-hydroxyisoleucine (4-HIL) and its effect on diabetic nephropathy	Dr. Madhava Naidu M Dr. Nandini CD (Co-guide)
35	Vaibhavi A Pimpley	Modulatory effect of green coffee polyphenols on obesity induced model	Dr. Pushpa S Murthy
36	Yogendra Prasad	Characterization of molecular mechanism underlying the cancer chemo-preventive potential of carotenoids in luminal and triplenegative human breast cancer cells	Dr. Ganesan P Dr. Poornima Priyadarshini CG (Co-guide)



# b) University of Mysore

Name of the Student	Title of the Thesis	Guide
Priya Prakash Sharma	Thermogenic properties of nutraceuticals from Indian marine brown algae in obese mouse	Dr. Baskaran V
Punarvasu TP	Studies on anticancer effects of hydrocolloid based self-assembled microparticles	Dr. Harish Prashanth KV
Rashmi HB	Development of food based nutraceutical formulation with anthelmintic potential from under-utilized fruit ( <i>Eugenia uniflora L.</i> ) and vegetable ( <i>Momordica dioca Roxb.</i> )	Dr. Negi PS

# c) Mangalore University

Name of the Student	Title of the Thesis	Guide
Koppada     Umashankar	Biotechnological approaches for enhancement of bioactives in tubers of <i>Decalepis hamiltonii</i>	Dr. Giridhar P
Rohith HS	Efficacy of probiotic bacteria in alleviating T helper cell associated immune response	Dr. Prakash M Halami
Shreelakshmi SV	Production of phenlics, <i>i-deoxynojirimycin</i> and resveratrol from <i>in vitro</i> culture of mulberry and their biological activity	Dr. Nandini P Shetty

# d) Recognitions by Academies

Recognition	Instituted by	Awardee
FRSB Fellowship	Royal Society of Biology, UK	Dr. Giridhar P
Fellow of Entomological     Society of India (FESI	The Entomological Society of India, New Delhi	Dr. Ezil Vendan S
ICMR-DHR Long-term     International Fellowship	ICMR, New Delhi	Dr. Mahejibin Khan
Fellow of STA-2023	The Society of Tropical Agriculture, New Delhi	Dr. Uma V Manjappara



# e) Individual Awards

Recognition	Instituted by	Awardee
Eminent Sr. Scientist     Award - 2023	CSER (Centre for Societal and Environmental Research), Ranchi	Dr. Giridhar P
Dr. G.B. Manjrekar Award (Biennial) - 2023	AMI, India	Dr. Prakash M Halami
Excellence in Research	Sanjivani Arts, Commerce, and Science College, Kopargon	Dr. Prakash M Halami
Subhash Bhatnagar     Memorial Award - 2022	AFST(I), Mysore	Dr. Padmavathi T



Dr. Padmavathi T., Principal Technical Officer, FOSTIS/Library, receiving the Shubhash Bhatnagar Memorial Award - 2022 instituted by AFST(I), Mysore



Dr. Prakash M Halami, Chief Scientist, Dept. of Microbiology & Fermentation Technology, receiving the Dr. G. B. Manjrekar award (Biennial) – 2023 instituted by AMI, India

# f) Other Recognitions

Name	Member / Panel Expert & Host Institution
Dr. Sridevi Annapurna Singh	<ul> <li>Member of CSIR Governing Body; Senate Member of AcSIR, CSIR; Member of Advisory Committee of CSIR – Traditional Knowledge Digital Library (CSIR-TKDL); Member of CSIR Taskforce Committee to review/monitor and guide the implementation of Jigyasa 2.0 programme</li> </ul>



Name	Member / Panel Expert & Host Institution	
	<ul> <li>Member of CSIR Taskforce on Nutra Sector; Member of Task-Force committee on "CSIR-Mission Mode Programme on Advancing Technological Leads for Assuring Safety of Food (ATLAS); Member of Recruitment and Assessment Board of CSIR; Member of Food Authority of FSSAI</li> </ul>	
	<ul> <li>Member of Expert Committee for Tomato Grand Challenge for development of Comprehensive and focused intervention in design of tomato value chain, pre-production, primary processing, post-harvest, storage and valorization constituted by Ministry of Consumer Affairs, Food and Public Distribution</li> </ul>	
	<ul> <li>Chairperson of SIRO (DSIR) Screening Committee for recognition to In-house R&amp;D (RDI) units; Chairperson of Taskforce for developing standards for Indian Mithai and Namkeens constituted by FSSAI; Chairperson of Expert Committee to examine the approval of Non- specified Food and Food Ingredients, FSSAI</li> </ul>	
	<ul> <li>Chairperson of the 'Task Force on Enhancement of Shelf Life of Millets' constituted by the Ministry of Agriculture and Farmers Welfare; Chairperson of Drinking Water &amp; Carbonated Beverages Sectional Committee, FAD 14, Bureau of Indian Standards</li> </ul>	
	<ul> <li>Member of Codex Coordination Group (CCG3):         Foods of Plant Origin (Sub-group on Fresh Fruits         &amp; Vegetables); Member of Codex Committee on         Contaminants in Foods (CCCF15) of FSSAI;         Member of DST Fund for Improvement of S&amp;T         Infrastructure (FIST) Program, DST, GOI, New         Delhi; Member of the Committee on 'Smart         Proteins', BIRAC, DBT</li> </ul>	



Name	Member / Panel Expert & Host Institution	
	Advisory Committee Member of NIFTEM Research Development Council; Member of Research Advisory Committee of ICAR-Indian Institute of Millet Research (IIMR), Hyderabad	
	<ul> <li>Member of the Governing Body of National Agri Food Biotechnology Institute (NABI), DBT, Mohali; Member of Governing Body of Centre of Innovative and Applied Bioprocessing (CIAB), DBT, Mohali; Member of Project Review &amp; Monitoring Committee, NECTAR, DST, GOI</li> </ul>	
	<ul> <li>Member of Scientific Advisory Committee, International Life Science Institute (ILSI), India; Member of Board of Studies of Adikavi Nannaya University, Rajamundry; Member of Sub- Committee of Women Child Health &amp; Nutrition TEC, DBT, GOI</li> </ul>	
	<ul> <li>Member of Selection committee – National Technology Day Awards 2022 of TDB/DST; Member of Pushti Committee of Department of Women and Child Development, Government of Karnataka</li> </ul>	
	<ul> <li>Member of Vision Group on Biotechnology, Directorate of Electronics, IT and BT, Government of Karnataka; Member of the Core Group on 'Right to Food and Nutrition' of the National Human Rights Commission (NHRC); Member Representative of the Governing Body of Coffee Incubation Centre</li> </ul>	
	<ul> <li>Member of delegation led by Director General, CSIR visited Norway to strengthen India-Norway S&amp;T relations and to discuss focused technology cooperation through CSIR &amp; Norwegian Research and Technology Organisations</li> </ul>	



Name	Member / Panel Expert & Host Institution
Dr. Vikas Singh Chauhan	<ul> <li>Member, DRDO-Life Sciences Research Board (LSRB)'s specialist panel on Food Science, Hill Agriculture, Bioremediation and Bio-resources (FSH&amp;ABB)</li> </ul>
	Expert Member, Technical Advisory Committee for R&D Projects of Mahatama Gandhi Institute for Rural Industrialisation (MGIRI), Wardha
Dr. Prakash M Halami	Chairperson, Bureau of Indian Standards, FAD29 alcoholic drinks
	Member, Scientific panel on antibiotic residue, FSSAI, New Delhi
	Member, BOS in Life Sciences, JSS Academy of Higher Education, Mysore
	Member, BOS, Department of Biotechnology, University of Mysore.
	Member, BOS, St. Philomena's College, Mysuru
	Member, BOS, St Joseph's University, Bangalore
Dr. Negi PS	Member, APEDA Authority, New Delhi
	Convener, Fruits, Vegetables and Allied Products     Sectional Committee (FAD 10 / Panel IV) of     Bureau of Indian Standards
	Expert Member, Technical Advisory Committee (TAC) of Technology Development and Utilization Programme for Women (TDUPW) of Department of Scientific and Industrial Research
	Expert Committee Member, MoFPI to Review curriculum and course content under the capacity building component of PMFME scheme
	Expert Member, Appraisal committee of MoFPI to Review the proposals received from States / UTs



Name	Member / Panel Expert & Host Institution
	for Common Incubation Centre establishment under PMFME scheme
	Member, Technical Committee, APEDA, New Delhi
Dr. Prabhasankar P	Member, FSSAI - Scientific Panel on Cereals, Pulses & Legume and their Products (Including Bakery)
	Member, BOS, Home Science, Sri Padmavathi     Mahila Visvavidyalayam (SPMVV), Tirupati
	Academic Council Member, Faculty of Food Technology, University of Mysore
	<ul> <li>Member, Ready-to-Eat Foods and Specialized Products Sectional Committee, FAD 24 (Food and Agriculture Department, Bureau of Indian Standards)</li> </ul>
Dr. Umesh Hebbar H	<ul> <li>Expert Member, Reviewing of projects under S&amp;T Scheme of KVIC</li> </ul>
	Member, External Examiner for a candidate to conduct Pre-doctoral viva-voce from JSS Science and Technology University, Mysuru
	DAC – External Member, for Ph.D from School of Biosciences and Technology, VIT, Vellore
	Expert Member, Evaluation of Master's degree thesis, NIFTEM-T
	<ul> <li>External Examiner, for conducting viva of Ph.D. thesis from School of Chemical and Bio Engineering (SCBE), Addis Ababa Institute of Technology, Ethiopia</li> </ul>
	Member, Food and Agriculture Division Council (FADC) of BIS
	Member, BOS, Dept. of Food Science and Technology, University of Mysore



Name	Member / Panel Expert & Host Institution
	Member, BOS, Food Technology, Rajiv Gandhi University, Arunachal Pradesh
	<ul> <li>Member, Committee for screening the applications received against scientific positions at NABI, Mohali</li> </ul>
Dr. Sandeep N Mudliar	Member, Program Advisory Committee, Karnataka Biotechnology Commission
	Member, BIS, Water Committee
	<ul> <li>Technical Member, DST-TIFAC Committee on biofuels and bio-products (LCA and Techno- Economics)</li> </ul>
	<ul> <li>Technical Expert for CETP Committee of Karnataka Industrial Area Development Board (KIADB), Bangalore</li> </ul>
Dr. Tanaji G Kudre	<ul> <li>Expert Member, Slaughter House and Meat Industry Sectional Committee (FAD 18) under the Bureau of Indian Standards (BIS), India</li> </ul>
	<ul> <li>Member, Working Group under the MoEF &amp; CC for deliberating on the applicability of Environment Clearance under the provisions of EIA, 2006 for slaughterhouse and meat processing units</li> </ul>
	<ul> <li>External Expert, for finalizing the research program in the area of Food Processing and Value Addition for master's and Ph.D. program for Central Agricultural University, Imphal, Manipur</li> </ul>
Dr. Jaydeep A	Member, FSSAI Scientific panel on cereals & pulses
	Member, FSSAI Food Analysts Exam Board
	<ul> <li>Member, BIS, Panel on Fortified Rice &amp; related Commodities, FAD 16/Panel 7</li> </ul>
	Chair/Member, Board of Examiners for the



Name	Member / Panel Expert & Host Institution
	evaluation of the Ph.D thesis in Biochemistry of University of Kerala, Thiruvananthapuram; Bioscience of M.G. University, Kottayam
Dr. Gothwal PP	<ul> <li>Senior Member, State Level Empowered Committee for appraisal of new food processing industry proposals by Secretary, Department of Dairy and Animal Husbandry, Govt. of Uttar Pradesh</li> </ul>
	<ul> <li>Expert Member, in the area of Agriculture Sci. (Food Technology) for the selection of SRF/RA Selection Committee at Human Resource Development Group (HRDG), CSIR, New Delhi</li> </ul>
	<ul> <li>Member, State Level Empowered Committee for appraisal of new food processing industry proposals by Chief Secretary, Department of Horticulture and Food Processing, Govt. of Uttar Pradesh</li> </ul>
Dr. Pushpa S Murthy	Member, Selection Committee, for the Screening     & Selection Committee to evaluate and select     suitable start-ups for the incubation program. Atal     Incubation Centre, Coffee Board (AIC CCRI CED)
	<ul> <li>Member, Food and Agriculture Division (FAD-09)         of Bureau of Indian Standards for Stimulant         Foods Sectional Committee, FAD 6</li> </ul>
	<ul> <li>Advisory Member, Biotechnology Department, Sidaganga Institute of Technology, Tumkur, Karnataka</li> </ul>
Dr. Giridhar P	Member, BIS, PCD-18 Flavours and Fragrances
	Member, BIS, Project Advisory Committee
Dr. Usharani D	Research Council Member, ICAR-National     Institute of Secondary Agriculture
	<ul> <li>Member, Scientific panel of pesticide residues of FSSAI</li> </ul>



Name	Member / Panel Expert & Host Institution	
	<ul> <li>Expert Member, for setting question papers and evaluating exams for the recruitment of scientists in the field of Food Technology to Agricultural Scientists Recruitment Board</li> </ul>	
	<ul> <li>Member, BIS Technical Committee - FAD 13- Oils and Oil seeds. FAD 28: Test methods for Food Products, FAD 15- Food Hygiene, Safety Management and Other Systems Sectional Committee-Alternative Member, BIS- Technical Committee - CHD -07, Chemical Hazards- Principal Member</li> </ul>	
Dr. Prasanna Vasu	Member, BOS, Department of Food Science and Technology, St. Joseph's University, Bangalore	
	Technical Committee Member, BIS- FAD 28 Test methods for Food Products	
	Technical Committee Member, BIS— FAD 29     Alcoholic Drinks	
	BIS- Technical Committee -CHD -07, Chemical Hazards-Alternate Member	
Mrs. Vanajakshi V	Member, Technical Committee, BIS - FAD-14     Drinking water and carbonated beverages     Sectional Committee – Alternate Member	
	<ul> <li>Member, Technical Committee, FAD 30-Water purification systems Sectional Committee – Alternate Member</li> </ul>	
	BIS CHD 36: WG01 – To prepare a document on subject field test kit (FTKs) to be used for surveillance of drinking water working group – Alternate Member	
Dr. Shiva Sankar Reddy Singam	<ul> <li>Member, Technical Committee, BIS-FAD2</li> <li>Member, Sugar Industry Sectional Committee</li> </ul>	



Name	Member / Panel Expert & Host Institution
Dr. Nandini CD	Member, Fixed Dose combination related to vitamins and minerals, Central Drug Standard Control Organisation, New Delhi
	Member, Sugar Industry Sectional Committee, FAD 2, BIS
	Panel member for Scientists evaluation, IASST,     Guwahati, Assam
Dr. Gopinath M	Panel Expert in GITAM University, Visakhapatnam for the selection of MURTI Faculty Fellows
Dr. Mukesh Kapoor	<ul> <li>Member, FAD 31 Food Microbiology Sectional Committee, Bureau of Indian Standards, Ministry of Consumer Affairs, Food &amp; Public Distribution, Government of India, New Delhi</li> </ul>
	Member, FAD14, Drinking Water and Carbonated Beverages Sectional Committee, Bureau of Indian Standards, Ministry of Consumer Affairs, Food & Public Distribution, Government of India, New Delhi
Dr. Muthukumar SP	Member, Apiary Industry Technical Committee, FAD 3, Bureau of India Standards, New Delhi
	Member, Scientific Panel on Biological Hazards (SP-06), FSSAI, New Delhi
	<ul> <li>Nominee, Committee for Control and Supervision of Experiments on Animals (CCSEA), Govt. of India, New Delhi.</li> </ul>
	Expert Member, Institutional Biosafety Committee,     Vipragen, Mysore
	Joint Secretary, Laboratory Animal Scientists     Association (LASA), India
Dr. Asha Martin	Principal Member, Technical Committee on Food Biotechnology Sectional Committee (FAD-23) of



Name	Member / Panel Expert & Host Institution
	the Food and Agriculture Division of Bureau of Indian Standards (BIS)
	Member, Human Ethical Committee, University of Mysore
	Expert Member, Project Review and Steering Group (PRSG) for Ministry of Electronics and Information Technology
Dr. Syed Musthapa M	External Expert, Research Advisory Board (RAB),     JSS Medical College, JSS AHER, Mysore
	Member, BOS, Islamiah College, Thiruvalluvar University, Tamil Nadu.
	<ul> <li>Member, BOS, Vivekananda College of Arts and Sciences for Women, Periyar University, Tamil Nadu</li> </ul>
Dr. Harish Prashanth KV	<ul> <li>Research Advisory Member, MIMS, Mandya under the Department of Health Research and Family Welfare, Government of India and Department of Medical Education, Government of Karnataka</li> </ul>
	<ul> <li>Member, Research Advisory Committee (RAC), Adichunchangiri University, B.G. Nagar, Karnataka</li> </ul>
	Advisory Panel Member, Advanced Noble Synergies Private limited, Mysuru
	Scientific Advisor, for company "ICurry",     Vijayawada, Andhra Pradesh
Dr. Vijayaraj P	Member, FSSAI Scientific Panel on Oils and Fats (SP-15)
Dr. Sarma MVRK	Member, FSSAI Scientific Panel on Alcoholic Beverages (SP-21); Member, BOS, Yuvaraja's college (Autonomous)



Name	Member / Panel Expert & Host Institution
Dr. Bettadaiah BK	Member, Food and Agriculture Division (FAD-09)     of Bureau of Indian Standards for Spices and     Condiments
	Member, Spices Board, Ministry of Commerce and Industry, GOI, Kochi
	Member, Committee of Experts, Spices Board- CFTRI Pilot Incubation Facility
	Convener, AcSIR Academic Committee, CFTRI,     Mysore
	Convener, Board of Studies, Dept. of Food Science and Technology, University of Mysore
	<ul> <li>Member, Department Advisory Board, Dept. of Chemistry, JSS Science and Technology University, Mysore</li> </ul>

## g) Other Awards

nstituted by	Awardee
National Magnetic	Anisha Biswas
Resonance	(Ph.D. student of
Society of India	Dr. Sachin R Chaudhari,
National level)	PPSFT Department)
\ R S	ational Magnetic esonance ociety of India

# h) Best Research Papers / Posters Awards

One Week One Lab (OWOL), CSIR-CFTRI, Mysore, July 3-7, 2023

- Sandopu Sravan Kumar, Attar Singh Chauhan, Giridhar P., Basella rubra's techno-commercial relevance as evident from its research innovations
- Yajat S. Murthy, Ashish Rao, Pushpa S. Murthy, Bean to brew
- Kunnummal S.P., Mahejibin Khan, Pectin and bioactive rich nutraceutical formulation

for the modulation of gut microbial diversity and anti-inflammatory responses

- Govinda Raju K., Rohith R., Hariprasad B.R., Adulteration in milk - Is the milk we consume safe?
- Umamaheshwari P., Bhavana B., Prasanna Vasu, Food quality and safety: Food additives
- Prasanna Vasu, Megha M., Mithuna K.M., Ninni Sutradhar, What makes your honey... honey: Honey analytical facility at CSIR-CFTRI



- Amrutha Kala A.L., Girish Bharadwaj A.N.,
   Spice of your life with right spice
- Vanajakshi V., Swathi S., Parvati Hudade, Microbial food safety
- Ipsita Jena, Vijayaraj P., Exploring a multiomics strategy to identify active lipases in pearl millet for enhancing shelf life

# 11<sup>th</sup> International Conference of Laboratory Animal Scientist's Association (LASA), Indian Institute of Science (IISc), Bengaluru, November 7-8, 2023

- Mohammed Touseef Khan, Krupashree K., Muthukumar S.P., Nanoencapsulated bioactives from *Picchorhiza* kurroa ameliorated fuminosin B1-induced aberrant lipid metabolism in C57BL/6 mouse model
- Mukhlis Y., Natesh J., Syed Musthapa M., Complementary efficacy of DIM-enriched diet in 4T1-syngenic mice breast tumor model

# 55<sup>th</sup> Nutrition Society of India, NIN, Tarnaka, Hyderabad, November 25-26, 2023

- Polam Rekha, Narsing Rao G., Sridhar R., Madhusudan Rao D., Srinivasulu Korra, Development of instant kheer mix from ash gourd (*Benincasa hispida L.*) and evaluation of its nutritional composition
- Srinivasulu Korra, Madhurya S., Sandeep Kumar, Sesha Sainath A.V., Keshava Murthy P.S., Jeevan Prasad Reddy, Preparation and characterization of cardanol-incorporated PLA films for food packaging applications
- 9<sup>th</sup> International Food Convention (IFCoN) on TRIMSAFE organized by Association of Food Scientists and Technologists (India), CSIR-CFTRI, Mysore, December 7-10, 2023
- Srinivasulu Korra, Madhurya, Sandeep Kumar, Sesha Sainath A.V., Keshava

- Murthy P.S., Jeevan Prasad Reddy, Preparation and characterization of aminefunctionalized graphene-incorporated PLA films for food packaging applications
- Umashankar K., Kiran S. Mawale, Arnab S. Mahapatra, Giridhar P., Efficacy of Cu-chitosan nanoparticles treatment on growth and flavour metabolite production in tubers of *Decalepis hamiltonii*
- Sandopu Sravan Kumar, Giridhar P., Nutritional and nutraceutical potentials of depigmented Basella rubra fruit waste
- Sandesh Suresh K., Akil Salim J., Suresh P.V., Tanaji G. Kudre., Evaluation of fuel properties, engine performance, and combustion and gas emission characteristics of biodiesels produced from marine fishmeal industry oil using calcined shrimp shell and crab shell catalysts
- Swapna Majhi, Selina Majhi, Vasthavika E.V., Mohan A. Dhale, Mohankumari H.P., Application of *Monascus purpureus* pigments as natural antifungal and colouring agent to prevent mold growth
- Varsha H.S., Sridevi Annapurna Singh, Ramaprasad T.R., Madan Kumar P., Prakash M. Halami, *In-vitro* alpha-amylase inhibition activity by postbiotic extracts obtained from probiotic bacteria
- Peerzade I.J., Muthukumar S.P., Prakash M. Halami, Efficacy of antimicrobial peptide from probiotic *Bacillus licheniformis* MCC 2514 in *Salmonella typhimurium* challenged mice
- Mohd. Shakeb, Deepak V., Umesha B.A., Sathyendra Rao B.V., Studies on dehusking of barnyard millet using rubber roll sheller with varying differential speed of rubber rollers



- Mithuna K.M., Prasanna Vasu, Production of large neutral amino acid-enriched protein for the management of phenylketonuria
- Ninni Sutradhar, Prasanna Vasu, Studies on anti-inflammatory agents of Indian honey
- Megha M., Ramaprasad T.R., Prasanna Vasu, Fractionation and identification of chickpea (*Cicer arietinum*) proteins for branched - chain amino acid enrichment
- Parvati Huded, Prabhu Darshan, Ramaprasad T.R., Prasanna Vasu, Understanding the role of donkey milk in modulation of inflammatory response in rats induced with inflammatory bowel disease
- Jyothibai P., Ramaprasad T.R., Prasanna Vasu, Isolation and characterization of branched-chain amino acids enriched proteins from goat milk
- Umamaheswari P., Girish Bharadwaj A.N., Bhavana B., Prasanna Vasu, Quantitative analysis of additives, contaminants and adulterants for food safety: Method verification and validation
- Tejaswini Nayak, Prakruthi Appaiah, Tanaji G Kudre, Vijay Shinde, Prasanna Vasu, Praveena Bhatt Mudliar, Indirect ELISA platform for detection of deoxynivalenol (DON) using avian antibodies: A cost effective alternative
- Neha Tawar, Sandeep N. Mudliar, Roopavathi
  C., Prasanna Vasu, Sukumar Debnath,
  Addressing pathogen and aflatoxin issues in
  byadagi chilli powder using multipin
  atmospheric cold plasma
- Sindhu R. Nambiar, Mathen Mathew, Jayadeep A., Determination of blending efficiency and folic acid in fortified rice

- kernels from different zones of India
- Rohith R., Ishika K., Amrutha Kala A.L., Physicochemical quality evaluation of masala powders
- Sanjay K., Usharani D., A functional role of polyphenolics activity towards lipid metabolism
- Naryanasamy R., Rajasekaharan R., Usharani D., Biochemical insights into ABHD16B overexpression in Saccharomyces cerevisiae through lipidomics
- Sunil Kumar B.T., Swathi S., Vanajakshi V., Umesh Hebbar H., Sridevi Annapurna Singh, Evaluation of antioxidant, antibacterial and antifungal activities of extracted melanin pigment from niger seed hulls
- Darshini I.S., Pramod Kumar P., Priyanka D.N., Harish Prashanth K.V., Soluble chitosan derivative improves cognitive impairment and oxidative stress in a Wistar rat model of streptozotocin-induced neurodegenerative disease
- Pramod Kumar P., Harish Prashanth K.V., Development and evaluation of bilobalide microemulsion by oral intervention for targeting Alzheimer's disease (AD)
- Chandankumar K.P., Ashrafi Hossain, Suresh Kumar G., Jayadeep A., Evaluation of carotenoid and phytosterol components and their bioaccessibility from differently milled proso millet
- Rajalakshmi P., Anbarasu K., Sweetcorn nano vesicles are enriched with phytochemicals attenuating breast cancer progression through activation of PDK1/AKT mediated apoptosis



- Suraj P., Rajeshwar S. Matche, Temperature control strategy for undergoing power outages in refrigeration
- Sadeeya Khan, Rajashree Kannan, Rajeshwar S. Matche, Enhancing edible films with eugenol and gold nanoparticle for improved characteristics
- Harshitha M.D., Chithra R., Roopavathi C., Mamatha S.S., Production and optimization of pectinolytic enzyme-pectinase from marine bacteria
- Ashwath Kumar K., Sudha M.L., Akhila Sri, Roopavathi C., Prabhasankar P., Effect of additives on the quality and microbial characteristics of par baked burger buns during storage
- Shashanka Rao J.N., Vyshnavi G., Tamilselvan T., Prabhasankar P., Charcoal cones: A comparative study of natural activated charcoal with synthetic brilliant black bn as food colourant in ice-cream waffles
- Tamilselvan T., Saravanan M., Prabhasankar
   P., Influence of mechanical activation using planetary ball milling on the development of little millet-based gluten-free bread
- Pinchu Elizabath Thomas., Saravanan M., Bharath A.P., Prabhasankar P., Virgin coconut oil-based functional oleogel as a fat replacer in filling creams
- Jethani H., Punil Kumar H.N., Chauhan V.S., Umesh Hebbar H., Thin layer drying of Arthrospira platensis extract using dehumidified air dryer: Effect of additives on drying kinetics and moisture transfer parameters
- Sunil Kumar B.T., Swathi, Vanajakshi V.,

- Umesh Hebbar H., Sridevi A. Singh, Evaluation of antioxidant, antibacterial, and antifungal activities of extracted melanin pigment from nigerseed hulls
- Bhavana B.K., Sukumar Debnath, Sandeep N. Mudliar, Life cycle assessment of fermentative xylitol production from wheat bran: A comparative evaluation of sulphuric acid and chemical-free wet air oxidationbased pretreatment
- Atreyee Bal, Ayush Anand, Navin Kumar Rastogi, Sukumar Debnath, Ultrasound assisted extraction of anthocyanin from blue pea and hibiscus flower
- Cathrine M.S. Bethi, Gopinath M.S., Fenugreek exosome-like nanovesicle containing phytoferritin, as a novel bioavailable source of iron to treat anemia
- Muzaffar Chonche, Abhilipsa Das, Shibani Bose, Anjana R., Ashok S., Sarma M.V.R.K., Kunal Sharan, Isomalto-oligosaccharide supplementation prevent bone loss and influence gut-microbiota in ovariectomized mice model of osteoporosis
- Sunil Ambedkar Doraikan, Poornima Priyadarshini C.G., Millet derived bioactive peptides: Characterisation and antiadipogenic potential through Inhibition of DPP-4 and key adipogenic markers

# 92<sup>nd</sup> Annual Meet of The Society of Biological Chemists, BITS Pilani, KK Birla Goa Campus, December 18-20, 2023

 Tanaji G. Kudre, Anushma V., Preparation and characterization of antioxidant, ACEinhibitory and anticancer sialoglycopetides from Labeo rohita roes



 Sreeram P. Kalarikkal, Gopinath M.S., Exosome-like nanovesicles derived from onion and garlic in hydrogel formulation for the treatment of psoriasis

International Conference on Microbiological Research: Current Challenges and Future Perspectives, Bharathidasan University, Tiruchirappalli, Tamil Nadu, India, January 9-11, 2024

- Kunnummal S.P., Mahejibin Khan, Plantbased nutraceutical formulation modulates the serum biochemical indices and oxidative stress in Wistar rats exposed to formaldehyde via gut microbiome and its metabolites
- Allena M.S., Mahejibin Khan, Antioxidant, metabolomics, and metagenomics analysis of brown top, finger and pearl millets after in vitro fermentation by human fecal samples
- Nafee C.P., Mahejibin Khan, Isolation of mucin degrading bacteria from human fecal samples and their enzymes characterization

# Best Research Papers / Posters Awards in other Seminars

- Sori N., Mahejibin Khan, Role of pectic oligosaccharide in regulation of mucin and tight junction proteins in mice model, International Conference on Recent Research and Innovations in Life Sciences, SDM MMK, Mysore, June 27-28, 2023
- Mohammed Touseef Khan, Seema Mudhol, Manasa Vallamkondu, Muthukumar S.P., Krupashree K., Nanoencapsulation of apocynin and vanillic acid into hydroxypropyl beta-cyclodextrin method:

- Preparation, characterization and evaluation of bioavailability, Two day International Conference on Bridging the gap on the Intersection of Science, Technology, Education, Commerce and Management, De Paul College, Mysore, July 15-16, 2023
- Shikku P., Pushpa S. Murthy, Allspice leaves oleoresins as value-added ingredient for food and pharma industry, International Conference on Applications on Natural Products, Nanomaterials and Nano Pharmaceuticals, (ICAN3), August 9-10, 2023
- Neelam A. Revankar, Pooja P., Negi P.S., Development of fruit-based probiotic smoothie using finger millet, International Conference on Millets for Achieving Nutritional and Economic Security (ICMANES 23), NIFTEM, Kundli, September 21-23, 2023
- Kiran S. Mawale, Giridhar P., Foliar application of chitosan nanoparticles modulates plant growth and helps to control thrips infestation in *Capsicum* spp., XLVI All India Botanical Conference, Sant Gadge Baba Amravati University, Maharashtra, November 4-6, 2023 (*Best presentation* and *IBS gold medal*)
- Aswathi K.N., Bhawana, Sandeep Mudaliar, Pushpa S. Murthy, Environmental impacts of robusta coffee by pulped natural/honey coffee process: A life cycle perspective, International Conference on New Horizons in Biotechnology, Trivandrum, Kerala, November 26-29, 2023
- Mahejibin Khan, Millets-gut microbiome interaction modulate human metabolome and influence immunity status, International Conference on One Health Initiative:



- Harmonizing Human, Animal and Environmental Health (OHI-2023), GLA University, Mathura, January 18-20, 2024
- Naryanasamy R., Rajasekharan R., Usharani D., Biochemical insights into ABHD16B overexpression in Saccharomyces cerevisiae through lipidomics, International Conference on Bioactive Lipids in Health and Disease, University of Mysore, February 23-24, 2024
- Dattatreya Govindan, Sandopu Sravan Kumar, Giridhar P., Paramesha M., Effect of
- processing time on the proximate composition, antioxidant activities, and bioactive profiling of green tea, National Conference on Advanced in Food Technology and Nutrition (AFTN)-2024, Kuvempu University, Shankaraghatta, Karnataka, March 15-16, 2024
- Shivani Tripathi, Sachin M. Eligar, Pushpa S. Murthy, Coffee husk polysaccharides: Functional food ingredients and sustainable benefits, National Conference on Recent Trends in Biotechnology Research, Truvanamalai, Tamil Nadu, March 22, 2024

# I) Editors / Editor-in-Chief /Co-Editor / Executive Editor / Associate Editors of reputed journals

SI.No.	Name	Role	Journal / Publisher
1	Dr. Vijayendra SVN	Editor	Journal of Food Science and Technology, AFST(I), Mysore, Springer
2	Dr. Prakash M Halami	Editor	Journal of Food Science and Technology, AFST(I), Mysore, Springer
3	Dr. Negi PS	Chief Editor	Indian Food Industry, AFST(I), Mysore
		Associate Editor	BMC Complementary Medicine and Therapies, BMC, Part of Springer Nature, New York, USA
		Associate Editor	International Journal of Genuine Traditional Medicine, Association of Humanitas Medicine, Seoul, Republic of Korea
4	Dr. Prabhasankar P	Associate Editor	Journal of Food Measurement and Characterization, Springer
		Editor	Blue Biotechnology, Nova Publishers, USA
		Editor	Research and Reviews: Journal of Food Science and Technology, STM Journals, Noida, U.P.
5	Dr. Aashitosh A Inamdar	Editor	Journal of Food Science and Technology, Springer



SI.No.	Name	Role	Journal / Publisher
6	Dr. Navin K Rastogi	Associate Editor	Journal of Food Process Engineering, John Wiley, USA
		Executive Editor	International Journal of Membrane Science Technology, Cosmos
7	Dr. Muthukumar SP	Review Editor	Frontiers in Nutrition, Frontiers Media, Switzerland
		Review Editor	Frontiers in Sustainable Food Systems, Frontiers Media, Switzerland
8	Dr. Pushpa S Murthy	Guest Editor	Frontiers in Microbiology, Springer
9	Dr. Giridhar P	Associate Editor	3 Biotech, Springer
10	Dr. Harish Prashanth KV	Editor	Research and Reviews: Journal of Food Science and Technology, STM Journals, an imprint of CELNET (Consortium e- Learning Network Pvt. Ltd.)

# j) Member of Editorial and Advisory Boards

SI.No.	Name	Journal / Publisher
1	Dr. Navin K Rastogi	<ul> <li>Journal of Engineering, Hindawi</li> <li>The Scientific World Journal, Hindawi</li> <li>Research &amp; Reviews: J. Food Science &amp; Technology, STM</li> <li>Journal of Membrane Science &amp; Technology, Omics</li> <li>Journal of Food Research and Technology, Jakraya</li> </ul>
2	Mr. Matche RS	<ul> <li>Methodox, Elsevier</li> <li>Indian Journal of Nutrition, Open Science Publications, Hyderabad</li> <li>International Journal of Food Science and Nutrition, Engineering, Scientific &amp; Academic Publishing Co., Rosemead, CA, 91731, USA</li> <li>International Journal of Agriculture Food Science</li> </ul>



SI.No.	Name	Journal / Publisher
		<ul> <li>&amp; Technology (IJAFST), Research India Publications, Delhi</li> <li>International Journal of Knowledge Management and Information Technology (IJKMIT), Research India Publications, Delhi</li> </ul>
3	Dr. Negi PS	<ul> <li>Journal of Food Science, IFT, Chicago, USA</li> <li>Signpost Open Access Journal of Organic and Biomolecular Chemistry, Research Signpost, Thiruvananthapuram, India</li> <li>Indian Journal of Horticulture, Indian Academy of Horticultural Sciences, New Delhi, India</li> </ul>
4	Dr. Muthukumar SP	Journal of Laboratory Animal Science, Laboratory     Animal Scientists' Association (India)
5	Dr. Syed Musthapa M	<ul> <li>Non-coding RNA Research, Elsevier, USA</li> <li>Indian Journal of Natural Products and Resources (IJNPR), CSIR-NIScPR, India</li> </ul>
6	Dr. Kunal Sharan	<ul> <li>Nature Scientific Reports, Springer Nature</li> <li>Frontier in Endocrinology, Frontiers</li> </ul>
7	Dr. Rajagopal K	<ul> <li>Frontiers in Microbiology, Frontiers, Sweden</li> <li>Nature Communications, NPG group</li> <li>Nature Scientific Reports, NPG group</li> <li>mBio, American Society for Microbiology (ASM)</li> <li>Access Microbiology, UK Association for Microbiology</li> <li>The Protein Journal, Springer</li> <li>Frontiers in Cellular and Infection Biology, Frontiers, Sweden</li> <li>Probiotics and antimicrobial proteins, Springer</li> </ul>



#### 10. Participation in Exhibitions

- One lab one week program: Organized by CSIR-IIP held at Districts Chamapawat, Uttrakhand, April 1-4, 2023
- 8<sup>th</sup> Edition of Science Festival (SCIFFI)-2023: Vidnyan Parishad, Goa (Aunit of Vijnana Bharati, India), ESG Complex, Panaji, Goa, April 18-20, 2023
- Secondary Agriculture Focusing On Processing, Value Addition and Marketing: Indian Society of Extension Education (ISEE) at UAS, GKVK, Bengaluru, Bengaluru, June 22-24, 2023
- CSIR-CFTRI One Week One Lab (OWOL)
   Expo: Organised by CSIR-CFTRI at CFTRI campus, Mysuru, July 3-7, 2023
- Food Technology Expo-2023 (Focus on Millets): Organized by NNS Media and MOFPI, GOI India held at Pragati Maidan, New Delhi, July 21-23, 2023
- Mainstreaming Research, Technology & Innovation in Ushering Blue Economy in India: Organized by CSIR-NIO, Goa &
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A view from CSIR-CFTRI One Week One Lab (OWOL) Expo

- Fishery Dept. Hyderabad held at CSIR-NIO Panaji, Goa, August 17-18, 2023
- Foodpro North-East Expo: Organised by Confederation of Indian Industry, MoFPI, Govt. of India, Guwahati, Assam, September 14-16, 2023
- A view from International Conference on Millets for Achieving Nutritional and Economic Security (ICMANES): Organized by NIFTEM, Kundli
- International Conference on Millets for Achieving Nutritional and Economic Security (ICMANES): Organized by NIFTEM, Kundli, September 21-23 2023
- CSIR-Ten Decadal Achievements on CSIR Foundation Day: Organized by CSIR at Bharat Mandapam, Pragati Maidan, New Delhi, September 26-27, 2023
- World Food Day 2023, CSIR-CFTRI, Hyderabad: Organsised in association with AFSTI, Hyderabad Chapter, Hyderabad, October 16, 2023
- Millets Mahotasav: Organized by Department of Agriculture, Govt of UP held at



A view from International Conference on Millets for Achieving Nutritional and Economic Security (ICMANES): Organized by NIFTEM, Kundli



- Indira Pratishthan Lucknow, October 27-29, 2023
- World Food India 2023: Organized by NIFTEM, MoFPI, in association with FICII, Pragati Maidan, New Delhi, November 3-5, 2023
- 14<sup>th</sup> Agrovision 2023-Mega National Expo: Organized by Govt. of India and Govt. of Maharashtra, Nagpur, Maharashtra, November 24-27, 2023
- International Nutri Cereal Convention (INCC): Organized by ICAR-Indian Institute of Millets Research (IIMR), Novotel HIIC, Hitech City Hyderabad, November 27-28, 2023
- Food Expo 2023: Organised by IIA, Lucknow and inaugurated by Hon. Industry Minister of Uttar Pradesh held at IIA Bhawan, December 01-03, 2023
- 9<sup>th</sup> International Food Convention (IFCoN)
   Food Expo on the theme "TRIMSAFE":
   Organized by Association of Food Scientists
   & Technologists (India) Co-organized by CSIR-CFTRI, DRDO-DFRL & CSIR-IITR, CSIR-CFTRI Campus, Mysuru, December 7-10, 2023

- Mondei Exhibition, Nabarangpur: Organized by ORMAS, DRDA, Nabarangpur, Odisha. December 10-14. 2023
- Alva's Virasat Agriculture, Handicrafts and Food Maha Mela: Alva's Education Institute, Alva's Institute of Engineering and Technology, Moodbidre, December 14-17, 2023
- Conclave on Exploring Global Markets for Millets & its Value added Products: Organized by KAPPEC, Govt. of Karnataka, Hotel Shangri-La, Bengaluru, January 2, 2024
- International Trade Fair on Millets and Organics 2024: Organized by Govt. of Karnataka, APEDA and IMMR, Hyderabad, Palace Grounds, Bengaluru, January 5-7, 2024
- CSIR Pavilion at Indian International Science Festival (IISF)-2023: Organized by DBT, DST, CSIR, ICMR, ISRO, MoES and other Ministries, Govt. of India, DBT THSTI - RCB Campus, Faridabad, January 17-20, 2024



A view from Expo-2023 (Focus on Millets held at Pragati Maidan, New Delhi



A view from Food Expo 2023 at Lucknow



- KISAN MELA: Organised by CSIR-CIMAP.
   The Programme was inaugurated by Hon Chief Minister of UP, Hon Minister of Agriculture, UP and Hon DG CSIR, January 30-31, 2024
- Seed Festival at CAbC, MSSRF: Organized by Community Agrobiodiversity Centre of M.S Swaminathan Research Foundation, Wayanad, Kerala, March 1-2, 2024
- Nutrition Program: Organized by AIIMS, New Delhi, March 28, 2024



A view from International Trade Fair on Millets and Organics 2024 held at Bengaluru



A view from KISAN MELA at CSIR-CIMAP



A view from CSIR Pavilion at Indian International Science Festival (IISF)-2023 held at Faridabad



A view from Seed Festival at CAbC, MSSRF held at Wayanad

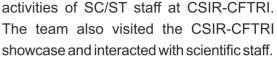


# 11. Visit of Important Delegates to the Institute

 High level delegates of Government of Chhattisgarh visited CSIR-CFTRI on June 16, 2023 to understand millets cultivation and processing, minor forest produce collection and processing along with the promotion of horticulture crop etc. Team of delegates led by Mr. Pradeep Sharma, Advisor to Hon'ble Chief Minister, Chhattisgarh, Dr. Kamal Preet Singh, Agriculture Production Commissioner and others visited the facilities of the Institute.



 Delegation from National Commission for Scheduled Castes (NCSC) led by Ms. Anju Bala, Former Member of Parliament and Member NCSC visited CSIR-CFTRI on June 16, 2023 to overview the welfare



 Taiwan delegation led by Mr. Wanh Yun-Chieh, Economic Secretary, Economic Division, Taipei Economic and Cultural Centre in India, Ms. YiChun TU and Ms.



Jessi Fu of Industrial Technology Research Institute (ITRI), Taiwan visited the Institute on June 19, 2023 and interacted with Scientists regarding possibilities of collaboration between CSIR-CFTRI and Food Industry Research and Development Institute (FIRDI), Taiwan on food processing technology, capacity building, technology transfer etc.

 Denmark delegation visited CSIR-CFTRI on September 22, 2023 and interacted with







Scientific staff pertaining to Indo-Denmark cooperation strategies including funding tools, research opportunities and student mobility.

 Indian Botanical Society Foundation Day lecture was organised at CSIR-CFTRI on December 28, 2023. Professor Manoj Kumar Dhar, Director of the Academy of Scientific and Innovative Research



 Japanese delegation consisting of Dr. Siddabasave Gowda and Prof Teruo Sone,



(AcSIR), Ghaziabad, gave the lecture on the topic "Exploring the beauty and benefits of saffron: the golden spice". An interaction with the institute's staff and students was organised, and various concerns were addressed for the benefit of the researchers.

Shri. Surya Pratap Shahi, Hon'ble Cabinet
 Minister for Agriculture, Uttar Pradesh along with his team, visited the facilities,





Dean of Graduate School of Global Food Resources, Prof. Katsuhiko Ogasawara, Faculty of Health Sciences from Hokkaido University, Japan visited CSIR-CFTRI and its facilities on January 19, 2024 and interacted with scientists regarding collaborative research.

 Poland delegation consisting of Prof. Piotr Szulc, Poznan University of Life Sciences, Department of Agriculture; Przemys?aw





Lecyk - Agricultural Advisory Center in Brwinów Branch in Pozna?; Prof. Joanna Kobus-Cisowska, Maria Zdebska and Barbara Majoch - from Industry visited CSIR-CFTRI and its facilities on January 29, 2024 and interacted with Director and Scientists about collaborative research on post-harvest technologies and value added products from ginger.

Oman delegation led by Prof. Ali Al Bimani,
 Vice-Chancellor, National University of

Science and Technology (NUST), Sultanate of Oman and his team along with Prof. Mubarak Pasha, The First Vice Chancellor Sreenarayanaguru Open University, Kollam (The State University of Kerala) visited CSIR-CFTRI and its facilities on February 28, 2024. The Director and Scientists of the Institute discussed about collaborative research and HRD activities in Food Technology with the delegation.







### **Outreach Activities**

### a) One Week One Lab (OWOL) Campaign at CSIR-CFTRI

The Institute organized OWOL campaign during 3-7th July 2023. This event served as a platform for showcasing the institute's cutting-edge research, technologies, expertise, and facilities in the field of Food Science & Technology. With a theme of "Celebrating Food Research," the campaign aimed to ignite the minds of young innovators, students, start-ups, academia, and industries, encouraging them to explore opportunities through deep tech ventures. The week-long campaign showcased the diversity and depth of CSIR-CFTRI's research since



Welcoming the Guests for the Inaugural session



Inauguration of the One Week One Lab Program at CSIR-CFTRI on 03-07-2023

1950 and expertise in the field of Food Science & Technology through a series of sessions, engaging and panel discussions, interactive programs, culinary show, open day, expo and poster presentation competition with a focus on "Research, Innovations, and Sustainability in Food Science and Technology." Each day was dedicated to a specific theme, providing participants with valuable insights, networking opportunities, and a glimpse into the world of food science and technology.

The proceedings of the "One Week One Lab (OWOL)" campaign at CSIR-CFTRI has marked a successful and impactful event. Throughout the week, participants were immersed in a diverse range of sessions, engaging discussions, and interactive programs, all focused on the field of Food Science & Technology.

From the Start-up session to the Woman SHG, Farmer-Entrepreneurship day, the Students and Public day, the Millet Focus day, and finally, the Alumni, Al & Ayush Ahaar day, each theme brought forth valuable insights, knowledge, and collaboration opportunities. Esteemed guests, industry experts, and eminent speakers graced the event, sharing their expertise and experiences.



Dr. V Prakash, Former Director CSIR-CFTRI speaking in the session of "Lecture by Eminent Experts"



Posters depicting CSIR-CFTRI and other sister labs of CSIR were displayed at the expo. The participants of the poster competition represented from industries, R&D units, research institutes, schools, colleges, university, self-help groups, farmers, entrepreneurs, alumni and general public. Each day theme based poster session was inaugurated by the Chief guests and three best poster awards were given to recognize outstanding contributions in the respective categories.

"Women Self Help Groups and Farmer Entrepreneurship" was inaugurated by Dr. Soumya Swaminathan, Chairperson, M.S. Swaminathan Research Foundation and former Chief Scientist, World Health Organization (WHO). She emphasized the importance of nutrition education in schools and the integration of agriculture, health, and climate change sectors to ensure holistic health. She also spoke about the importance of returning to traditional food practices, conservation of seeds, and promoting tribal income. Dr. Mallela Venkateswara Rao, IAS, Chairperson of the West Bengal Electricity Regulatory Commission, emphasized the initiatives to promote secondary agriculture practices.



Inaugural address by Dr. Sowmya Swaminathan, Chairperson of M.S. Swaminathan Research Foundation

The session titled "SHG/FPO focus," featured a keynote address by Mr. Kurubur Shanthakumar, a prominent farmer leader, emphasizing the empowerment of farmers as a key driver of national development and contributing to economic and societal well-being. The keynote speaker, Dr. Anura V. Kurpad, Head of Physiology, St. John's Medical College, Bengaluru, emphasized the importance of holistic nutrition and the need to focus not only on proteins but also on fats as part of wholesome foods.



Women SHG

An open day with demonstration of food engineering and technologies including pasta making machine was organised. Dosa/idli and roasted ground nuts were distributed to the public. Also 12,200 cups of grape, apple, orange carbonated fruit beverages were served. Further, food safety, quality assurance of honey, packaged drinking water, milk, spices, edible oils, food additives and microbial safety were demonstrated to 8523 people including students and general public.

Various programs and sessions aimed at inspiring and educating the younger generation was organised. The JIGYASA student-scientist connect program included 97 students and 10 teachers from Kendriya Vidyalaya Schools



(KVS) — Mandya, Chamarajanagar, Mysuru, BRBNMPL (RBI), and CFTRI Mysuru. The program was inaugurated by Chief Guest Dr. Chindi Vasudevappa, former Vice-Chancellor of NIFTEM, Haryana. Dr. Sridevi Annapurna



JIGYASA: Student-Scientist Connect Program

Singh, Director of CSIR-CFTRI, interacted with the young minds and encouraged curiosity and scientific exploration. Innovative posters were displayed, showcasing the creativity and potential of the young minds. A session on "Students Meet Scientists" featured experts like Dr. Chindi Vasudevappa, K.S.V.A.S. Sharma, Dr. Suresh Bhamidi, Dr. Obul Reddy Bandapally, and Prof. Jamuna Prakash. They interacted with students, sharing knowledge and experiences, and fostering curiosity.

A culinary contest was held under the themes Traditional foods with a modern twist/fusion foods and Novel dishes with millets for men and women to showcase their creativity and innovation in cooking using healthy and sustainable ingredients. It was fireless cooking in the men's category. This contest attracted students and staff to understand nutritious healthy foods. Also, novel dishes with millets on millet focus day enabled new innovations of millet dishes.

"Eat Right India Movement," emphasizing the importance of promoting healthy eating habits and food safety practices was organised. Dr. Sachdev Meenakshi, Chief Dietitian, spoke on the importance of millets as a healthy and sustainable food source. Experts from FSSAI (Food Safety and Standards Authority of India) delivered a talk and interactive session highlighting the benefits of incorporating millets into the diet and their role in ensuring food security and nutritional well-being was held. The day concluded with the "Eat Right Walkathon 2023," flagged off from Cheluvamba Mansion by dignitaries. About 500 participants, including staff and students, walked 2-3 km in CSIR-CFTRI campus holding placards on importance of millets importance and eat right habits About 20 stalls of CSIR-CFTRI licensee in the expo led to provide market for the food products leading to wide publicity on food innovations of CSIR-CFTRI.



Flagging of Eat Right Walkathon 2023

The dignitaries inaugurated drones show by NAL Octa-Med and NAL Octa-Agri, created by CSIR-National Aerospace Laboratories (NAL), Bengaluru. The session of the CSIR-CFTRI Licensee meet was held to foster collaborations and partnerships between CSIR-CFTRI and industry players in the food sector. Dr. R.



Subramanian, Former In-charge Director, CSIR-CFTRI moderated the second session of the meet. Experts such as Dr. Abhay Anant Pashilkar, Director, CSIR-NAL, Mr. Ananta



Stalls of CSIR-CFTRI Licencees during OWOL

Padmanab from Bigbasket, Dr. Akanksha Jain from NRDC, New Delhi, Dr. Ashish Ranjan from Flipkart, Shri M. P. Banthanal from KAPPEC, and Dr. Reeba Abraham from APEDA participated in the meet.

A total of 21 CSIR-CFTRI products were launched on each of the five days including barley-seaweed based anti-obese supplement "Seaslim", Freshness Keeper Paper, Arabinoxylan from wheat bran, Baker's yeast, Spice Bread, Fiber Enriched Rusk, Gluten-free Cake mix,



Inauguration of the drones NAL Octa-Med and NAL Octa-Agri, created by CSIR-National Aerospace Laboratories (NAL), Bengaluru by dignitaries

Quinoa Germ, Glucose-Amla mix, Finger Millet Semolina, Instant Finger Millet Rava Idli Mix, Instant Finger Millet Halwa Mix, Ready-to-eat Malted Ragi based Weaning Food, Instant Finger Millet khichdi mix, Instant Finger Millet Upma mix, Millet Puttu Podi mix, Ragi based Malt Hydrolysate, Millet husk based biodegradable key chain, Isomaltooligo



Panel Discussions on Millets



Poster session viewing by the dignitaries (101 posters were received under five themes on each of the five days)

saccharides Powder, Egg & meat wafers (5 variants) and Pandhra Rassa.

Networking with stake holders, CSIR-CFTRI licensees and MoU signing with ICRISAT led to identify gaps and create new projects and opportunities for CSIR-CFTRI and stakeholders.



The event showcased the commitment of CSIR-CFTRI to innovation, research, and technology transfer in the field of food science and technology. The release of new technologies, exhibition of innovative posters, and the fostering of collaborations with academia, industry, and alumni further emphasized the institute's dedication to driving positive change in the food industry.

The final day of the campaign celebrated the contributions of CSIR-CFTRI alumni and the intersection of AI and food science, emphasizing the importance of Ayurvedic food for holistic health. The event began with an alumni function of MSc (Food Tech.) course of CSIR-CFTRI, where Dr. Dilip Kulkarni, President of Jain Irrigation Systems Limited, was the Chief Guest. The Golden Jubilee and Silver Jubilee alumni of MSc (Food Tech.) course of CSIR-CFTRI were honoured for their achievements. Dr. Dilip Kulkarni received the outstanding Alumnus award 2023.

Robots exhibited by Holoworld, Holosuit were inaugurated by the dignitaries Shri Jitendra J Jadhav, Former Director, NAL, Director, ADA & Programme, Director (Comabt Aircraft), Ministry of Defence, Dr. G. Narahari Sastry, Director, CSIR-NEIST, Jorhat, Dr. Sridevi Jade, Head, CSIR-4PI, Dr. Meenakshi Singh, Chief Scientist, Head, Technology Management Directorate and Dr. C. Janaki Associate Director, C-DAC and Dr. Sridevi Annapurna Singh, Director CSIR-CFTRI. The robot show attracted the school children tremendously. Children interacted with the technical personnel and their queries were addressed.

Dr. R.S Sodhi, former MD of Amul and President of the Indian Dairy Association,

provided valuable insights into the dairy industry and its advancements. He emphasized the challenges faced by the industry and appreciated CSIR-CFTRI's contribution in the development of infant milk powder, which earned nearly 3000 crore revenue for AMUL. The panel discussion on Artificial Intelligence (AI) and Natural Language Processing in the food industry focused on the challenges faced by the industry, AI techniques, and the need for AI-based technologies for food processing, smart farmer investment, and quality assurance. The panel also suggested initiating a nodal FT-AI Hub in collaboration with other CSIR, ICAR, and start-up industries.

A panel discussion on the application of Artificial Intelligence in Food Science and Technology focused on various aspects of AI, including its role in industry 4.0, food product categorization, high-performance computing (HPC) facilities, natural language processing, and data intelligent utilization. Dr. G. Narahari Sastry, Director, CSIR-NEIST highlighted the need for Al algorithms and technologies for food sector empowerment and income generation. Dr. Sridevi Jade highlighted the need for food product categorization, while Dr. C. Janaki highlighted the need for high-performance computing facilities and natural language processing for labeling, grading, packaging, and supply chain management. Dr. Gopal Krishna Patra highlighted the importance of block chain and physics-based AI in food technology applications. Dr. Suvendu Bhattacharya highlighted the need for genetic algorithms in understanding rheology and food processing. Shri Manilal P. emphasized the need for valid datasets on nutrition aspects of food and their availability for future projects.



The Ayush Ahaar session focused on the integration of traditional Indian medicinal practices in promoting health and well-being. Speakers like Dr. Narahari Sastry, Director of CSIR-NIEST, Dr. Sulochana Bhat, and Mr. Vilas R. Shirhatti discussed the importance of Ayurveda, Rasa, seasonal dietetics, food consumption approaches, and FSSAI regulations. The day also featured 17 posters showcasing research and innovations in alumni contributions, AI, and Ayurvedic food.

The valedictory function was graced by Chief Guest, Dr. K.V. Rajendra, Deputy Commissioner, Mysuru, and Guest of eminence, Mrs. Shilpi Agarwal, Divisional Railway Manager, Mysuru, Dr. G. Narahari Sastry, Director CSIR-NEIST, Jorhat and Dr. Sridevi Annapurna Singh, Director CSIR-CFTRI. During the valedictory function, OWOL Souvenir was also released by the dignitaries. A brief proceeding of OWOL was presented by Dr. Prakash M. Halami, Chief Scientist, CSIR-CFTRI. Later, the dignitaries Dr K. V. Rajendra and Mrs. Shilpi Agarwal and Dr. G. Narhari Sastry appreciated the CSIR-CFTRI's contributions to the country as well as its visionary aspects in food innovation and technologies.



Dignitaries at Valedictory function of OWOL

The "One Week One Lab (OWOL)" campaign was a testament to the power of knowledge sharing, networking, and collaboration in advancing the field of Food Science and Technology. It served as a platform for budding entrepreneurs, SHGs, students, researchers and professionals to connect, learn, and contribute to the everevolving landscape of the food industry.

## b) Establishing Common Incubation Center under PMFME Scheme

CSIR-CFTRI has established an Incubation Centre (funded by MoFPI under PMFME scheme) with a purpose to provide common facility for production of Banana and Coffee based products. Banana and Coffee have been identified as products under One District One Product (ODOP) theme for Mysore and Kodagu district, respectively. In order to meet the requirements of entrepreneurs who are working or would like to venture in to this area, the Incubation Centre would provide the infrastructural facility. The Incubation Center has dedicated lines for Banana and Coffee based products. Both the lines have an estimated capacity of handling approximately 100-150 kg/h of raw materials. The CIC would be operated by Operation & Maintenance (O&M) firm, as per MoFPI guidelines.





# c) JIGYASA: Student-Scientist Connect Program

JIGYASA outreach programs were conducted under the themes namely:

- One day visits to CSIR-CFTRI
- Lab specific activities / onsite experiments Royal Society of Chemistry – camp
- Demonstration programme at school
- Curtain raiser IISF
- Scientists as Teachers and Teachers as Scientists

Eleven programs were done covering 1731 students and 129 teachers. The students from Jawahar Navodaya Vidyalaya, Mysore; Kendriya Vidyalayas of Mysore, BRBNMPL, Mandya & Chamarajanagar; CFTRI School; Mahabodhi School; Vidya Vardhaka School; Government High Schools Kukkarahalli & Vinayakanagara; Maharani's Women's Commerce and Management College; Govt PU College Vontikoppal and Mathrumandali College from Mysore, participated in the programs at CSIR-CFTRI, Mysore.

The mobile food processing unit "CFTRI on Wheels" was taken to GHS Keelanapura. Tomato processing and preparation of orange juice were demonstrated to the enthusiastic

students and teachers of the school. CSIR-CFTRI scientists visited the remote Govt. High School at Byluru in Chamarajanagar district and acquainted the students with activities at CSIR-CFTRI, beneficial effects of millets and detection of food adulteration followed by a science guiz.

Scientists of the Institute participated as judges in the science exhibitions held at GHS Jalpuri and GHS-Uttanahalli and interacted with students on the innovations they displayed. The Royal Society of Chemistry sponsored Yusuf Hamied Chemistry Camp was conducted for 70 students from various Government High Schools from Mysore district nominated by the office of DDPI Mysore, KV Mandya and Chamarajanagar. The students conducted fun experiments in chemistry during the three days event.









SI No.	Programmes carried out	Date	No. of Students	No of Teachers
1.	Visit of JNV, Mysuru (Climate Clock)	21-04-2023	20	02
2.	Visit of CFTRI school, KVs of Mysuru, BRBNMPL, Mandya, & Chamarajanagar (Student as Scientist Program)	28-06-2023	42	06
3.	Visit of CFTRI school, KVs of Mysuru, BRBNMPL, Mandya, & Chamarajanagar (Student as Scientist Program)	05-07-2023	100	10
4.	CSIR-CFTRI Jigyasa team visits GHS Keelanapura, Mysuru Taluk (CFTRI on Wheels)	11-08-2023	222	10
5.	Visit of Govt. High School students & teachers, Mysuru Taluk and KVs Mandya & Chamarajanagar (Chemistry Camp)	30-08-2023 to 01-09-2023	71	10
6.	Visit of students and teachers of 3 Schools and 3 Colleges (CSIR Foundation or Open Day)	26-09-2023	584	25
7.	CSIR-CFTRI Jigyasa team visits His Highness of Maharaja's Oriented Infentry School (GHS), Jalpuri, Mysuru. (Science Innovation Fair)	20-11-2023	60	20
8.	Visit of JNV School, Mysuru (India International Science Festival - IISF)	09-12-2023	80	04
9.	CSIR-CFTRI Jigyasa team visits Govt. School Bylur, Chamarajnagar District (Janjatiya Gaurav Divas 2023)	20-12-2023	176	10
9.	Visit of Jigyasa team to Govt. School, Uttanahalli, Mysuru. (Science Innovation Fair)	28-02-2024	176	10
10.	Visit of Jigyasa team to Govt. School, Uttanahalli, Mysuru. (Science Innovation Fair)	28-02-2024	176	22
10.	"My most liked science subject": Presentation by 6-8th standard students from CFTRI School	28-02-2024	200	10
	TOTAL		1731	129



### d) Informative Series in Kannada through All India Radio

# I) Successful Completion of "CFTRI Siridhaanyada Siri"

"CFTRI Siridhaanyada Siri", a millet-based information series in Kannada produced jointly by CSIR-CFTRI and All India Radio (Akashvani), Mysuru on the occasion of 'International Year of Millets 2023' has been successfully completed with its twenty episodes which was broadcasted through Akashvani FM 100.6 (AIR, Mysuru) on every Saturday at 6.35 AM and repeated at 6.10 PM (5 mins each) from 4th Mar 2023 up to 15th Jul 2023. In addition to the 20-episodes, an interview with the Director, CSIR-CFTRI was also aired by AIR, Mysuru. As

per Akashvani, Mysuru, the program was very popular and listeners were awaiting to understand the health benefits of different varieties of millets.

#### ii) CFTRI – Shodha – Anushodha:

CSIR-CFTRI and All India Radio (Akashvani) Mysuru have jointly produced a forty-episode series on "Innovations and researches of CFTRI" in Kannada, titled as "CFTRI – Shodha – Anushodha". This program was being broadcasted through Akashvani FM 100.6 (AIR, Mysuru) at 6.35 AM and repeated at 6.10 PM on all Saturdays, from 22-07-2023 to 20-04-2024. The program covered the major contributions of CSIR-CFTRI to the society for the last seven decades.

### e) Demonstration of Free Technology at Institute

SI No.	Name of the technology demonstrated	Date	No. of beneficiaries
1.	Ready-to-Use dosa batter in retail packs	May16-17, 2023	13
2.	Ready-to-Use idli batter in retail packs	May18-19, 2023	15

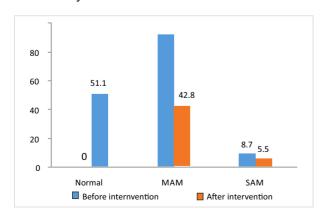


### II. R&D for Societal Benefits

### Nutritional Intervention Programme: Nutrition intervention for moderately acute malnutrition (MAM) and severely Acute Malnourished (SAM) children at Nanjangud taluk:

The study was undertaken to alleviate moderate and severe forms of malnutrition in Nanjangud taluk of Mysore district. A total of 252 children in the age group of 1-5 years were enrolled for the study, out of which 91% were MAM children and 8% SAM children from rural areas of Nanjangud. The nutritional status of children i.e. height, weight and haemoglobin values and indicators of iron deficiency anaemia was recorded.

The children were provided with a weekly pack of food supplements developed in CSIR-CFTRI for alleviation of malnutrition. The pack contained the supplements for six days with different colour codes to enable the beneficiaries to select the supplement to be consumed on a particular day. The product name, serving size and nutritional composition were also indicated. The supplements were provided in the Anganwadi centres for six months by the Directorate of Women & Child



Development (DWCD) officials. At the end of six months (June-2023), the impact of the intervention was evaluated by reassessing nutritional status. The results revealed a 48% of 'MAM' and 3% of 'SAM' children shifted to the 'Normal' nutritional status category. Occurrence of anaemia was reduced by 26% and severity by 17%. The food-based interventions showed good compliance that were well accepted by the children and had improved attendance. The results are promising as improvement in nutritional status is quite challenging in malnourished children due to reduced absorption and utilisation of nutrients. Continued period of intervention could have completely corrected their nutritional status. This model can be adopted PAN India to reduce the severe forms of malnutrition that have devastating effects on the growth and development of children.

## b) Setting-up of Mobile Millet Processing Unit

Versatile millet processing line was arranged on a Mobile Processing Unit which becomes first of its kind. This Mobile Millet Processing Unit can be used at farm gate and for demonstrations and training purposes. It has a capacity of 50 to 100 kg/h and houses destoner, centrifugal and rubber roller sheller dehusker, polisher, emery grinder, hobart planetary mixer, papad press etc.





### Azadi <sub>Ka</sub> Anuli Mahotsa

### Mobile Millet Processing Unit





CSIR - CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSURU - 570020



### III. Skill Development Activities

- a) Skill Development Programmes / Short Term Courses
- Training Programs conducted at CSIR-CFTRI exclusively for Women

CSIR-CFTRI has successfully conducted two specialized training programs exclusive for women from rural India with key focus on woman empowerment. Out of these two programs, one was exclusively for tribal women of Mysuru.

### Processing Techniques for Chatua, 13-15<sup>th</sup> Nov 2023

A three-day training program titled "Processing Techniques for Chatua" was conducted during 13-15<sup>th</sup> November 2023. The program was sponsored by Department of Women & Child Development, Government of Odisha for the benefit of SHG members who are involved in the preparation of "Take Home Ration" (THR). 30 women participants attended the training program with the key focus on nutritional significance of THR, quality maintenance, precleaning, processing protocols for THR



preparation, roasting techniques and quality parameters, pulverization of Chatua ingredients, importance of hygiene and Good Manufacturing Practices, packaging and storage techniques, Food safety and FSSAI guidelines, mechanical mixing & fortification techniques for micronutrients, importance of nutrition in women and child health etc. Apart from this, exposure visit to pilot plant facilities with demonstration on drying of fruits and

different types of food processing techniques such as pickle making, papad making and ginger candy making. A talk on nutritional aspects of food and importance of value addition of food was explained for tribal women empowerment. 13 Tribal women from the different tribal areas of Mysuru district participated in the programme. Participation certificates were distributed in the concluding session.





vegetables, drying of vegetables, osmotic drying of selected fruits etc. were arranged.

# 2. Opportunities in Food Processing for Tribal Empowerment, 24<sup>th</sup> Nov 2023

On the occasion of Janjatiya Gaurav Divas 2023, a workshop under CSIR- Integrated Skill Initiative on "Opportunities in Food Processing for Tribal Empowerment" was conducted for the tribal women on 24<sup>th</sup> November 2023. Dr. Ravi U.M., Researcher and Resource person, Janapada Loka, Ramanagar inaugurated the workshop with floral tribute to Bhagwan Birsa Munda and delivered a talk on lifestyle and food habits of tribals in Karnataka. Dr. Sridevi Annapurna Singh, Director, CSIR-CFTRI presided over the inaugural function. Hands on demonstration was arranged at various pilot plants by expert faculty members covering



# ii) Training Programme conducted exclusively for NRLM/SRLM Officials

A training programme on "Value Addition of Agri Commodities & CFTRI Technologies for Rural Development" was conducted exclusively for National Rural Livelihood Mission (NRLM) and State Rural Livelihood Mission (SRLM) Officials at CSIR-CFTRI, Mysore during 26 to



28<sup>th</sup> July 2023. The programme was conducted on the basis of an MoU signed between Ministry of Rural Development (MoRD), GoI and CSIR-CFTRI to provide technical support to MoRD for the range of interventions in the food Processing sector for strengthening of SHG enterprises across the country.



One of the key focus of this programme was to give an exposure and orientation for NRLM's / SRLM's officials about the strength of CSIR-CFTRI in the area of Food Science & Technology including the existing technologies available for commercialization, licensees & licensing

procedures, glimpse on the areas of research & development undertaken by the Institute and willingness to take projects on sponsored / consultancy / collaborative mode. Total 23 officials attended this three-day programme.

## iii) Training Programme under ITEC for Guyanese Delegation

CSIR-CFTRI successfully organized a training programme on "Rice Milling and Value Addition to Rice" for Guyanese Delegation under Indian Technical and Economic Co-operation (ITEC) Programme sponsored by Ministry of External Affairs (MEA), Government of India during 27th February to 18th March 2024.

29 Guyanese delegates attended this training programme. Basically, the programme was designed for Guyana Rice Development Board (GRDB), but apart from GRDB, this course had representations from Guyana School of Agriculture, University of Guyana, Institute of Applied Science & Technology, Guyana Food Safety Authority, Guyana Marketing Cooperation, Banks DIH LTD., Ministry of Home Affairs, Ministry of Local Government & Regional Development, Ministry of Agriculture and its allied departments/Institutes etc.

The training programme was inaugurated by Dr. S. Zakiuddin Ali, Chief Scientist (Retd) & Former Head, GST on 27<sup>th</sup> Feb. 2024. He enlightened the fact that Rice – one among the three major cereals (wheat & maize are the others), has been termed internationally as the grain of life because it is supposed to be supporting as a stable and sustainable food for half of the world's population. From the paddy to the customer, rice is always preferred in a whole grain form and broken grains reduce the economic value. To make commercially superior quality whole grain rice, every stage of rice processing is important. About 90% of the rice for the world is grown in South-East Asia and Southern Asia. India is contributing 35-40% of total rice trade in the past few years.

The training was started with a lecture on "Grain Processing - an Overview, Production and Agronomy" followed by a lecture cum demo on morphology and histology of grains. DOP by methylene blue test for crack detection was arranged. A visit to International School of Milling Technology was also organized on the same day. In the subsequent days of first week, lectures on the topics such as Rice milling; Electrical safety in rice mills; Food plant layout;



Packaging of rice and rice products; Drying of paddy; Ageing of rice etc were conducted. Demonstrations on milling of raw paddy; FAQ and physical properties of paddy were also arranged in the first week. A visit to a local rice mill (Bannur rice mills) was arranged on 1<sup>st</sup> March and the participants were able to understand about traditional rice mills of India used for parboiling and raw milling of paddy.

In the second week of the program, topics like Factors affecting milling quality; Rice byproducts and its utilization; Physicochemical properties of rice; Effect of processing on nutritional and nutraceutical quality of rice; Principles and methods of parboiling; Fortification of paddy; Convenience rice based products; Quality assurance of rice and rice products etc. were covered along with demonstrations on Physicochemical properties of rice (pasting properties and texture measurement); Quality of ricebran; Parboiling of paddy; Extrusion cooking; Rice flaking etc. were covered. Visit to a traditional rice puffed unit in Srirangapatna and visit of Centre of Excellence on Millets were also arranged during the second week.

The third week started with a full day exposure visits to M/s Agri Process Innovations &



Inaugural session of the ITEC training programme

Technologies (APIT) and M/s Buhler India, both situated at Bengaluru. Both APIT & Buhler having world class industrial machineries available in the product line especially for rice processing, the visits were great learning experience to the participants. Hi-tech IoT and automation technique involved in rice processing industries were demonstrated. In the third week, lectures on rice starch and its modification; Infestation control in stored paddy & rice; HACCP and its implementation in paddy processing; Export potential of aromatic rice (Basmati) and its related protocol; Cooking quality of rice; Fermented rice based products; Food safety and quality aspects of grain products; Food extrusion technology; An overview of CFTRI technologies etc. were covered. The demonstrations on popping/ puffing of paddy; In-house pilot-plant infestation control system; Rice-milk mix; Cooking quality of rice; Drum drying of rice flour; Development of traditional rice based products etc. were arranged in addition to the visits to facilities of CFTRI - Food Safety & Analytical Quality Control Laboratory (FS&AQCL) and Central Instruments Facility & Services (CIFS) to view and understand the instruments and methods used for food analysis.



Demonstrations to participants



In addition to the in-campus training and multiple visits to various industries pioneered in rice processing; visits to cultural, historical & heritage places in and around Mysuru were also arranged in connection with this ITEC programme.

The valedictory session was organized on March 18, 2024. Dr. S Ayyappan, Chairman, Research Council, CSIR-CFTRI handed over the participation certificates to the delegates.











Training Programme on Rice Milling and Value Addition to Rice under Indian Technical and Economic Cooperation Programme
Sponsored by Ministry of External Affairs, Government of India organised by CSIR – Central Food Technological Research Institute (CFTRI), Mysuru, India
27° February to 18° March 2024



The Guyanese Delegation with the Chief Guest, Dr. S. Zakiuddin All [Chief Scientist (Reld) & Former Hood, GST] and Dr. Scidevi Annapurne Singh [Director, CSIR-CFTRI]
The delegation (in Alphabetical order): Mr. Abdoel DaSNa, Mr. Assem O'neil Williams, Mr. Amt Parbat, Ms. Astronomy Remnanne, Ms. Candates Dianna Anthony, Mr. Devin Mohan,
Ms. DevwattleOss, Mr. Drew Joshus JudiusFserber, Mrs. Gangadai Dindayal Samaroo, Mr. Hansinj Udhoo, Ms. Kimberly Nateestra Edwards, Ms. Lisa Maris Douglas, Ms. Marian Pamela
Samart, Ms. Marian Hoherkirit, Ms. Kimeda Audimuss Henry, Ms. Nantha Chandressattle Singh, Mr. Phibam Joseph, Ms. Restma Nedt, Ms. Sabiens Glen Oriens, Ms. Sandra Sukhu,
Mr. Serepersaud Macohat, Ms. Sharisne Nyota Roberts, Ms. Stacia Akio Mc Donald, Mr. Surendra Ramkissoon, Mr. TarneshRamnauth, Ms. Thajwittis Jagnanan, Mr. Tyrone Sylvester English,
Mr. Versuth Pentaud, Mr. Wajid Saheed Khan.



## b) Training Programmes under PMFME Scheme

One of the major components of the scheme is skill development through training to support beneficiaries. Under the project implementation plan, CSIR-CFTRI conducted training programmes in online mode for District Resource Persons of Karnataka. 392 participants from various districts of Karnataka participated in the training programmes. Training focused on Scope of PMFME scheme, Food Processing Techniques, Product quality, Regulatory requirements, Licensing, Marketing and Financial supports from Institutions. These

programmes were conducted with the support from KAPPEC, Bangalore, which is the State Nodal Agency for the implementation of PMFME Scheme.

### c) Azadi ka Amrit Mahotsav IP Festival

To propagate the awareness of intellectual property rights, the Institute arranged multiple training programmes within the Institute and visited various colleges in Mysore. As a part of Azadi ka Amrit Mahotsav IP Festival, the following events were organized in the month of July 2023.

SI No.	Event details	Date	No. of beneficiaries
1.	IP Awareness programme in GSSS College of Engineering and Technology, Mysuru	July 14, 2023	400 (students and faculty)
2.	Online Workshop on "IPRs for Academia, Researchers and Industry	July 19, 2023	250 (registered participants)
3.	IP Awareness programme JSS College of Arts and Science, Mysuru	July 21, 2023	130 (students and faculty)
4.	IP Awareness programme for CSIR-CFTRI staff, research scholars and students	July 24, 2023	100 nos.
5.	IP Awareness programme for JSS Medical College	July 24, 2023	100 (students and faculty)
6.	<ul> <li>IP Awareness programme at CSIR-CFTRI for students &amp; Faculty of the following Colleges:</li> <li>Mount Caramel College, Bengaluru</li> <li>Kalpataru First grade Science College, Tiptur, Karnataka</li> <li>Dept of Microbiology Davengere University, Davengere, Karnataka</li> </ul>	July 26, 2023	160



### d) Farmer Centric Activities

A number of training programmes were organised for FPOs/farmers at CSIR-CFTRI, Mysuru. Around 300 farmers/members of FPOs were trained through 16 training programmes. Training programmes on various topics such as Processing of Millets for Value Added Products, Chilly & Spices, Oranges, Sweet Potato etc. were conducted which directly benefit the farmers for their sustainable livelihood generation. Some of the programmes were sponsored by Hon. Balasaheb Thackeray Agribusiness & Rural Transformation (SMART) Project, DIU, ATMA, Amravati, Maharastra;

Watershed Support Services and Activities Network (WASSAN), Koraput, Orissa; and different clusters at Maharashtra. One of the major training programmes was "Processing of Tamarind and Value Addition" sponsored by DRDA, Chittoor, KVIC-SFURTI-Tamarind Cluster, Andhra Pradesh through which 100 farmers/SHGs were trained in 5 batches.

The Institute also organized around 45 training programmes either in regular mode or custom made (exclusively for sponsoring/funding agency) as below which also includes Farmer Centric Programmes:

SI No.	Title of STC/SDP	Duration / Date(s)	Total Participants	Programme Category
1.	Pre and Post Harvest Management of Oranges	24-26 April 2023	28	Farmer Centric
2.	Analytical Approaches to Current Food Safety Issues in Food Industry	17-19 May 2023	15	Regular
3.	Bakery Products Processing and Value Addition	14-16 Jun 2023	20	Regular
4.	Basics in flour Milling and Quality Evaluation of Flour	03-07 Jul 2023	20	Regular
5.	Processing of Chilly and Spices	17-19 Jul 2023	14	Regular
6.	Online Workshop on Intellectual Property Rights (IPRs) for Academia, Researchers & Industry	18-Jul-23	231	Special Programme for awareness on IPR
7.	Value Addition of Agri Commodities & CFTRI Technologies for Rural Development (Exclusively for NRLM)	26-28 Jul 2023	23	Custom-made / Exclusive



SI No.	Title of STC/SDP	Duration / Date(s)	Total Participants	Programme Category
8.	Application of liquid chromatography -mass spectrometry (LC-MS) in (glyco) protein analysis	07-09 Aug 2023	5	Regular
9.	Baking Science and Technology	07-11 Aug 2023	20	Regular
10.	Processing of Millets and Grains for Value Addition	08-10 Aug 2023	25	Farmer Centric
11.	Processing of Millets and Value added Products	16-18 Aug 2023	29	Farmer Centric
12.	Post-Harvest Technologies of Fruits and Vegetables	21 Aug-01 Sep 2023	47	Regular
13.	Grain Process & Products for health & Wellness	22-26 Aug 2023	28	Regular
14.	Development of Pour over Millet Beverage and Curd through Probiotic bacteria	28-30 Aug 2023	25	Regular
15.	Processing of Millets and Value - added Products	25-27 Sep 2023	30	Farmer Centric
15.	Fundamentals of Food Analysis for Process Hygiene and Microbial Food Safety Criteria (FSSAI) -1	25-27 Sep 2023	12	Custom-made / Exclusive
17	Fundamental of Food Analysis for process hygiene and microbial food safety criteria (FSSAI) - 2	04-06 Oct 2023	12	Custom-made / Exclusive
18	Spices and Flavours: Current Trends in Processing, Formulations and Quality Evaluation	09-13 Oct 2023	19	Regular
19	Analytical Quality Evaluation of fortified Rice (FS&AQCL training)	31 Oct-03 Nov 2023	11	Custom-made / Exclusive
20	Fundamental of Food Analysis for process hygiene and microbial food safety criteria (FSSAI) - 3	06-08 Nov 2023	15	Custom-made / Exclusive
21	Nutri-Cereal Process & Products Technology	06-10 Nov 2023	7	Regular



SI No.	Title of STC/SDP	Duration / Date(s)	Total Participants	Programme Category
22.	Value addition to Fruits and Vegetables (KAPPEC)	07-09 Nov 2023	26	Custom-made / Exclusive
23	Processing of Spices (Masala Powder) for Spices Cluster, Mangalwedha, Solapur District Maharashtra	08-11 Nov 2023	15	Farmer Centric
24	Processing Techniques for Chatuua (WCD, Odisha)	13-15 Nov 2023	30	Custom-made / Exclusive
25	Sensory Analysis – an Approach to Consumer Preference	13-15 Nov 2023	22	Regular
26	Development of Pour Over Millet Beverage and Curd Through Probiotic Bacteria	20-24 Nov 2023	7	Regular
27	Overview of Food Packaging materials and their applications	22-24 Nov 2023	11	Regular
28	Opportunities in food Processing for Tribal Empowerment (Jan Jatiya Gaurav Day Celebration 2023 - one day workshop)	24-Nov-23	13	Special Programme
29	Processing of Sweet Potato & Value Addition	29-Nov-2023	7	Farmer Centric
30	Fumigation, Prophylaxis and Pest Management Techniques for Stored Food Commodities	01-15 Dec 2023	44	Regular
31	Hands on training program on vitamin profiling by HPLC / LCMS/MS (FSSAI) - 4	18-20 Dec 2023	16	Regular
32	Advanced Spectrometric based Analysis (GC-MS, LC- MS/MS, FT-IR & NMR) in Food Science	08-12 Jan 2024	6	Regular
33	Post Harvest Technologies for Value Addition to Sweet Lime, Custard Apple, Onion, and Chilli Sponsored by Hon. Balasaheb Thackeray Agri-Business & Rural Transformation (SMART) Project, Diu Chhatrapati Sambhaji Nagar, Maharashtra	22-23 Jan 2024	30	Farmer Centric



SI No.	Title of STC/SDP	Duration / Date(s)	Total Participants	Programme Category
34	Application of Instrumental Analysis in additives and toxins (FSSAI) - 5	22-24 Jan 2024	22	Custom-made / Exclusive
35	Chromatographic Techniques (GC, HPLC, UHPLC) and their analytical approaches in Food Analysis	05-09 Feb 2024	7	Regular
36	Processing of tamarind and Value addition (Batch -1)	19-20 Feb 2024	21	Farmer Centric
37	Extraction and Quality Assurance of Edible Fats and Oils	19-21 Feb 2024	8	Regular
38	Pesticide analysis in various food matrices	21-23 Feb 2024	12	Custom-made / Exclusive
39	Processing of tamarind and Value addition (Batch -2)	22-23 Feb 2024	19	Farmer Centric
40	Processing of paddy and pulses for value addition	26-28 Feb 2024	13	Farmer Centric
41	Processing of tamarind and Value addition (Batch -3)	26-27 Feb 2024	19	Farmer Centric
42	Rice Milling and Value Addition to Rice under Indian Technical and Economical Programme (ITEC) sponsored by Ministry of External Affairs (MEA), Government of India	27 Feb-18 Mar 2024	29	Custom-made / Exclusive
43	Processing of tamarind and Value addition (Batch -4)	04-05 Mar 2024	22	Farmer Centric
44	Processing of tamarind and Value addition (Batch -5)	11-12 Mar 2024	21	Farmer Centric
45	Processing of Millets for Value Added Products (Sponsored by Swami Vivekananda Youth Movement, Saragur, Mysuru District)	26-28 Mar 2024	15	Farmer Centric
		Total Participants	1071	



### State-wise Representation of Participants of STC/SDP: 2023-24



State/UT	No. of Participants
Andaman and Nicobar Islands	2
Andhra Pradesh	117
Arunachal Pradesh	1
Assam	2
Bihar	2
Chandigarh	1
Chhattisgarh	2
New Delhi	7
Goa	1
Gujarat	7
Haryana	5
HimachalPradesh	1
Jharkhand	3
Karnataka	286
Kerala	52
	1

State/UT	No. of Participants
Ladakh	1
Madhya Pradesh	4
Maharashtra	216
Meghalaya	1
Nagaland	1
Odisha	94
Punjab	4
Rajasthan	88
Tamil Nadu	105
Telangana	11
Tripura	5
Uttar Pradesh	15
West Bengal	8
Sub-total (India)	1042
International (Guyana)	29



### e) Training programmes organized by Resource Centres of CSIR-CFTRI

### i) RC - Hyderabad

SI No.	Programme details	Date	No. of beneficiaries
1.	Hands-on Training Programme on Food Processing and Preservation for prospective entrepreneurs from MCED, Aurangabad	May 15-26, 2023	20
2.	Hands-on Training Programme on 'Food Processing and Preservation' Sponsored by Rashtriya Krishi Vikas Yojana, ICAR, New Delhi & Govt. of Odisha	June 20-23, 2023	15
3.	Hands-on training programme on 'Value added products from Minor millets'	March 25-28, 2024	15

### ii) RC-Lucknow

SI No.	Programme details	Date	No. of beneficiaries
1.	05 days Skill-Entrepreneurship Development Program on processing, preservation and value addition of Food & Agro based products for commercial use in Sonbhadra District of Uttar Pradesh with special emphasis on development of women entrepreneurs funded by DSIR at Siddharthnagar		40
2.	05 days Skill-Entrepreneurship Development Program on processing, preservation and value addition of Food & Agro based products for commercial use in Chanduali District of Uttar Pradesh with special emphasis on development of women entrepreneurs funded by DSIR at Balrampur	Nov 23-27, 2023	61
3.	05 days Skill-Entrepreneurship Development Program on processing, preservation and value addition of Food & Agro based products for commercial use in Fatehpur District of Uttar Pradesh with special emphasis on development of women entrepreneurs funded by DSIR at Bahraich	Feb 12-16, 2024	50
4.	05 days Skill-Entrepreneurship Development Program on processing, preservation and value addition of Food & Agro based products for commercial use in Chitrakoot District of Uttar Pradesh with special emphasis on development of women entrepreneurs funded by DSIR at Shravasti	Feb 19-23, 2024	46





### **ENGINEERING SCIENCES**

# Food packaging materials based on functional polymer nanocomposites (Umesh Hebbar H)

The increasing global concern for environmental sustainability has propelled the development of biodegradable food packaging materials. The work focused on the preparation and characterization of biodegradable food packaging film using polyvinyl alcohol (PVA) and k-carrageenan. The work aimed to create a sustainable packaging solution that addresses the limitations of conventional packaging materials. PVA, water soluble and biodegradable synthetic polymer and k-carrageenan, a natural polysaccharide derived from red sea weed were selected as the main components for the film formation. The resultant film was characterized for assessing its suitability for food packaging applications. Mechanical properties and barrier properties were evaluated to determine the film's strength and ability to preserve food freshness. Characterization of films was also done by FTIR, UV-visible spectroscopy and XRD. The 20/80 (wt%) PVA/k-carrageenan film displayed higher tear strength of 1.346 N/mm. Pure carrageenan and blend films having more than 60 wt% of carrageenan are not heat sealable. As the carrageenan content increased in the blend, the water vapour transmission rate increased. The FTIR studies revealed strong interaction between PVA and carrageenan through hydrogen bonding. The film can also extend the shelf-life of packed food as carrageenan is having inherent antimicrobial property.

## Tender coconut water from shell to gel (Roopa BS)

Tender Coconut Water (TCW) is perishable, susceptible to oxygen and due to enzymatic reactions, fails in retaining the organoleptic properties at ambient condition. In order to extend its shelf-life and enhance the electrolytes, several preserving and processing







Concentrated TCW (CTCW)





Tender coconut water gels



techniques were adapted. One such technique is freeze concentration where the process is carried out at low temperature by enhancing sodium, potassium, calcium, magnesium, zinc. phosphorus without affecting its original organoleptic properties. Two and three layered packaging material was selected and studied for its suitablility to preserve fresh and concentrated TCW (CTCW of 40°Brix) at 4°C and microbial load results showed less than reference limit with acceptable sensory quality for 22-25 days and 45 days, respectively. After reconstitution in drinking water CTCW showed retention of colourless, clear liquid like appearance, no change in consistency, no turbidity, pleasant TCW aroma, astringency and mouthfeel with sweet-sour taste. TCW gels from fresh as well as concentrate were formed by following Placket-Burman experimental design. Screening of experiments by objective studies showed increase in gel firmness (0.69-3.02 Nmm), gel strength (0.005-0.084 J), compression area (0.02-0.12 Nmm), initial force (0.63-1.30 N) with increase in concentration of salt with good cohesive properties. Both objective and subjective study results of TCW gels reveals that the independent variables such as gel setting temperature, concentration of salt, TCW °Brix, concentration of gelling agent, dipping time, dipping agent and gel formation time were effecting the gel properties.

# Nanofiltration for processing vegetable oil and spice oleoresin (Rastogi NK)

The alternate solvents used in the study were less non-polar compared to hexane. The relative polarity of ethanol (0.65) was the highest, followed by 1-propanol (0.62), 2-propanol (0.55), acetone (0.36), ethyl acetate

(0.23) and hexane (0.01). All five alternate solvents exhibited significantly higher extractability than hexane. Generally, extractability increased with the polarity of the extraction solvent, and alcohols showed greater extractability. Lipids content was more than 99% in the extracts of intermediate polar solvents, ethyl acetate (99.8%) and acetone (99.5%). While polar alcohols, 2-propanol (97.4%), 1-propanol (97.3%) and ethanol (96.6%), with their greater ability to extract nonlipid compounds such as sugars, showed relatively lower levels of lipids content in their extracts. Nevertheless, all the alternate solvents exhibited significantly higher lipid yields than hexane. The highest yield was obtained with ethyl acetate (22.8%), followed by 2-propanol and 1-propanol (22.6%). The TAG yields obtained established that ethyl acetate (20.3%) resulted in a higher yield than most non-polar hexane (19.9%), while 2propanol nearly had an equal yield (19.8%). The corresponding increase in TAG vield in ethyl acetate was 2.1%. Thus, the extraction studies revealed that ethyl acetate and 2propanol possesses the potential to replace hexane in terms of their higher extractability and, more importantly, greater TAG yield among the five alternate solvents taken up in the study.

# Mobile processing unit in North-East for processing of fruits and vegetables (Punil Kumar HN)

Huge quantities of fruit and vegetables are wasted each year due to problems associated with lack of facilities for their storage, transportation, infrastructure, perishable nature of produce, heterogeneity, etc., among others. In this direction, TIFAC, in its earlier report has



identified areas of technological interventions needed in fruit and vegetable processing in North Eastern region and recommended a technology road map for North East India emphasising short, medium and long term plans to catch up with the national bench mark. In this direction, mobile food processing unit (MPU) is a multi-optional technological intervention for the processing of fruits and vegetables which enables doorstep "processing on wheels" option to small farmers. MPU carries micro/small fully equipped processing equipment for processing of the farm produce. During the glut season, MPU can substantially support the farmers and producers in a big way. The proposed MPU designed by the institute can be used in farms to produce semi-finished or finished product along with skill development and promotion. The suitable vehicle chassis for body building as well as equipments for processing has been identified and procurement of chassis has been done. The process of identifying suitable agency for body building is in progress.

## **Integrated spouted bed roaster** (Shesha Narayana K)

The roaster unit is designed to dry/roast food grains, nuts and berries in an energy efficient manner. The roaster that is being fabricated has a drying/roasting chamber, draft system, chaff/ immature grain separator, venting system, control and instrumentation system. Heater has control system to heat the chamber to the required temperature with cut-in and cut-out provision. This ensures that the chamber is heated to the set range of temperature only so that there is no under-heating or over-heating. This makes the system energy efficient and also ensuring that the grains are heated to the necessary temperature without over-heating.

Roaster chamber has multiple draft system. It consists of a forced draft compressor, an induced draft compressor and a compressor which performs hot air re-circulation and exhaust. There is provision for balancing of the draft inside the roaster chamber. Provision has also been made for fixing of the draft tube inside the roaster chamber. Valve controls at appropriate locations in the equipment ensures optimum conditions for the selected grains. Compressor motors are fitted with variable frequency drives to make the roaster further energy efficient. Provision for instrumentation has been made to know the temperature and pressure at appropriate locations.

# UV-cold plasma hybrid for enhancing microbial safety quality of *Byadagi* chilli (Sukumar Debnath)

The study aims to evaluate the effectiveness of multipin atmospheric cold plasma (MACP) in enhancing the quality of Byadagi chilli powder while combating Aspergillus spores. A 25 g sample was evenly spread in a petri plate and underwent cold plasma treatment at 10 kV and 20 kV for 1, 5, and 10 minutes, with interelectrode gaps of 5 cm and 7 cm. Microbial and aflatoxin analysis was conducted on both control and treated chilli samples. The study highlights the effectiveness of MACP in reducing pathogenic and mycotoxin concerns in Byadagi chilli powder. In a preliminary study involving the spiking of aflatoxin, only AFB1 was detected which was reduced from 9.4 ppb to 2.4 ppb with 20 kV for 10 minutes with a 5 cm electrode gap, resulting in a 74.45% reduction. Moreover, this treatment significantly reduced the naturally occurring total plate count by 3.7 log, coliform count by 3.2 log, and yeast/ mold count by 2.8 log. This innovative approach



addresses critical food safety issues, ensuring the continued success of *Byadagi* chilli as a vital Indian export to North America and Southeast Asia.

## Common incubation centre under PMFME scheme (Umesh Hebbar H)

CSIR-CFTRI has established a Common Incubation Centre (CIC) funded by MoFPI under PMFME scheme with a purpose to provide common facility for production of banana and coffee based products. Banana and coffee have been identified as products under One District One Product (ODOP) theme for Mysore and Kodagu districts, respectively. In order to meet the requirements of the entrepreneurs who are working or would like to venture into this area. the CIC would provide the infrastructural facility. The incubation centre has dedicated lines for banana and coffee based products. Both the lines have an estimated capacity of handling approximately 100-150 kg/h of raw materials. The CIC would be operated by Operation & Maintenance firm, as per MoFPI guidelines.

# Project implementation under PMFME scheme (Umesh Hebbar H)

One of the major components of the scheme is skill development through training to support the beneficiaries. Under the project implementation plan, CSIR-CFTRI conducted training programmes in online mode for District Resource Persons of Karnataka. Nearly 392 participants from various districts of Karnataka participated in the training programmes. Training focused on Scope of PMFME scheme, Food Processing Techniques, Product quality, Regulatory requirements, Licensing, Marketing and Financial supports from institutions. These

programmes were conducted with the support from KAPPEC, Bangalore, which is the State Nodal Agency for the implementation of the PMFME Scheme.

# Intelligent food packaging for monitoring spoilage and extension of shelf-life of perishable foods (Arunkumar P)

Micro curcumin (MCur) synthesised by ultrasound technique, yielded microparticles ranging from 0.5-0.8 µm, that were loaded to methylcellulose (MC) to develop MCur/MC films. Both bulk curcumin (BCur) and MCur loaded MC films were evaluated for its efficacy in extending the shelf-life of chicken meat. The parameters such as TVC (Total Viable Count) and pH levels were monitored to assess chicken meat spoilage. Results indicated that the TVC of 3% BCur/MC films stored at 4±2°C spoiled by day 5 as its pH was 6.4 which exceeded the pH threshold (6.3). The 3% MCur/MC stored under similar conditions lasted until day 8 with pH of 6.2, showcasing the potential of MCur in significantly prolonging the shelf life of chicken meat under refrigeration conditions by 3 days.

# Hydrogel-based pads for the shelf life extension of fruits and vegetables (Keshava Murthy PS)

Hydrogel films were developed using gelatin, carrageenan biopolymer, and citric acid as cross-linking agents. In addition to enhancing the multifunctional properties, green synthesized copper nanoparticles CuNPs were used and blended them with the gelatin-carrageenan biopolymer blends. The effect of CuNPs on mechanical moisture barrier and water absorption studies of gelatine-carrageenan blend film was investigated. The



CuNPs incorporated films enhanced carrageenan-gelatin films' mechanical, water barrierand antioxidant properties. Shelf-life study with mushrooms was also performed in comparison with PE plastic film. Carrgeenangelatin-CuNPs films showed absorbed moisture and absence of a fogging effect in

comparison with PE film-packed mushrooms. The results suggest that the developed hydrogel films have the potential to be used as a moisture-absorbing material to avoid the moisture-fogging effect caused by fruit and vegetable packaging.



Mushrooms packaging with PE and hydrogel film



### TECHNOLOGY DEVELOPMENT

## Convenience-based artisan bakery products (*Prabhasankar P*)

Ready-to-bake cookie dough: The cookie dough standardized and formulated with wheat flour was processed in different forms so as to suit the needs of commercial feasibility with refrigerated condition where it can be directly baked fresh at domestic levels. The cookie dough was sheeted and cut into circular discs,



(a) Cut mould



(b) Sheet



(c) Dough

moulded into cylindrical shape and dough sheets were processed to study the dough properties and post baking characteristics of the processed dough. The processed cookie dough in three different forms were stored at 4°C and analysed for cookie characteristics. According to the observation, the cylindrical dough had slightly significant difference values among the samples as it had to be manually cut and baked and had higher crispiness values, followed by circular disc. The stored processed dough were also checked for microbial load at the end of 60 days and found to be free from food borne pathogens. Further work on the standardization of dough with extended shelf-life is in progress.



Baked cookie dough



Cross section of cookie

# Coconut oil and bioactive compound enriched edible oleogel as a shortening alternate to bakery fats (*Prabhasankar P*)

Foods high in hydrogenated fat, such as cakes, cookies and pastries are linked to obesity and lifestyle diseases. Many baked goods, like cakes and cookies contain significantly high amounts of hydrogenated fat. To address this, a new method has been proposed to turn liquid oil into solid-like gels without chemical modification. Coconut oil, valued in Ayurvedic medicine and showcasing proven scientific health benefits, is more chemically stable and less prone to oxidation than other vegetable oils. Based on these considerations, coconut oil-based edible oleogels enhanced with lipophilic bioactive compounds were developed, which were incorporated into bakery products as a fat replacement. The medium chain triglycerides-rich coconut oil was successfully blended with soybean and sunflower oil, which enhanced the fatty acid profile, especially MUFA and PUFA. Furthermore, safe and



commercially viable gelators were selected and oleogels were prepared at the lab scale using the direct dispersion method without altering their chemical composition. The prepared DSB, BSW, 10CP50, and 75CP100 oleogels were characterized for their physical, chemical, rheological, and microstructural properties. The results showed that DSB and 75CP100 had higher oil binding capacity. The microstructural and thermodynamic properties revealed a stronger gel network structure in DSB and 10CP50. The rheological properties confirmed the pseudoplastic or shear thinning nature of oleogels, as viscosity decreased with increasing shear rate. The prepared DSB and BSW oleogels were incorporated into muffins and







Oleogels incorporated cookies

10CP50 and 75CP100 into cookies by 25% and 50% replacement of commercial shortening to meet the consumer requirements. After systematic evaluations 25% replacement was optimized. Based on rheological parameters, DSB and 10CP50 oleogels were identified as having superior physical and sensory properties compared to all other formulations. Currently, the optimized oleogels are being evaluated in preclinical studies to assess their toxicity and efficacy using animal models.

# Centre for Promotion of Additive Manufacturing (CPAM) - agri and food processing (Negi PS)

3D Food printing facilitates the production process from mass manufacturing to personalized manufacturing, and it is based on personal nutritional needs. This technology allows for the customization of nutrient intake and offers food to be consumed in more aesthetic way. 3D food printing can optimize development of functional foods by enriching with required micro and macronutrients, substituting undesirable fat and allergic proteins, and printing multi-ingredient appealing food for various needs. The properties of inks are critical for their applications in printing of foods. Various types of edible inks have been developed for 3D printing purposes, including those utilizing proteins, polysaccharides, lipids, and flours as structuring agents. In extrusion-type 3D printers, the edible inks must be capable of flowing through the orifice, setting on the platform, and then maintaining their shape. Rheological properties of various vegetable inks were studied, and they were utilized to obtain 3D printed shapes. Texture of these 3D printed shapes was analysed post-processing.



# Industrial scale cold plasma unit for decontamination of fruits and vegetables (Negi PS)

Cold plasma, plasma activated water, ozone, infra-red exposure, ultrasonication, UV exposure and electrolyzed water dip are the contaminant removal techniques for various fruits and vegetables that are studied. The browning index of cold plasma-treated apples was low throughout the storage at ambient as well as cold condition. All the treated spinach samples showed a significant reduction in a\* values, indicating degradation of the green color, however, a\* values were retained in cold plasma-treated spinach at the end of 6 days. The cold stored, ultra-sonicated grapes showed a less microbial count (2.01 log CFU/g) at the 12th day of storage. In tomatoes, a delayed ripening was observed after the cold plasma treatment. The pesticidal residue analysis using a mixture of organophosphate pesticide (malathion, fenthion, chlorpyrifos) showed a reduction (59.9, 73.48, 58.51%, respectively) in their content in apples after cold plasma treatment. After cold plasma treatments, the spinach samples showed a reduction of 99.9 and 97.5% in malathion and chlorpyrifos residues, respectively; whereas in grapes and tomatoes spiked with chlorpyrifos, a reduction of 35.92 and 100%, respectively, was observed. A plasma activated water unit was designed and fabricated for industrial scale applications. The cold plasma/ plasma activated water treatment is a novel decontamination method which have the potential to reduce the microbial load and pesticidal residue without compromising the quality.

## Export protocol for fresh okra (Abelmoschus esculentus) (Negi PS)

Okra (Abelmoschus esculentus) is a highly nutritious crop with several health benefits. However, fresh okra pods deteriorate rapidly after harvest due to high water loss, fruit softening, and blackening of ridges. High temperature increases respiration and ethylene production rates that initiate senescence. Although storage at low temperature extends the postharvest life by inhibiting physiological changes, it may also cause chilling injury stress in okra pods. Chilling stress also induces a high respiration rate and weight loss. Various nonthermal treatments, such as UV light, cold plasma (DBD), and plasma activated water (PAW) were used to treat the okra. Treated okra packed in zip-lock bags (non-perforated)/ PP boxes/ CFB boxes with PE film was stored at ambient conditions and in the cold room at 10°C to analyse changes in quality parameters during storage. Further, the pesticide residue reduction was also analysed after decontamination treatments. Okra treated with DBD, packed in plastic box wrapped with cling wrap (10 m) and stored at 10°C had better visual appearance and quality in terms of higher-carotene content and lower browning enzymatic activity than control sample until 16 days. A substantial reduction in microbial count was observed after DBD treatment, and the chlorpyrifos residue reduction achieved was 65%. An improvement in color retention (chlorophyll content) and total phenolic content (TPC) were observed in PAW treated samples during storage in both conditions. The shelf life of okra was increased to 15 days under cold conditions after PAW treatment.



# Empowering growers of ragi and other small millets in Odisha State through CSIR-CFTRI scientific intervention (Usha Dharmaraj)

The shelf-life studies of the different ragi based instant mixes (upma mix, idli mix, halwa mix) developed under the project were evaluated. Also the changes in moisture content, colour, water activity and free fatty acid contents of the samples stored at ambient and accelerated storage conditions were evaluated. It was observed that the samples exhibited 3.5 months shelf-life under accelerated storage conditions and 7 months shelf-life at ambient storage conditions with good sensory acceptability. Training program was conducted for the 36 SHG members for 3 days. The program included demonstrations on destoning, refining and extrusion cooking of ragi, preparation of readyto-eat and ready-to-cook ragi chatuua, preparation of ragi based kichadi mix, roasting ragi flour emphasizing the importance of proper roasting using mechanical method and preparation of ragi laddu. Apart from this, the information on nutritional benefits of ragi, design and flow chart of the milling machines, microbial safety and good manufacturing practices, were provided to the participants.

# Numerical analysis of heat and mass transfer in various grain drying process (Shruti Joshi)

Drying models are necessary to optimize the drying process and develop better strategies for control of the system. A Multiphysics model was developed for drying of banana slices using COMSOL Multiphysics software. This model enables to predict temperature and moisture distribution inside the banana material during any stage of the drying process. The simulated

results were compared with experimental data from literature and the model was validated. The rice was cooked using microwave, electric cooker and induction pan cooking. It was observed that electric cooker required higher time to hydrate and cook rice as compared to induction and microwave cooking. The same was validated using the experimental Multiphysics model. The predictive model included many different effects such as transport of heat in the rice grain through conduction and convection. the vaporization of water and the transport of water and water vapor within the pores of the rice grain, and the permanent (plastic) shape change of the rice grain due to the pressure acting on the solid structure. The results showed that a lighter, more porous grain allowed for faster evaporation, which in turn increased the internal pressure on the rice grain and gave greater volume expansion for a higher quality puffed rice product. It was observed that the temperature gradient at the end of the drying process is negligible because of small thickness of the material. The results in the predictive model collaborated with the experimental model wherein the time required for hydration and cooking time was higher for electric cooker as compared to other two modes of cooking.

# Nanotechnology-based neuroprevention using chitooligosaccharide (COS) (Suresh PV)

Biologically active compounds such as chitooligosaccharides (COS) are considered as a powerful food factor that could elicit profound effects on the maintenance of human health, and disease prevention. The main objective of the investigation is the formulation and development of specific nano-COS (COS-NP)

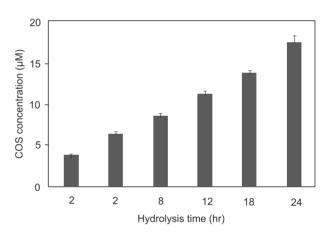


with potential neuroprotective effect by green technology and to evaluate the neuroprotective effect and related pathways of nano-COS in neuronal (SH-SY5Y) cells and induced Parkinson's disease (PD) mice model. The COS will be prepared from the chitosan hydrolysate of fully N-deacetylated chitosan using the microbial chitosanase produced by the selected microorganisms. The combined compression and high temperature using an alkaline solution method was found to be very effective in the preparation of chitosan with ultra-high Ndeacetylation (%DDA). The yield of resultant alkali-treated chitosan was 85-90% (w/w). Chitosan product with >99%DDA was achieved by the combined N-deacetylation method by the liquid phase <sup>1</sup>H NMR analysis. The combined compression and high-temperature Ndeacetylation method could be used to produce chitosan with ultra-high %DDA for the synthesis of COS with consistent quality.

The production of chitosanase by Purpureocillium *lilacinum* CFRNT12 in different media (8 number) was performed. Among the various media tested the colloidal chitosan mineral medium (Medium 3) with 2% colloidal chitosan exhibited significantly (p<0.5) high chitosanase activity (1416.8±47.9 u/ml) at 72 h of incubation as compared to other media tested. Hence, the Medium 3 with 2% colloidal chitosan was selected for further studies. The production of chitosanase by Beuverra bassiana BTMFS10 (Engiodondium album BTMF, MTTC 3742) in different media was performed. Among the various media tested the colloidal chitosan mineral media (Medium 4) with 2% colloidal chitosan exhibited significantly (p≤0.5) high chitosanase activity (1331.3±97.66 u/ml) at 72 h of incubation as compared to other media tested. Hence, the

Medium 4 with 2% colloidal chitosan was selected for further studies.

The chitosanase produced by *P. lilacinum* CFRNT12 was concentrated and used for the COS production from the colloidal chitosan prepared from the alkali-treated chitosan. The maximum yield of COS obtained from the chitosan substrate after 24 h of hydrolysis was 17.5±0.8 µM. TLC analysis showed that colloidal chitosan hydrolysate contained mainly COS. The results indicate the potential chitosan hydrolyzing activity of the chitosanase preparation from *P. lilacinum* CFRNT12 toward the production of COS.



Time scale production of COS from colloidal chitosan substrate using the chitosanase from *P. lilacinum* CFRNT12 at different hydrolysis times

# Nuclear magnetic resonance based metabolites profiling of coconut water (Sachin R Chaudhari)

The project achieved its objectives of developing a robust <sup>1</sup>H NMR method for coconut water analysis and establishing reference ranges for key metabolites. Results provided insights into coconut water maturity stages, guiding producers and consumers in selecting the ideal stage for consumption. Notable findings include

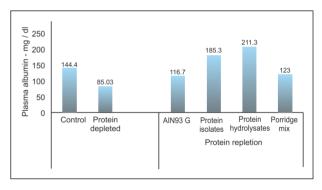


changes in sugar ratios, with mature coconut water exhibiting decreased G/F ratio and increased S/G ratio. This research contributes to improving coconut water quality and informs decision-making in the industry.

## Nutrition interventions for maternal, child and geriatric populations (Jyothi Lakshmi A)

Aging is associated with progressive loss of muscle mass, quality and strength which initiates at the age of forty. Lean body mass declines with age and this is primarily due to loss and atrophy of muscle cells. Protein hydrolysate were prepared from groundnut and pumpkin seeds and incorporated in a semolina and green gram based porridge mix. The efficacy of protein hydrolysate incorporated porridge mix was tested in protein deficiency induced adult Wistar rats. The initial weight of protein deficiency induced adult rats was 306 g, they were further categorised into three groups, wherein one group was supplemented with control diet, the second group with AIN93 diet substituted with 50% of protein from plant based protein isolate, third group with protein hydrolysate. One group was fed with porridge mix incorporated with protein hydrolysate for 50% of protein from greengram. On replenishment for six wks, the body weight of the normal rats increased by 22 a. Among the protein deficiency induced groups, AIN93 diet supplemented group containing casein gained 117 g, while plant protein isolate substituted group gained 110.7 g and protein hydrolysate supplemented group gained 126.5 g. The porridge supplemented group also showed weight gain of 73.5 g. Albumin level in the blood that was depleted on induction of protein deficiency increased on protein supplementation, the albumin values rose to different levels that varied by protein

source and form. Albumin content of plant protein isolate and hydrolysate substituted groups showed higher increase than the AIN93 diet group which contained casein, the porridge group showed values similar to that of the control group. Protein depletion showed a muscle loss in rats by 45%. On protein replenishment the muscle weight increased in all the protein group with higher value in hydrolysate group. Though the porridge group showed a comparatively lower increment, it was higher than the control group. It can be inferred that plant proteins are efficacious in correcting the protein deficiency and hydrolysates with higher digestibility is better absorbed and utilised by the body.



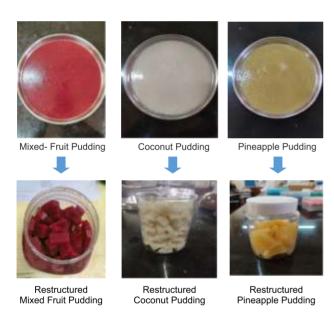
Plasma albumin content of rats on protein depletion and repletion - g/L

## Formulation of various fruit puddings (Chauhan AS)

Various restructured puddings based on banana puree, guava puree, pineapple, coconut puree and coconut-beetroot puree were formulated and stored in packed form at low temperature (6°C) for assessment of their storage stability. The individual puree (500 g) was mixed with required quantities of sugar, milk solids, hydrocolloids and citric acid and heated to a desired brix (30°Brix). Thereafter it was poured to the SS plate for uniform spreading, cooling



(RT for 1 h) and cutting into any desired shape and thickness. The formulated puddings were evaluated for microbiological and sensory analysis (9-point hedonic scale). All the packed puddings (without preservative) were stable for 60 days at low temperature (6°C) and microbiologically safe to consume and it had good sensorial acceptance. The physicochemical properties of the puddings were also stable during storage at low temperature (6°C). All the formulated puddings were good source of minerals [calcium (154-158 mg/100 g and potassium (236-240 mg/100 g)] and provides 120-125 calories per serving (100 g).



# Fine tuning of millet value chain for export markets (Sridevi Annapurna Singh)

Unique expertise of the institute has been applied to extend millet shelf life and fine-tune the millet value chain for export markets. The key focus was to design and fabricate machinery for millet processing, develop semolina production techniques and extend the shelf life of milled millet products. Additionally, the project involved studying lipase activity and

understanding its structural characteristics to innovate novel shelf-life extension technologies, assessing the impact of millet polishing on nutrient content and storage quality and creating phytonutrient-rich and traditional instant millet mixes. De-hulling efficiency of various millets was studied using rubber roll shellers, hydrothermal treatments, and combined de-hulling techniques. A design for a millet de-hulling machine with an integrated sheller was completed. Processing studies on kodo and proso millet produced shelf-stable semolina with a storage stability of up to 9 months. Thermal and milling treatments extended the shelf life of pearl millet flour, with packaging studies confirming 8-month stability. Lipid composition and lipase activity in sorghum millet brans were analyzed, revealing different lipase types in pearl millet's bran, germ and endosperm. Minimal polishing of foxtail, little and proso millet preserved nutrients and nutraceuticals. Novel products, including phytonutrient-rich instant multi-millet mixes and spirulina-fortified RTC porridge mix were developed, showing good nutrient content, sensory acceptability, and enhanced shelf stability. Collectively, the institute's advancements in millet processing, shelf-life extension and the development of nutrient-rich millet products not only promote greater millet utilization but also enhance the export market potential, positioning India as a key player in the global millet industry.

# Formulation and product development of ayurveda recipes (Sridevi Annapurna Singh)

Product development of shortlisted 10 recipes have been undertaken under a collaborative project in which 4 selected formulations have been committed to be subjected for nutritional



safety and efficacy studies, which are Kapikacchu pupalika, Navanga yusha, Triphala bhavita yava rotika, and Panchamrita yusha. In the shortlisted 10 recipes, one of the recipes known as Surana modaka has been replaced by the recipe Veshtani, as Aruskara, one of the ingredients in the formulation of the product had toxic content. Out of 10 recipes, 9 have been formulated and standardized into final product. Further physicochemical and storage studies are in progress. Initial trials are on for the remaining one formulation. Analysis of the products prepared are being carried out.







Kapikacchu Pupalika

Panchasara Panaka

Navanga Yusha







Triphala Bhavita Yava Rotika

Beeja Laduka

Mohan bhog







Ashtaguna Manda Vedanika

Panchamrita Yusha



Veshtani

### Preparation and standardization of Mohanthal prasadam (Chetana R)

Ambaji temple Mohanthal prasadam was formulated using general steps of preparation followed by Ambaji temple using the locally available raw materials and coarse gram flour was prepared. Standardization of the product was carried out considering three primary factors (particle size of Bengal gam flour, crystallization of the sugar syrup and quality of ghee) which influenced the sensory, textural properties and storage stability of the finished product. For the standardized product, colour, textural profile and sensory analysis were carried out. For the physicochemical properties, parameters like, moisture, water activity, total fat, FFA and PV were analysed. To improve the packaging quality of the product, tray sealing method was used considering two varieties of packaging materials, namely, PET film and metallized aluminum foil.





Tray seal using (a) metalized aluminium foil and (b) PET / PP materials

### Customised anti-fatique products from coconut and by-products (Chetana R)

The anti-fatigue activity of coconut testa which is a powerhouse of flavonoids and phenolic contents has not been reported especially in foods. Hence, antioxidant-rich food formulations were tried with combinations of virgin coconut oil (VCO), testa oil, testa fibre and coconut testa phenolic concentrate. An antioxidant-rich



powder from testa phenolic concentrate has been prepared which can be easily added to food products. Product formulation was mainly carried out using testa oil, testa fibre/phenolic concentrate, VCO and defatted coconut fibre along with other ingredients. Products prepared were Chikki with defatted testa powder and testa phenolic concentrate, Virgin coconut oil-based VCO shots and syrup/(combi syrup or confectionery oleogel) with testa oil and low GI extruded snack-corn grits, barnyard millet with coconut residue/fibre and testa concentrate.

Chikki with added polyphenols: Testa fibre were powdered/ground and this was utilized to prepare chikki at various levels of addition. Testa with oil, defatted testa fibre and testa phenolic concentrate was added for the preparation of chikki. Testa phenolics was extracted with alcohol, concentrated and then used for value addition.



Chikki with added polyphenols

Confectionery oleogel: VCO and sugar syup of 60°B were used to formulate the emulsions. Emulsifiers GMS and lecithin (1:1) and bees wax were added at 0.25% at 0.5% respectively. Curcumin was added to the warm oil and the product was prepared. The product was removed from water bath and stirred continuously till it thickened to a semi solid consistency. This blend was further conditioned

in a refrigerator for 4 h and then stored at room temperature for further studies. The results showed no major differences in whiteness index. The texture (consistency) of the oleogels showed a decrease in the values with an increased ratio of VCO or testa oil and decrease in the amount of sugar syrup. Addition of colour and flavour improved the sensory acceptability. Chocolate was very popular and this could be used in bakery as fillings and for decoration. Sensory analyses of oleogels showed that the product was acceptable in terms of consistency however with the addition of flavours it was highly accepted.





Oleogel with added Curcumin and pineapple flavour

Oleogel with added Chocolate

Low GI extruded product: Extruded snacks were tried using a twin screw extruder using corn grits, barnyard millet, coconut fibre, testa fibre and testa concentrates. Initial trials have been completed and studies are on-going with respect to physicochemical characteristics of the products. Animal experiments are yet to be initiated.





Low GI extruded product



#### Farm based S&T interventions for socioeconomic development in the aspirational district of Nabarangpur, Odisha (Nagender A)

A four-day hands-on training programme was organized for 15 women participants from Nabarangpur for creating awareness on food processing operations and value addition. Fruit and vegetable products such a RTS beverages, squashes, mixed fruit jam, tomato ketchup, extruded millet RTE snack, bakery biscuits etc. were demonstrated.

### Instant mixes and value-added products from minor millets (Sathiya Mala K)

Proximate analysis for the minor millets namely barnyard millet, proso millets, kodo millet and little millet procured from the local market was carried out. Standardization and storage studies of various composite millet products like instant soup mix, instant idli mix, instant dosa mix, vadiams, papads, millet flakes-based nutribar was carried out. A hands-on training programme on value added products from minor millets was conducted which was attended by 16 prospective entrepreneurs. Training was provided on the production of composite millet products.

# Skill development programme on processing, preservation and value addition of food and agro based products for commercial use in aspirational districts of Uttar Pradesh (Gothwal PP)

A survey of the aspirational districts of Uttar Pradesh such as Sonbhadra, Chandauli, Fatehpur and Chitrakut were conducted for finalizing food and agro based raw materials availability and training schedules. Prospective women entrepreneurs were selected with the help of leading NGOs of the region as well as through State Government officials. A bilingual training manual both in English and Hindi regarding geography, production of fruits and vegetables, cereals and pulses, and other agro crops grown in Sonbhadra, Chandauli, Fatehpur and Chitrakut districts of Uttar Pradesh were prepared. The preparation, preservation and management of the food and agro based value added products as proposed in the project were given in detail in the manual with recipes and methodology to be distributed among women trainees. Five days training-cum demonstration programs on technologies developed by the Institute were conducted in the aspirational districts of Uttar Pradesh for processing and value addition of agro/food based raw materials available in the region.

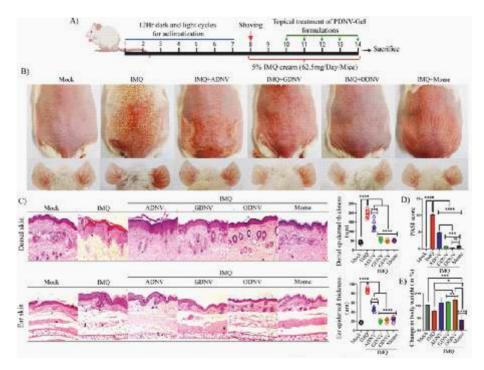


#### TRANSLATIONAL RESEARCH

### Garlic and small onion derived nanovesicle topical formulation (Gopinath M)

Psoriasis is a chronic inflammatory skin disease with only corticosteroids as the mainstay treatment. Though, biologics targeting TNF/IL23/IL17A pathways are effective in clinical trials they remain expensive. Several plant bioactives hold therapeutic potential for psoriasis due to their known anti-inflammatory/ oxidant activity. However, their clinical use is limited by their low bioavailability and aqueous solubility. Edible plant-derived exosome-like nanovesicles (PDNVs) are intrinsic nano-sized structures isolated from plants. In particular, PDNV-associated bioactives have enhanced bioavailability and solubility. Herein, the development of a topical hydrogel formulation of

garlic and shallot-derived PDNVs as a costeffective therapeutic for psoriasis treatment is reported. In the initial screen for different PDNVs with anti-inflammatory activity, apple, garlic and shallot PDNVs displayed potent suppressive effect on the pro-inflammatory TNF pathway. In imiquimod-induced psoriasis-like inflammation model in vivo, topical application of either shallot and garlic PDNV hydrogel formulation, led to complete recovery to normal skin phenotype, evidenced by reduction in epidermal hyperplasia and suppression of both local and systemic inflammation. Given that plant PDNVs are cheaper to produce, shallot and garlic ENVs can be exploited as a natural and cost-effective topical alternative to conventional biological agents against psoriasis.



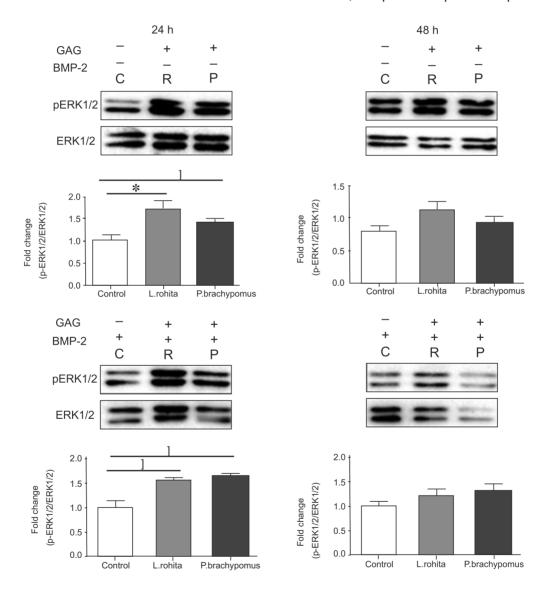
Topical application of garlic (GDNV) or onion (ODNV) lead to amelioration of psoriasis phenotype induced by imiquimod (IMQ) treatment. A) Schematic represents the overall treatment regimen. B) Macroscopic images of mice back skin that has been treated with IMQ alone or IMQ along with apple ENVs (ADNV) or GDNVs or ODNVs or mometazone (Mome) cream. C). H&E images showing the decrease in hyperproliferative epidermis and inflammation in GDNV and ODNV treated mice. D & E). PASI score and change in body weight in indicated groups



## Valorization of byproducts from fish industry (Nandini CD)

Attempts were made to determine the mechanism by which chondroitin/dermatan sulfate (CS/DS) promoted osteogenesis. Results indicated that CS/DS supported osteoblast differentiation by promoting collagen production, extracellular matrix formation, and

subsequent mineralization. The mechanism behind these effects were elucidated by assessing key molecules involved in osteogenesis in response to exogenous CS/DS with/without BMP-2. CS/DS alone significantly increased pERK1/2 and ATF-4 expression levels differentially in a time-dependent manner, without significant effect on BMP-2, RUNX2, and pSmad-5 protein expression.



Effect of CS/DS on pERK1/2 expression MC3T3-E1 cells were cultured in the presence of CS/DS ( $50 \mu g$ ) or with exogenous BMP-2 (20 ng) for 24h and 48h. The expression of pERK1/2 protein expression analysis was determined by western blot analysis, and bands were normalized to total ERK1/2 levels. Three independent experiments were carried out. Data represented as the mean  $\pm$  SEM and values are significant at \*p < 0.05, \*\*p < 0.0 compared to their controls

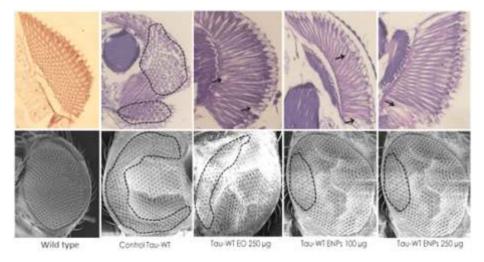


## Guar gum $\beta$ -manno-oligosaccharides based standardized synbiotic mixture (Kunal Sharan)

Osteoporosis is characterized by the microarchitectural deterioration of bone resulting in increased bone fragility and fracture risk. Emerging evidence suggests that the gut microbiome plays a role in regulating bone metabolism and probiotics can protect against bone loss. The study explored the potential of guar gum-β-manooligosaccharides (GG-β-MOS) as prebiotic source in a synbiotic mixture to prevent ovariectomy-induced bone loss in mice. GG-β-MOS were obtained by hydrolyzing guar gum using the ManB-1601 enzyme. Treatment with GG-β-MOS, and GG-β-MOS+probiotics prevented an increase in body weight induced by ovariectomy. However, other treatments, including FOS and probiotic alone, showed no significant effects. Liver-to-body weight ratios remained unchanged across groups. Additionally, treatment with Ovx+GG-β-MOS+Pro prevented an increase in white fat weight observed post-ovariectomy. Analysis of the gut microbiome revealed variations in alpha and beta diversity indices among treatment groups. The bacteriome of each treatment category showed significant dissimilarity. Results obtained from micro-computed tomography of long bones showed an improvement of bone micro architecture in the ovariectomized mice treated with probiotics, GG- $\beta$ -MOS and GG- $\beta$ -MOS+Pro. However, GG- $\beta$ -MOS+Pro had a better effect on bones as compared to other groups. Overall, GG- $\beta$ -MOS show promise as prebiotics to mitigate bone loss and influence gut microbiome composition.

### Nanoencapsulated Eugenol (NE) (Poornima Priyadarshini CG)

This study focuses on the efficacy of eugenol (EO) and eugenol nanoparticles (EON) in inhibiting tau aggregation, a hallmark of Alzheimer's disease (AD), using in vitro, in silico, and in vivo analyses. EON, modified with maltodextrin polymer, demonstrated concentration-dependent inhibition of tau aggregation in vitro. In silico experiments revealed that eugenol interacts with tau amino acid residues predominantly via hydrophobic interactions. Additionally, in a transgenic Drosophila model, EON showed promise in reducing tau-mediated pathology, improving survival and mitigating cognitive deficits. These



Effect of NE on eye morphology of Drosophila melanogaster Tau transgenic (UAS- hTauWT)



findings suggest that eugenol nanoparticles hold potential as a therapeutic agent for Alzheimer's disease.

## Nanoformulated apocynin against abnormal fatty acid metabolism induced by fumonisin B1 in liver (Muthukumar SP)

The efficacy of nano-formulated apocynin in mitigating fumonisin B1-induced abnormalities in liver lipid metabolism using C57BL/6 mice was investigated. Native apocynin (50 mg / kg) and nano-formulated apocynin (25 mg / kg) were orally administered alongside fumonisin B1 (2.25 mg / kg). Results demonstrated that nanoencapsulated apocynin significantly reduced hepatotoxicity compared to the native form. It restored antioxidant enzymes and key proteins involved in lipid metabolism while protecting against hepatocyte damage, as evidenced by histopathology. Biochemical markers such as ALT and AST returned to normal levels with nano-apocynin treatment. Western blot analysis revealed alterations in proteins like ABCA1, LXR, LDLR, and PCSK9, implicating their role in fumonisin B1-induced hypercholesterolemia. The study concludes that nanoformulated apocynin holds promise in treating fumonisin B1-induced liver damage and associated metabolic disturbances, surpassing the efficacy of native apocynin. These findings provide valuable insights into potential therapeutic avenues for addressing liver lipid metabolism abnormalities induced by fumonisin B1 toxicity.

## Iron-fish collagen/gelatin peptide chelate incorporated food products (Uma V Manjappara)

Iron chelates of structurally constrained tri and tetra peptides were synthesized and shown to be effective iron delivery systems *in vitro* and *in vivo*. To obtain a cheap and sustainable source of peptides it was proposed to hydrolyse gelatin from fish processing by-products and chelate with iron and study the iron bioavailability. Hydrolysis of gelatin was performed using different commercially available enzymes like trypsin, pepsin and papain and standardised for obtaining maximum hydrolysis. The best hydrolysate obtained was chelated with iron and incorporated into chapatis and studied for release of iron at different pH. Hydrolysis with papain yielded the best results with a degree of hydrolysis of 70% and release of iron from chapati was confirmed at pH 2 and 6.6.

### Laxative property analysis of spent coconut fiber (SCF) (Ramaprasad TR)

The laxative property of coconut fiber was determined by measuring the intestinal transit in experimental rats induced with constipation using loperamide. The easy movement of food in the intestine determines the transit time and hence the fecal output. The results indicated that administration of loperamide decreased the intestinal transit compared to control group, whereas supplementation of rat diet with fiber from spent coconut significantly increased the intestinal transit ratio at the two tested concentrations (2.5 and 5.0%). When compared to control, loperamide intestinal transit ratio was found to be decreased by 46%. Whereas, in 2.5% and 5.0% CF fed group, it was found to be increased by 156 and 199% respectively. Further, administration of coconut fiber prevented the lesion formation in the intestine as triggered by loperamide. To understand the molecular mechanisms, the signal pathway involving PKA, 5-HT, etc. are in progress.



### Medium chain triglycerides (MCTs) enriched oil (Suresh Kumar G)

The process of cold finger melt crystallization was employed for the dry fractionation of multicomponent TAG mixtures in Virgin Coconut oil (VCO). The objective of the experiments was to optimize crystallization parameters to yield a Medium Chain Fatty Acid (MCFA)-rich olein fraction and a Long Chain Fatty Acid (LCFA)rich stearin fraction. The study investigated the isothermal crystallization and melting behaviour of VCO. Crystallization parameters crucial for the fractionation process design were determined. The olein fraction demonstrated a maximum of 4.5% higher content of MCFA containing triglyceride species compared to the stearin fraction, indicating a 1.5% improvement from the feed VCO. Notably, a cooling finger temperature reduction from 28°C to 19°C and higher percentage of MCFA-containing TAGs in the olein fraction. Product development is under progress.

### Multi-sourced edible oil fortified with lipid nutraceuticals (Vijayaraj P)

The study aims to combat the global obesity epidemic and its complications by improving the quality of edible oils in the diet, aligning with ICMR and FSSAI amendments. Nutritional intervention is more effective than supplements or medications in managing obesity. The health benefits of fats and oils depend on the balance of fatty acids such as saturated (SFA), monounsaturated (MUFA,  $\omega$ -6), and polyunsaturated (PUFA,  $\omega$ -3) fatty acids. WHO and ICMR recommend a 1:1:1 ratio of these fatty acids. No single oil provides this balance, so FSSAI suggests blending of vegetable oils. Recently, FSSAI introduced Multi-Source

Edible Oil (MSEO), a blend of three oils, to ensure adequate  $\omega$ -3 intake while maintaining the recommended ratios. A non-enzymatic process for producing MSEO with a balanced fatty acid profile was developed in the institute. Characterization of the oil blends showed quality and stability, indicating a positive impact on health, feasibility, and industrial relevance.

## Adipocyte-derived extracellular vesicles activate hepatic stellate cells mediated by SREBP-cleavage activating protein (Madan Kumar P)

Obesity is a global health problem which leads to fatty liver and recent scientific evidences confirmed an increased expression of SREBP as a major characteristic of obesity. The effect of mature adipocyte-derived extracellular vesicles (MA-EVs) on hepatic stellate cells (HSCs) was evaluated in this study. MA-EVs extracted from conditioned media was characterized by TEM analysis and Western blot method. MA-EVs activated HSCs as evident from marked increase in the expression of  $\alpha$ -SMA, a marker for HSC activation. Also, the mRNA expression of TNF-α and IL-6 were significantly upregulated in a-EVs treated condition. Further, animal experiments are underway to confirm the profibrogenic role of MA-EVs in a high fat diet induced fatty liver mice model.

## Sterol regulatory element binding protein during hepatic stellate cell activation (Madan Kumar P)

Fatty liver disease (FLD) is a severe global health issue and activation of hepatic stellate cell (HSC) is the central event in FLD pathogenesis. Recent scientific evidence has suggested increased sterol regulatory element binding protein (SREBP) activation as one of a



major characteristic of FLD. However, studies on the role of SREBP during HSCs activation is not clearly determined. Therefore, in this study it was aimed to delineate the molecular mechanisms behind the therapeutic target potential of SREBPs in experimental FLD models. For the first time, an in vitro model was established to study the effect of SREBP signaling in human HSCs. For SREBP activation, HSCs were grown using SREBP induction media. Real time PCR analysis showed increased expression of  $\alpha$ -SMA. SREBP-1, SREBP-2 genes in SREBP induction media compared to control media. RNA seg analysis is currently underway to delineate the role of SREBPs during HSC activation. Further experiments to study the role of SREBP inhibition is being studied in fatty liver models.

### Food formulation with enhanced bioavailability (Anbarasu K)

The use of cowpea (*Vigna unguiculata*) as the base for the value-added vegan milk formulation which will be further enriched with the addition of soy milk derived exosomes (soy protein hydrolysates) and exosomes derived from sprouted ragi to meet the protein and mineral requirement at RDA was studied. Further, the fabricated vegan milk protein formulation will be assessed for their acceptability pertaining, to sensory evaluation, microbial studies, and shelf-life studies using the standard protocol. An *in vivo* assessment of the formulated milk will also be carried out in order to evaluate the muscle restorative potential of the value-added vegan milk.

## Value-added dietary formulation by the virtue of coconut milk exosomes and sesamol (Anbarasu K)

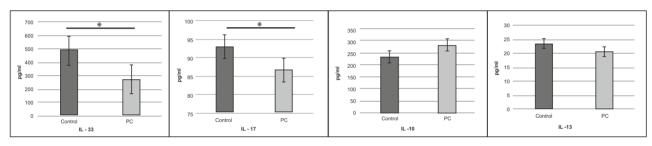
Phytochemical based approach i.e., formulation of a value-added cancer food in the form of coconut milk-based yoghurt/ milkshake enriched with the addition of coconut milk exosomes loaded with bioactive components of sesame seeds (sesamol) was studied. The effect of the foresaid food formulation on the modulation of different cell signaling molecules involved in various apoptotic pathways will be explored. The exosomes from coconut milk have been isolated using ultracentrifugation and chemical-based isolation and characterized using DLS, SEM and mineral analysis and exosomes isolated showed to be in the ideal size range of 50 – 200 nm with the zeta potential in the range of -12 to -30 mV. The SEM analysis showed that the isolated exosomes have exhibited the spherical morphology in the expected size range and mineral analysis results have revealed that the isolated coconut milk exosomes are rich in minerals especially selenium which might aid in empowering these exosomes for its anticancer potential. Alongside selenium the lipidomic analysis of coconut milk exosomes through GC-MS analysis have showed that these exosomes are also rich in lauric acid as its major lipid component shows potent anticancer properties. The isolated exosomes were further loaded with sesamol and the anticancer potential of this formulation is now being evaluated starting with MTT at both 24 and 48 h which was found to be 23.5 µg (MCF-7). Whereas, the MTT of sesamol alone was found to be 1240 µg and 1310 µg (24 h) and 347.16 µg and 600 µg (48 h) for MCF-7 and MDA MA 231 respectively.



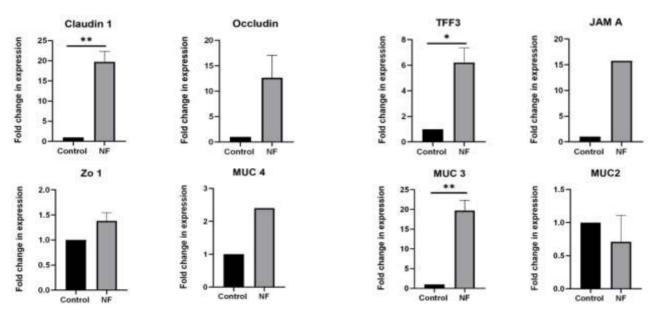
### Pectin derived prebiotic oligosaccharide in prevention of food allergy (Mahejibin Khan)

Mast cells (MCs) are key effector cells of allergic diseases and other inflammatory reactions. MCs also have an important role in asthma, as well as chronic obstructive pulmonary disease, allergic rhinitis, respiratory infections and lung fibrosis. MCs activation has also recently been described in many other inflammatory conditions also. The prophylactic role of pectin containing nutraceutical formulation (NF) on Wistar rats were studied. NF modulated the gut bacteria and increased the proliferation of butyrogenic bacteria compared to the control. Treated group showed increase in serum

antioxidants and reduction in pro-inflammatory cytokines IL-33, IL-17 and II-6, whereas level of IL-10 increased. Reduction in IL-33 is directly correlated with inhibition of mast cells activation. Fecal metabolites analysis showed increased Short Chain Fatty Acid (SCFA) and other small metabolites such as IPA, IAA, benzoic acid that contribute to reduce inflammatory response. Moreover, treated group displayed upregulation of claudin1, occulidin, muc3, muc4, Tff3, Zo-1 and JAM-A factors, which helps in repair of mucosal wound injury in intestinal epithelium. These results confirm that pectic oligosaccharide based NF can be used as prophylactics to reduce food allergy.



Effect of NF on serum cytokines



Effect on NF formulation of mRNA expression of intestinal tight junction protein



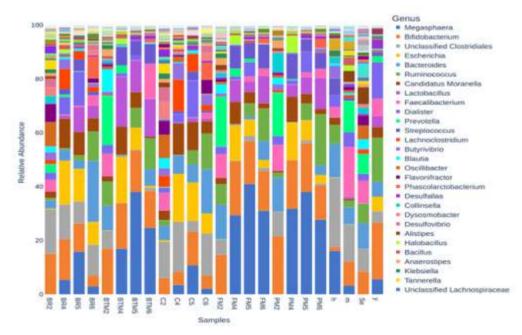
## Prophylactic and therapeutic nutrient supplements for functional gastrointestinal disorder (FGID) (Mahejibin Khan)

*In vitro* fermentation of brown top millet (BTM), pearl millet (PM), finger millet (FM) and black rice (BR) were carried out with human fecal samples collected from 4 healthy volunteers keeping fermentation medium and fecal slurry (10%) as control. Samples were collected at 0, 6, 12, 18 and 24 h. Change in pH, short chain fatty acids (SCFAs) and antioxidant assays including ABTS, DPPH, phosphomolybdenum, FRAP and total phenolics were carried out for all the in vitro fermented samples. Change in microbial diversity was studied by next generation sequencing. A drastic increase in SCFA's and significant increase in antioxidant activity were observed in millet and black rice samples at different time points compared to the control. Microbial diversity analysis revealed that there was no significant change in alpha diversity, whereas beta diversity increased in all

the group compared to the control. In BTM, FM and PM, the relative abundance of firmicutes and actinobacteria increased and bacteroidetes decreased, whereas in BR, both firmicutes and bacteroidetes counts decreased and actinobacteria increased. Moreover, proteobacterial counts decreased significantly in all the millets and no significant change was observed in BR.

## Galactomanno-oligosaccharides as potential therapy for inflammatory bowel disease using omics-based approaches (Mukesh Kapoor)

q-RT-PCR studies suggested suppression of pro-inflammatory cytokines (IL-1 $\beta$ , IL-1 $\alpha$ , NLRP3, and TNF- $\alpha$ ) and improved levels of MUC-2 in colonic tissues after GG- $\beta$ -MOS administration. GG- $\beta$ -MOS (up to 28-fold) and positive control (up to 14-fold) groups showed significant (p <0.05-0.01) reduction in the expression of IL-1 $\beta$ , IL-1 $\alpha$ , NLRP3 and TNF- $\alpha$ 



Gut bacteria modulation at genus level during *in vitro* fermentation of millet and black rice with human fecal samples



which were up-regulated by DSS (2.7 to 28-fold p<0.05-0.01). Upon DSS challenge, the MUC-2 gene was found down-regulated (up to 1.58fold). However, the expression of MUC2 was found to increase, although not significant, in the presence of GG-β-MOS/FOS. LEfSe analysis revealed the presence of different genera among the various groups. Clostridium. Pseudomonas, Olsenella, Desulvibrio, Bacillus. Lachnoclostridium. Bifidobacterium. Stenotrophomonas, Fastdiosipila, Staphylococcus, Aeromonas, Paenibacillus and Chlamydia had notably high abundance in GGβ-MOS groups, while presence of DSS increased the abundance of Bacteroides, Alistipes, Tannerella, Odoribacter, Clostridioides, Oscillibacter, Anaerostipes, Blattabacterium, Flavonifractor, and Flavobacterium. Lactobacillus. Blautia, Akkermansia, Streptococcus, Eggerthella, and Acinetobacter were found enriched in the FOS group. In order to decipher the molecular determinants behind the utilization of GG-β-MOS RNA-seg analysis is going to be performed in microflora members found enriched in the metagenomics analysis. Herein, Akkermansia muciniphila DSM 22959. Limosilactobacillus fermentum NCIM 2165, Limosilactobacillus reuteri DSM 20053 are being passaged in appropriate growth medium supplemented with GG-β-MOS. KEGG enrichment analysis highlighted that GG-\u03b3-MOS/ FOS supplementation up-regulated important pathways involved in the metabolism of carbohydrates viz., carbon metabolism, TCA cycle, glycolysis/gluconeogenesis, pyruvate metabolism, and pentose phosphate pathway. biosynthesis of amino acids and metabolism of tryptophan, tyrosine, phenylalanine, lysine, leucine, valine, isoleucine. The alteration of host metabolites in control and GG-β-MOS

supplemented groups was analysed by GC-MS based untargeted metabolomics and the results are being analysed using MetaboAnalyst software. Taken together, dietary GG-β-MOS by selectively favouring desirable gut microbiota and restoring production of postfermentation metabolites, promoted mucosal repair and regulated aberrant immune responses in DSS-induced colitis mice. The utilisation pattern of GG-B-MOS and monosaccharides (Glc, Gal, and Man) by Limosilactobacillus fermentum NCIM 2165 and Limosilactobacillus reuteri DSM 20053 from the growth medium was studied using TLC. Glc and Gal were most rapidly utilised and was not found in the fermentation media after 24 h of growth. Man remained un-utilised till the end of the fermentation period (72 h) in L. reuteri. However, Man was completely utilized by L. fermentum. DP2 GG-β-MOS and some amount of DP3 GG-β-MOS were found depleted after growth of L. fermentum NCIM 2165 for 72 h. Limosilactobacillus reuteri DSM 20053 did not utilize GG-β-MOS during the course of fermentation. Growth curve analysis of L. fermentum NCIM 2165 and L. reuteri DSM 20053 on GG-β-MOS, control sugars (Glc, Gal and Man), and carbon-free minimal media (MM), wherein L. fermentum showed preferential utilization and rapid growth on GGβ-MOS while, L. reuteri showed lack of growth on GG-β-MOS. L. fermentum registered up to 3.2 higher log CFU/ml in the presence of GG-β-MOS when compared to carbon-free medium and other control sugars (Glc, Gal, Man). A slight decrease in the pH of fermented media towards the acidic side after GG-β-MOS fermentation was also observed. L. fermentum NCIM 2165 was passaged five times in synthetic defined MRS medium (SDM)



containing different carbon sources (glucose, mannose, and galactose) and GG-β-MOS, as the sole carbohydrate source and submitted for whole genome expression profile analysis.

## Targeting gut health using under utilized berries/pseudoberries as source of prebiotics and nutraceuticals (Praveena Bhatt)

In in vitro experiments, extracts of berries namely, Syzygium cumini (ScHWE, ScLJ), and Rubus niveus (RuE), were evaluated for their functional and beneficial attributes, especially with respect to their gut modulatory potential. The extracts were tested for their ability to increase the adhesion of probiotic bacteria namely Lacticaseibacillus rhamnosus, Lactiplantibacillus plantarum, Bifidobacterium breve and B. adolescentis, to CaCo2 monolayer cells. Results indicated that berry supplementation to bacteria could significantly enhance their adhesion potential by 1.5 to 5fold, in comparison to experimental control. In a microbiota challenge assay, berry extracts were found to selectively increase probiotic colonization to mucin while significantly decreasing that of selected foodborne pathogens. ScHWE and RuE were also found to be effective in significantly reducing cellular oxidative stress (38-49%) by inhibiting total ROS. In gastrointestinal simulation experiments, results indicated that the antioxidant activity to the extracts was appreciably retained during gastrointestinal transit with enhancement in bioabsorption. In a novel attempt, an in vitro artificial gut dysbiotic model was created to study the microbiota modulatory potential of the extracts. Most notably, in vitro fermentation with berry supplementation in the dysbiotic state, indicated recovery in the balance of Firmicutes to Bacteroides ratio equivalent to positive control, with a substantial increase in beta diversity. Interestingly, highly significant increase was observed in bacterial species that produce high amounts of butyrate namely Megashaera elsdinii, Faecalibacterium prausnitzii followed by Eubacterium rectale. which are also reported for their antiinflammatory and immunomodulatory potential. There was also a clear increase in the relative abundance of bifidobacterial species (esp B. adolescentis and B. angulatum) and Lactobacillus sp. (esp L. casei and L. gallinarum) in the supplemented samples. A substantial decrease in pathogenic species of Clostridium, Dialister and Collinsella, organisms reported to be present in high numbers in patients suffering from inflammatory bowel disorder, was also observed. Functional pathway analysis using the metagenomics data, clearly indicated, a significant upregulation of enzymes related to polyphenol catabolism particularly those involved in the conversion of glycosides to aglycones. Metabolomic analysis of fermenta indicated significant increase in organic acids (SCFAs) and also presence of bioactive metabolite, urolithin. Results thus indicated, the potential of the extracts for their application as functional ingredients in improving human gut health. Further, pre-clinical studies using animal models and development of functional products is in progress.

## Regulatory genes involved in pungency in Capsicum sp. (Giridhar P)

Primers were designed for CaMYB31, ERF, JERF and housekeeping genes (Actin and alpha tubulin). PCR conditions were optimised



for the same and recorded for expression studies in the placental tissue of the *C. annuum* Meghana variety. The gene-specific sequences spanning 200bp were selected to design the dsRNA dsRNAiCaMYB31 construct. Generation of dsRNAiCaERF pUC18 construct: The gene ERF from *Capsicum*. The 250-bp gene-specific sequences were selected to design the dsRNAdsRNAiCaERFc construct. Generation of dsRNAiCaERFc construct. Generation of dsRNAiCaJERF pUC18 construct. The gene RT-PCR studies for the expression of TFs CaMYB31, ERF, and JERF in placental callus cultures grown under different conditions are in progress.

## Xanthosine metabolism and its effect on caffeine biosynthesis in coffee plants (Giridhar P)

Coffee tissue cultures are vital for gene transfer studies, hence, the establishment of callus cultures are underway. Optimized the conditions for the RNA extraction from robusta coffee leaves and cDNA was prepared. As a prelude to the differential expression studies on xanthosine pathway genes, primers were designed for the two chosen genes, GSDA and NSH1. PCR conditions optimization for these genes is being undertaken.

### Micropropagation of GI-tagged banana varieties (Sreedhar RV)

Authentic planting material of Nanjanagudu Rasabale (NR) and Kamalapur Red (KR) bananas were collected from their native sources (Nanjanagud and Kamalapur, Gulbarga) and have been maintained at the

institute. In vitro cultures of NR banana which can serve as source for need based commercial multiplication have been established and maintained. To develop DNA barcoding, protocols for extraction of DNA from various parts like leaf, fruit peel and fruit stalk have been standardized. Using universal rbcL and matK primers, the genes were successfully amplified and sequence confirmed in NR and KR. Sensory evaluation using e-nose showed significant variation in flavour profile among fruits from different sources. Odour map based on PCA showed significant discrimination. Taste profile analysis using e-tongue also revealed differences. Further work on DNA barcoding and metabolic fingerprinting is in progress.

## Ayurvedic anti-cancer formulation (Phyllanthus niruri, Tinospora cordifolia and Boerhaavia diffusa) for liver cancer management (Sandeep N Mudliar)

A cleaner and greener processing approach using supercritical extraction and FO membrane based concentration was developed for foodgrade ayurvedic formulation. The total polyphenol, total flavonoid and antioxidant content of the ayurvedic formulation was determined in comparison with conventional extraction methods. HPLC profiling of the phytoconstituent of ayurvedic anti-cancer formulation is currently underway. The ideal dose of ayurvedic anti-cancer formulation was determined *in vitro* by MTT assay. Further experiments to study the anti-cancer potential of ayurvedic anti-cancer formulation is being studied in HepG2 cells.



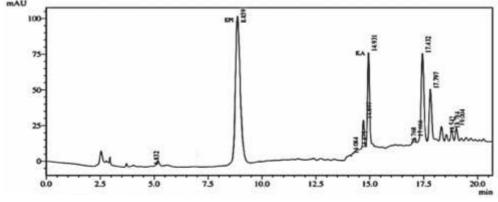
#### **FOOD PROTECTION AND SAFETY**

## Authentication of honey by analysis of specific phenolics and oligosaccharide markers (*Prasanna Vasu*)

Around 50 genuine honey samples of different geographical origin were procured from authentic stores/museum. The total phenolic contents (586 – 16003 µg/g) and total flavonoid contents (158 - 892 µg/q) were assessed in these honeys, and found marked differences in their quantities. The phenolics were analysed using HPLC in these honeys, and the profiling indicated that the majority of Indian honey contained gallic acid, ferulic acid and pcoumaric acid, followed by chlorogenic acid, protocatachuic acid, and in few, 2hydroxycinnamic, kaempferol, quercetin, epicatechin, chrysin, catechin and transcinnamic acid. As exemplified, karanj honey contained high amount of gallic acid, wild honey contained gallic acid and chlorogenic acid, litchi honey contained gallic acid and chrysin, ajwain honey contained epicatechin and chlorogenic acid, jambal honey contained vanillic acid, multifloral honey contained gallic acid and trans cinnamic acid. Sidr honey contained catechin and gallic acid, and so on. Syringic acid and myricetin were not observed in any of the Indian honey samples. Gallic acid, chlorogenic acid and catechins were found in majority of the honey tested, which can be considered as the floral markers for Indian honeys. Additionally, major and minor phenolics provides a good marker for authenticating botanical and geographical origin of honey.

## Microsomal epoxide hydrolases through multiscale modeling to understand lipid signaling and metabolism (Usharani D)

EH2 contains a phosphatase and an epoxide hydrolase (EH) domain. EH isoforms EH1, EH2, and EH3 have structural variations. EH1 and EH3 have an ordered helical structure in the NC loop and a helix at the N-terminus potentially linked to the transmembrane region. EH2 has a distinct pattern with more hydrophobic residues. These structural differences affect the formation of tunnels within the enzyme, affecting substrate transportation to the active site. EH2 has several prominent tunnels, while EH1 and EH3 display alterations in tunnel sizes and



A representative HPLC profile of phenolics in multi all India honey

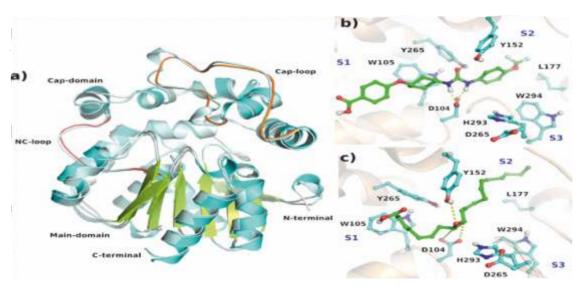


configurations. The Tback3 tunnel in EH1 and EH3 significantly facilitates substrate/inhibitor access to the enzyme's active site. The structural flexibility and distinct loop configurations among EH isoforms offer insights into the functional diversity of epoxide hydrolases across bacterial and mammalian species. Molecular docking techniques was used to study the impact of variable loops on substrate and inhibitor specificity within EH isoforms. The analysis focused on EH2 and revealed that a second-generation urea inhibitor binds stably to the enzyme, forming hydrogen bonds with key catalytic residues and showing distinct binding preferences within sub-pockets S1, S2, and S3. It was also observed that specific sub-pockets play a crucial role in substrate stabilization. While more studies are needed to understand the binding preferences of various epoxide isomers, the analysis shows the importance of sub-pocket interactions in substrate recognition and stabilization within EH2. EH1 prefers xenobiotic substrates, while weaker binding was observed for endogenous

substrates. Similarly, EH3 exhibited weak binding for specific substrates, indicating a shared trend among EH isoforms in their affinity for particular ligands. These findings emphasize the importance of understanding their substrate-binding preferences for potential therapeutic applications.

## Validation of published test methods of vitamins identified food matrices for revision of Indian Standards (Usharani D)

The multi laboratory validation of vitamin B12 has been initiated in the institute. The fortified atta with vitamin premix of 10 kg sample was prepared and 5 kg sample was sent to a food industry for vitamin B9 analysis. The homogeneity and stability studies of vitamin B9 and B12 suggest B9 is homogenous. Single laboratory validation (SLV) of vitamin B12 using the AOAC 2014.02 method and vitamin B5 IS 16642: 2018/ ISO 20639: 2015 encompass a rigorous process ensuring the accuracy, precision, specificity, linearity, and robustness



(a) A superimposition of EH2 X-ray crystal structure and most populated conformer of MD run. (b) The key residues lining the active site of EH2 along with its interaction of urea inhibitor (c) 9(10)-EpoME leukotoxin substrate binding towards EH2.



of the analytical procedure. Through meticulous validation studies, the method's accuracy was confirmed by comparing results with reference materials, while precision was evaluated through repeatability and intermediate precision assessments. Specificity was established to ensure the method's ability to exclusively measure vitamin B12 without interference from other compounds in the sample matrix. Linearity across a range of concentrations was demonstrated, and the method's robustness was evaluated under various experimental conditions. In the context of analysing cereals, milk powder matrices and premixes, the determination of standard deviation (SD), coefficient of variation (CVr), recovery (R), and recovery percentage (r%) plays a pivotal role for acceptance of method and to provide clue for limit of quantification of analysis.

### Analytical quality control and quality assurance in rice fortification (Giridhar P)

Standardization of process parameters (namely, type of iodine, strength of iodine, volume of iodine, amount of fortified rice, and time for observation) for testing the blending efficiency of both raw and parboiled fortified rice was undertaken. Enlisting developed method in the FSSAI standards for testing the blending efficiency of fortified rice was initially tested and also optimized the concentration of pivodine solution to identify the fortified kernel in the fortified rice. Screening of blending efficiency of fortified rice in representative samples from different States in India was carried out and blending to varying levels of blending efficiency was assessed. LC-MS/MS evaluation of premixes to ensure the purity and quantity of B9

and B12 was also carried out. Establishing a protocol for fine-tuning the rice matrix material and altered isocratic conditions for analysis of vitamin B9 and B12 through LC-MS/MS was completed.FRK and fortified rice evaluation of iron content with optimization of sampling, digestion, and analysis in ICP-AES were completed and participated in proficiency testing. FRK evaluation for the content of B9 in 8 zones of India was done by optimizing extraction and analysis by HPLC to ensure that the amount was 16.2 to 25.7 mg/kg, higher than the expected concentration of fortified rice samples. A short-term training program was conducted on analytical quality evaluation of fortified rice. The course included fundamentals of fortified rice, HPLC, mass spectrometry, sample preparation and extraction. Further data acquisition, analysis, interpretation and maintenance of mass spectrometry were covered to ensure a skill set in troubleshooting and measuring values of vitamins in rice fortification.

### Capacity building of food testing laboratories -training programs (Jayadeep A)

The objective was to conduct training programs at State food testing labs, impart knowledge on food analytical techniques for various parameters, and give hands-on exposure to high-end analytical equipment. A total of 6 separate trainings on various topics such as microbial tests in food samples; GC and GC-MS based analysis of oils and fats, heavy metals and minerals analysis, vitamin profiling by HPLC/LC-MS, instrumental analysis in additives and toxins and pesticide analysis in various food matrices were conducted.

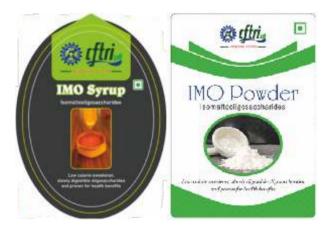


#### **CSIR PROJECTS**

## Fast Track Translational / Fast Track Commercialization Projects

### Value-added products using transglycosylating α-glucosidase (tAG) (Sarma MVRK)

The production of two variants of isomaltooligosaccharides (IMO), viz., IMO1 and IMO2 is carried through series of steps using tAG. IMO1 is obtained as a syrup, comprising of glucose, panose, isomaltose, maltotriose and other higher DP oligosaccharides. Whereas, the IMO2 variant is a powder and it contains panose, isomaltose, maltotriose and higher DP oligosaccharides. Additionally, the tAG enzyme mix was used at different levels of 2, 4 and 6 mg per 100 g of dough based on the α-glucosidase activity and the baking trials. The enzyme mix along with sugar significantly increased the volume of bread and decreased bread weight and hardness. The enzyme mix primarily being starch acting, the enzyme action of all the starch-based flours will get affected, and hence



IMO variants (A) IMO1 syrup, (B) IMO2 powder produced at pilot scale using tAG

the preparations of bread, bun, pizza base, naan (flatted Indian bread prepared in oven), and chapathi (flattened Indian bread prepared on heating pan) are additional extended applications of this enzyme mix where it endsup with free glucose in the preparations. IMO1 and IMO2 were used in the confectionary preparation such as cookies. Here the sugar which is 30% sucrose was replaced by 14.2% of IMO1 in weight basis.

## Functional oleogel based bakery products (*PrabhasankarP*)

Oleogels are structured fat system with a thermoreversible network of gelators which entrap the oil. The use of PUFA rich multisource oil has been proven to have several positive impacts on the human health. These oleogels can also be used as a carrier of certain bio-active molecules enhancing the functionality of the oleogels. Laminated baked productkhari was prepared by replacing 25% and 40% of the commercial shortening by oleogel and was analyzed for moisture and ash content, FTIR spectroscopy, water activity, texture analysis and scanning electron microscopy. The lower amount of FFA and peroxide value in the blended oil indicates that it is less prone to primary oxidation and in turn less susceptible to becoming rancid. The oleogel prepared with 8% and 10% gelator concentration with 2:6 and 2:8 ratio of beeswax and distilled monoglyceride (DMG) was found suitable to be used as a partial replacer of commercial shortening. The morphology of the



gelators can be seen as needle-like crystals and aggregates. The DMG is visible as a network of spherulite rosette-like structure. Storage modulus (G') was greater than loss modulus (G") with the dominance of elastic over viscous nature of oleogels which increased with increase in the gelator concentration. The oil blending capacity values were greater than 95% in all the combinations. The moisture content of all the products were around 5% and the ash percentage was between 1.4 to 1.6%. The vertical cross-sections of the khari showed how the layers were formed due to baking which appears to be suppressed with oleogel substitution. Texture analysis of khari showed reduced firmness (149 N.s, 40% replacement) than control (221.46 N.s) due to suppressed flaky layers from oleogel substitution. However, the GCMS results showed that the oleogels are much higher in PUFA (21.5-25%) than commercial shortening (8.64%).



Individual oils, blended oil and oleogels



Laminated baked product prepared with (a) commercial shortening; (b) 40% replacement of commercial shortening by the oleogel 2:6 and (c) 40% replacement of commercial shortening by the oleogel 2:8.

#### **Mission Projects**

Advancing Technological Leads for Assuring Safety of Food (ATLAS)

Edible and biodegradable materials for electrostatic coating to fruits and vegetables for enhanced shelf-life (Matche RS)

Fruits and vegetables are perishable commodities, and their tissues remain alive after harvest. Post-harvest losses for fruits and vegetables are mostly found all over the world. Living tissues respire and this has consequences in maintaining the quality and shelf-life of the produce. Edible coating on fruits and vegetables retards the respiration rate significantly and aids in extending the shelf-life of the produce. The work carried out is a step towards reducing the food wastage of perishable food commodities with enhanced efficiency and effectiveness of edible coatings. The coating material applied over the food commodity must be edible in nature such as shellac, antimicrobials, antioxidants, polysaccharides and protein-based coating materials. Electrostatic coating methods with uniform coating and lesser amount of coating material were used. The edible cellulose and alginate based coating materials were developed for electrostatic coating of fruits and vegetables. The safety study of sodium alginate and methyl cellulose reveals that it is relatively non-toxic to OECD-approved aquatic and terrestrial non-target species. The findings suggest that after being exposed to sodium alginate and methyl cellulose, species in a simplified aquatic food chain had no harmful effects on growth rate, survival and development endpoints. The effectiveness of the developed coating material was determined



by the comparative study with the commercial coating materials. Two commercial coating materials (wax and shellac) were selected for validation with an electrostatic coating based on their efficiency and market value. Tomato showed a shelf-life of 31 days with signs of spoilage and control tomatoes coated with VMW -50 (wax commercial coating material) deteriorated within 15 days. The orange fruit coated with shellac (electrostatic) showed lesser material consumption with 24-25 days of shelf-life with higher uniformity, adhesiveness and glossiness compared to dipping techniques. In comparison with wax and shellac commercial coating materials, the institute developed alginate and cellulose-based coating material showed higher efficiency and shelf-life enhancement (39-40 days) for both the oranges and tomatoes. The developed technologies are applicable in fruits, vegetables, agriculture and packaging industries.



Control, dip, and electrostatic coated oranges (storage condition @ 25-27°C;65%±2 RH)

### Estimation of carboxymethyl lysine in Indian foods (Nandini CD)

Carboxymethyl lysine (CML), one of the Advanced Glycation Endproducts (AGEs) formed as a result of processing was determined in various traditional Indian food products by LC-MS/MS. After standardising the protocol and adapting it to estimate the CML formed in traditional Indian foods, known samples were sent for analysis in three different laboratories. Methodology with instructions were shared. Results obtained were similar to those obtained by us, indicating that the protocol is adaptable for estimating CML in Indian foods.

### Protective role of chitin against biofumigant in stored product insect-pests (Ezil Vendan S)

In order to understand the chitin properties of stored-product insect pests and their association with the fumigant toxicity, chitin was isolated from the Callosobruchus maculatus, Sitophilus oryzae, and Tribolium castaneum adults and analysed with fumigant toxic effect of garlic essential oil. Chitin isolates were characterized using FT-IR, XRD, EA, SEM-EDS, and NMR techniques. Fumigant toxicity assay was performed under airtight condition in glass vial. The S. oryzae contains highest chitin content (19%), followed by *T. castaneum* (10%) and C. maculatus (8%). The degree of crystallinity was lower in *C. maculatus* (67.13%) than in S. oryzae (77.05%) and T. castaneum (76.56%). Morphologically, C. maculatus chitin displayed a flat lamellar surface with pores, while S. oryzae and T. castaneum exhibited densely arranged microfibrils based surfaces. Fumigant toxicity assays revealed varied susceptibility levels, C. maculatus exhibited higher susceptibility (0.27 µL/L air of LC50)



compared to *S. oryzae* and *T. castaneum* (14.35 and 3.74 µL/L air of LC50, respectively) to garlic essential oil. The higher chitin content, greater crystallinity, and densely arranged structures in *S. oryzae* might contribute to its tolerance towards fumigant. Additionally, physicochemical properties and penetration potentiality of the bioactive constituents might be linked to the toxicity in insects. Understanding these relations can enrich knowledge of chitin's role in fumigant toxicity mechanism.

## Integrated approaches for bioactives and value addition for floral resources under `CSIR Floriculture Mission'

## Pulsing solution for extension of the vase life of flowers viz Gerbera, Carnation, etc., (Matche RS)

Fresh-cut flowers are perishable and have a limited shelf life. There are two methods (wet and dry storage) mostly used to store cut flowers. A pulsing solution for wet packaging was developed to extend the vase life of flowers. The gerbera cv. Gerbera hybrida has a shelf-life of 3.5-4.5 days at a storage condition of 25-30°C and with controlled treatment and with the use of developed pulsing solution, the shelf-life increased by 8-9 days. The shelf-life of chrysanthemum cv. Pompom increased from 3.5-4 days to 7-8 days. The active ingredients were identified and the cost-effective pulsing solution was developed for gerbera and chrysanthemum flowers. Proof of concept studies to validate it in the lab environment was also carried out.

## Isolation of globosa and marigold floral volatiles, pigments and spent utilization for value added products (Bettadaiah BK)

Isolation of pigments from *Gomphrena globose* involves separation of the pigmented floral components from the bract and bracteoles. After separation, the flowers were spread out into perforated trays and dried. Dried flowers were subjected into multi-mill to separate the flower from the heads. Using various sieve sizes, the fibrous part, husk and pigmented part of these materials were separated using process machinery. Using a hammer multi-mill, the collected pink colour material was made into powder and processed for extraction.

Marigold oleoresin (MO) has been extracted using solvent extraction from three varieties of marigolds viz. *Tagetes erecta* deep orange, *Tagetes erecta* intense yellow, and *Tagetes patula* red-yellow mix. Bioactives incorporated films from these oleoresins using polylactic acid/ poly butylene adipate-co-terephthalate (PLA/PBAT) and polylactic acid (PLA) polymers were prepared. The effect of oleoresinincorporated films on the physical, mechanical, optical, antioxidant and biodegradability were studied.



Dried, milled and segregated globosa flower



## Ultrasound assisted extraction of anthocyanin from Blue pea and Hibiscus flower (Rastogi NK)

The optimization of anthocyanin extraction from Blue pea (Clitoria ternatea) and Hibiscus (Hibiscus rosa-sinensis) flowers involved experimenting with different solvent pH and extraction times. pH 6.0 for 3 h and pH 4.6 for 4 h were identified as optimal conditions for Blue pea and Hibiscus flowers, respectively. Various extraction techniques, including maceration, homogenization and ultrasound-assisted extraction (UAE), were then explored to enhance extraction yield. Ultrasound treatment. with parameters like amplitude and time was optimized. It was found to result in significant increase in anthocyanin content in both flowers compared to conventional methods. Among extraction techniques, UAE yielded the highest total anthocyanin content (TAC), total phenolic content (TPC) and antioxidant activity. Overall, ultrasound-assisted extraction proved effective in enhancing anthocyanin extraction. Integration of concentrated anthocyanin into dairy products like yogurt, ice cream and milk was studied, with analyses conducted up to 25 days. While anthocyanin content decreased over storage time, supplemented samples but maintained higher TPC and antioxidant activity compared to control. Based on sensory score, 1% concentration has the highest overall acceptability for all the products.

To enhance the extraction of anthocyanin colorant from Blue pea and Hibiscus flowers with ultrasound-assisted method, d ifferent extraction parameters such as ultrasonication amplitude (30-100%) and treatment time (up to 10 min) were optimized. The experiments were carried out at an ultrasonication pulse cycle of

1/1 second. The extracts were evaluated for total anthocyanin, phenolic content and antioxidant activity. Among all the combinations of treatments employed, Blue pea flower extract at 90% amplitude for 6 mins and Hibiscus extract at 90% amplitude for 1 min showed the highest total anthocyanin content. The ultrasound treatment resulted in more than ~90% increase for Blue pea (193.37 mg/100 g) and ~70% increase for hibiscus (1011.11 mg/100 g) flower in the total anthocyanin content compared to the conventional method. At the same time, ultrasound treatment resulted in higher antioxidant activity and total phenolic content. Also, it resulted in a lower negative b\* value (-2.78) for Blue pea flower extract indicating a darker blue color, and a lower positive a\* value (+1.41) for Hibiscus flower extract indicating a darker red color. Thus, ultrasound-assisted extraction can be used for the enhancement of extraction of bioactive compounds from the flowers.

### Novel effective bioformulation against stored grain and vegetable pest (Giridhar P)

A botanical insecticide has been formulated by incorporating bioactives and other ingredients. In the insecticide formulation, IGEPAL CO-720 was used as emulsifier, hydroquinone and epichlorohydrin were used as stabilizers, isopropyl alcohol was used as solubilizer and water was used as diluent. In order to enhance the insecticidal activity of botanical formulation, the identified bioactive molecules such as terpinolene, piperine, ocimene and gallic acid were mixed with pyrethrin extract for the synergistic potential of residual toxicity with knockdown effects against insect pests. As a result of residual toxicity bioassay, 0.03 and 0.09  $\mu$ l/cm2 of LC  $_{50}$  values were obtained for the



synergistic combination of bioactive molecules against the pulse beetle *C. maculatus* and grain beetle *S. oryzae* adults, respectively. The formulated botanical insecticide has been evaluated as prophylactic spray to prevent *C. maculatus* and *S. oryzae* infestations on stored food commodities. Within 3 h of exposure, 100% significant knockdown was observed.

## Identification of potential locations across India for seaweed cultivation and their valorization

## Cultivation and efficient utilisation of edible seaweeds for value addition, functional food (Chauhan VS)

The study focused on the preparation of pasta incorporating seaweed Gavralia brasiliensis powder at varying levels (0%, 2%, 4%, and 6%). In order to study the effect of fermentation, the seaweed-incorporated dough was partially fermented using Saccharomyces cerevisiae for 15-16 h. The cooking quality of the seaweedincorporated pasta was determined by checking the optimal cooking time, cooking loss, cooking yield and water absorption. The seaweedincorporated pasta prepared with fermented and unfermented dough were comparable in their appearance. The optimal cooking time was reduced with increasing amount of seaweed powder. The water absorption capacity and cooking yield were higher in the pasta prepared from unfermented dough. The seaweedincorporated fermented dough pasta showed a higher total phenolic content and total flavonoid content compared to the seaweed-incorporated unfermented dough pasta. Fermented dough pasta's chlorophyll and carotenoid content were comparatively higher than unfermented dough pasta. The cooked seaweed-incorporated pasta was subjected to sensory analysis. Based on the scores for taste/flavour and overall acceptability, 4% seaweed powder incorporated in fermented dough pasta was found to be acceptable.

### Phenome India: CSIR health cohort knowledgebase (*Prakash M Halami*)

Phenome India - CSIR Health Cohort Knowledgebase (PI-CHeCK) is a multiinstitutional project that aimed to study the health status of CSIR employees. A six-day comprehensive free health camp was conducted. With an increasing lifespan of an average individual, India, along with the global population, is seeing an increased prevalence of cardiometabolic disorders such as diabetes. obesity, fatty liver, etc. These diseases are likely to impact an individual's quality of life and healthy aging. PI-CHeCK study was conceived to develop personalized risk prediction scores for such cardiometabolic diseases, especially in the Indian population leveraging the costrength of CSIR's Pan-India presence and its large family of employees and pensioners.

PI-CHeCK is a one-of-a-kind study that aims at capturing longitudinal molecular, biochemical, and organ scanning data and integrating it with cutting-edge AI/ML models to enable the development of diagnostic and prognostic technologies, thus paving the path for precision medicine in India and perhaps globally. Pl-CHeCK is a long-term cohort study initiated by CSIR. It is an attempt to represent the diversified Indian population through all its labs spread throughout the country. The study will, therefore, encompass population and genetic diversity throughout the length and breadth of the nation. 309 Participants actively participated in the camp and 207 stool samples were collected for microbiome studies.



Millet sustaining health through research and innovation by analysis of nutrients and nutraceuticals to achieve global awareness (SHRI ANNA) (Sridevi Annapurna Singh/Meera MS)

Millets, known for their climate resilience and ability to thrive in arid conditions with minimal water and carbon footprint due to the C4 photosynthetic pathway, are also referred to as 'Shree Anna,' meaning the best among all food grains. Optimal processing of millets can help address malnutrition and prevent lifestyle disorders. Therefore, the CSIR Millet "SHRI ANNA" mission aims to promote the nutritional value of millets, develop innovative millet-based food products, enhance their shelf-life, and optimize processing methods to make millets and their products more accessible and beneficial to consumers. This initiative is undertaken in four work packages.

Nutritional profiling of 100 varieties of millets: A comprehensive study was conducted on 119 millet varieties, analyzing parameters such as proximate composition, in vitro protein and starch digestibility, mineral bioaccessibility, vitamins, fatty acid profile, amino acid profile, and available lysine. Antinutrients like phytic acid, oxalates, trypsin inhibitors, and c-glycosylflavones were also profiled. Surveys involving 2000 households across several States revealed varying levels of millet consumption, with Andhra Pradesh exhibiting

the highest range at 63-80%. Interestingly, Kerala and Tamil Nadu showed only 50% household consumption, predominantly of finger millet. Additionally, 18 dishes from the Western Himalayan regions were identified and mapped for nutritional analysis. Shelf-stable products like Millet Panjeeri, Millet Siddu, and Millet Nuggets were developed, with ongoing efforts to create a multipurpose multigrain millet-based premix to address malnutrition.

Promotion of region specific millet products: In the ongoing development of antistress beverages, Pearl Millet, Finger Millet, Kodo Millet, and Brown Top Millet were selected, with Kodo millet exhibiting the highest antioxidant activity. Antioxidant activity, ash, moisture, total phenolics, minerals, indolamines, and serotonin were measured. Evaluation is underway for beverages made from sprouted millets, including Pearl Millet, Sorghum, and Finger Millet, infused with spice nutraceutical extracts from ginger and turmeric.

Efforts are focused on optimizing millet milk extraction for multi-millet formulations and characterizing exosomes from industrial food waste like orange and beetroot peels to enhance milk with protein and minerals.

The process of semolina milling from husked grains of foxtail millet has been optimized. Grains underwent pre-treatment to modify the physical properties of various grain components. A two-break system, along with the pan sifter







Beverages made from sprouted millets and instant millet noodles



and purifiers, was employed using a modified flowsheet for semolina production. The optimization of pre-treatment and the semolina process is currently in progress.

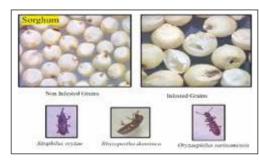
The process parameters, including moisture content and pre-processing parameters such as time and temperature, were optimized for little, proso, and barnyard millets, enabling the preparation of instant noodles with a cooking time of 6-7 minutes with minimal leaching. Furthermore, it was observed that pre-processing and the addition of hydrocolloids improved the dough characteristics.

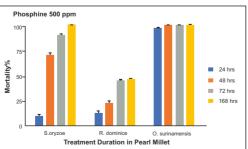
The total fat content and fatty acid profiling of millets such as Pearl millet, Jowar, Proso millet, Kodo millet, Foxtail millet, Finger millet, Barnyard millet, Brown top millet, and Little millet were studied. The fatty acid composition of the millets showed significantly higher levels of linoleic acid (C18:2), followed by oleic acid (C18:1), and palmitic acid (C16:0). The fatty

acid composition of millet bran oil is similar to that of rice bran oil.

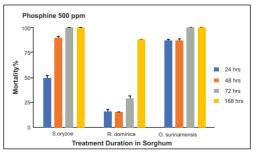
Additionally, exploration of by-product utilization, such as foxtail millet husk for pulp preparation and identification of a non-wetted biodegradable oil and water repellent emulsion, has shown promising potential. Finger millet flour has emerged as a candidate for edible cutlery development, while other millet husks demonstrate capability for producing biodegradable cutlery.

Shelf-life enhancement of the millet's products: Combatting pest infestations in stored grains has been a key focus, with ongoing efforts in optimizing fumigation and studying insect populations to devise holistic pest management solutions. Laboratory and field testing involve evaluating different doses of prepared compounds for *T. castaneum and S. cerealella* pheromones, along with testing traps and lures against these pests.







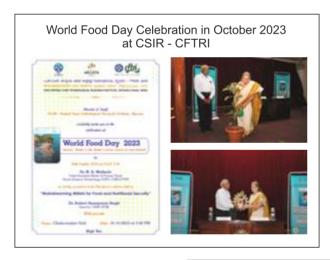


- (a) Distribution of insect infestation in sorghum and pearl millet (b) Optimisation of fumigation process
- (c) Effect of phosphine fumigation on stored grain insect pests in sorghum and pearl millet



Additionally, the mission is acquiring image and spectral data of millet varieties and developing mathematical models for storage chambers to enhance preservation techniques. The application potential of UV/ultrasound as a pretreatment for extending the shelf-life of millets revealed low peroxide values (PV) and free fatty acid (FFA) values in treated samples, attributed to UV treatment. Microbiological analysis indicated the safety of samples for up to 30 days.

Global awareness of health and nutritional attributes of millets: Various initiatives were undertaken to raise global awareness of the health benefits of millets. These included the inauguration of calendars, showcasing millet technologies, hosting dedicated panel discussions, and participating in the 9th IFCoN conference with a special focus on millets. Additionally, the All India Radio program on CFTRI Siri Dhanya furthered awareness about millets' health benefits. Furthermore, competitions involving millets were organized in government schools and colleges on Nutrition Day, facilitating consumer outreach and education.









## Bioconversion of edible oilseed byproducts into value added products (*Jyothi Lakshmi A*)

Groundnut is the fourth largest oilseed in the world and the meal contains around 50-60% proteins and is mostly used as feed or fuel. Freshly processed commercial oilseed cakes were procured from local oil mills and were characterized. The residual oil was extracted from oil cake received from the ghani industry. The oil content was approximately 9%, and the levels of free fatty acids (approximately 2.1%) and peroxide value (approximately 2.2%) were within FSSAI limits. The residual oil content of the expeller pressed cakes was 7% and free fatty acids was less than 1%. However, unexpectedly, the peroxide value was significantly high, around 35-40%. This higher value might be due to high friction followed by increased temperatures during the extraction process, which may contribute to the generation of high peroxide values. The extraction temperature and the expeller material will influence the product quality. The industrial sample data highlights the lack of a standardized process for oil extraction and producing quality oil cake for value addition.

Protein concentrates were prepared from ghani and expeller pressed groundnut seed oilcakes under optimised conditions used for reference samples. The yield of protein concentrates from commercial cakes ranged from 76-82% which were comparatively lower by 3-8.5% than the reference samples which probably depend on the quality of the groundnuts used. The protein content of carbohydrate rich flours i.e. the fraction left after protein extraction which ranged between 10-12%. Further characterisation of the protein concentrates and carbohydrate rich flours are under progress.

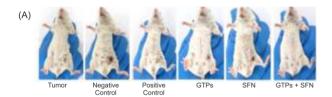
#### **CSIR First Projects**

Investigating the homeostasis of the gut microbiome and its impact on the epigenetic regulation of breast cancer (Syed Musthapa M)

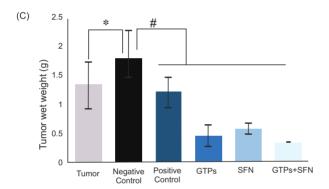
The gut microbiome significantly influences breast cancer by impacting host physiology, metabolism, and epigenetic modifications. Energy metabolites from the gut microbiome can modulate epigenetics, affecting cancer progression. Probiotics promote a healthy gut (eubiosis), while their absence leads to a dysbiotic state and epigenetic dysregulation, which are crucial in cancer development. Dietary bioactives like green tea polyphenols (GTPs) and sulforaphane (SFN) positively affect gut health and epigenetic regulation, potentially preventing breast cancer.GTPs and SFN have been found to promote beneficial gut microbiota and increase the production of short-chain fatty acids (SCFAs) and energy metabolites. Probiotics treated with GTPs and SFN notably inhibited the proliferation and metastasis of breast cancer cells. This suppression was mediated by the downregulation of epigenetic modifications and the activation of tumor suppressor genes. Additionally, dysbiosis led to increased tumor size, weight, and lung metastases, but these adverse effects were significantly mitigated by treatments with GTPs and SFN. The anti-cancer effects of GTPs and SFNs were linked to alterations in the gut microbial metabolic profile and epigenetic modifications, which in turn influenced oncogene and tumor suppressor gene expression, enhancing their anti-tumor effectiveness. Overall, the consumption of dietary DNA methyltransferase (DNMT) and histone deacetylase (HDAC) inhibitors significantly helps prevent breast



tumor incidence and metastasis. The inhibition of breast tumors is positively associated with the homeostasis of the gut microbiome.







GTPs and SFN modulate the gut homeostasis and inhibits the breast tumor growth

- A) Tumor bearing mice, B) Tumor size, and
- C) Tumor weight

Insight into the Quantitative Structural Activity Relationship (QSAR) of plant volatiles for development of biofumigants against stored product insect pests (Ezil Vendan S)

Plant essential oils and volatile phytochemicals are known as potential natural sources for developing biofumigants as an alternative to conventional fumigant pesticides. This present study was aimed to evaluate the fumigant toxic effect of five selected essential oils (cinnamon, garlic, lemon, orange, and peppermint) and phytochemicals (citronellol, limonene, linalool, piperitone, and terpineol) against the grain, pulse, and flour beetle adults. Furthermore, for the estimation of the relationship between molecular descriptors and fumigant toxicity of plant volatiles, quantitative structural activity relationship (QSAR) models were developed using principal component analysis and multiple linear regression. Amongst the tested essential oils, garlic was found as the most toxic fumigant. The phytochemical toxicity analysis revealed that terpineol, limonene, linalool, and piperitone as potential fumigants to Callosobruchus maculatus (< 20 µL/L air of LC<sub>50</sub>), limonene and piperitone as potential fumigants to Tribolium castaneum (14.35 and 154.11 µL/L air of LC<sub>50</sub>, respectively), and linalool and piperitone as potential fumigants to Sitophilus oryzae (192.27 and 69.10 µL/L air of LC<sub>50</sub>, respectively). QSAR analysis demonstrated the role of various molecular descriptors of essential oils and volatile phytochemicals on the fumigant toxicity in insect pest species. In specific, dipole and Randic index influence the toxicity in C. maculatus, molecular weight and maximal projection area influence the toxicity in S. oryzae, and boiling point and dreiding energy influence the toxicity in T. castaneum. The findings may provide insight of a new strategy to select effective essential oils and/or volatile phytochemicals against stored product insect pests.





Sridevi Annapurna Singh . . . . DIRECTOR Jayaprakashan SG

Kumar N

Director's Office Lokesh

Geetha S Mahesha I

Umashankar B Navin Kumar Rastogi

Venkatesh G Prakash N

Punil Kumar HN

**Department of Biochemistry** Puttaraju BV

Ravendra Pratap Singh (Head) Rajesh M

Anbarasu K Ramesh G

Asha Martin Roopa BS

Gnanesh Kumar BS Shesha Narayana K

Harish Prashanth KV Shivakumara M

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Chandrashekara N

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Keshava Murthy PS

Prabagaran P

Food Safety & Analytical Quality Control

Laboratory

Giridhar P (Head)

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Govindaraju K

Jinesh P

Mathen Mathew

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Shiva Sankar Reddy S

Sindhu R Nambiar

Umamaheshwari P

Usharani Dandamudi

Vanajakshi V

Vijaya Kumar BV

Fruit & Vegetable Technology

Pradeep Singh Negi (Head)

Gahire Anant Chintamani

Gomathy K

Revathy Baskaran

Vanitha T

Venkatesh K

Vijayalakshmi MR

Vithal Balavant Kudachikar

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Mohan Kumari HP

Mohd. Shakeb

Shruti Joshi

Somanna

Umesha BA

Usha Dharmaraj

**Microbiology & Fermentation Technology** 

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Mahejibin Khan

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Mukesh Kapoor

Neelakanteshwar Patil K

Praveena Bhatt Mudliar

Rajagopal K

Roopavathi C

Sarma MVRK



Nanishankar V Harohally Shiva R

Naveen J Somashekar D

Pooia JA Rao Swaroopa Rani D

Pushpa S Murthy Vinod Kumar N

Sachin Rama Chaudhari

Shivakumar L **Meat & Marine Science** Shivaswamy Suresh PV (Head) Venkatesha P Indira Dey Paul

Mohammad Ziaulla Y

**Plant Cell Biotechnology** 

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Shinde Vijay Sukdeo **Traditional Foods & Applied Nutrition** 

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Manjula TC Radha C

Ramakrishnan P Vikas Singh Chauhan (Head)

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Sudheer Kumar Yannam Nandini Prasad Shetty

**Construction & Civil Maintenance and** Sreedhar RV **Estate Management Unit** 

Thirumalesh BV Umesh Hebbar H (Head)

Gangadharappa GH (Coordinator) **Plantation Products, Spices & Flavour** 

Anand Kumar K **Technology** 

Borse BB (Head) Arulalan K Ganesha M Anil Kumar K Prashantha Bettadaiah BK Rakshith HA Hafeeza Khanum

Nagarajan S



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Keshava Prakash MN (Head)

Anbalagan K

Asha M

Bavani Eswaran M

Dhaneesh K Joseph GS

Lokesha C

Manjunatha JR

Padmere Mukund Laxman

Srirama R

Umapathi H

Vatcharavelu K

#### **Engineering & Mechanical Maintenance**

Umesh Hebbar H (Head)

Keshava Prakash MN (Coordinator)

Aravind C

Hemaraju R

Jayakumar B

Narasimha Murthy

Narayanan K

Naveen Kumar C

Putta Swamy

Somasundaran CC

Suresha H

Vijay Prasad Raju G

#### **Human Resource & Development**

Revathy Baskaran (Head)

**Co-ordinators** 

Bettadaiah BK (AcSIR / University)

Praveena Bhatt Mudliar (M.Sc. Food

Technology)

#### Raghunandanan MV (Short Term Courses)

Jeyarani T

Lakshmi K

#### **IT Services & Computational Solutions**

Sridevi Annapurna Singh (Head)

Suresh PSN (Coordinator)

Jyothi K

Manohar SRM

Sanjailal KP

Srividhya CS

Tejas P

#### Library

#### Padmavathi T (Coordinator)

Somashekar KS

Suneetha R Bhandarkar

#### Planning, Monitoring & Coordination

Sreerama YN (Head)

Anita CS

Chaya Devi R

Kumar B

Kusuma K

Raghunandanan MV

Seema Kumari

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**Development** 

Inamdar AA (Head)

Anilkumar Bellatti

Mamatha SS

Parigi Ramesh Kumar

Pattekhan HH

Raghavendra SV

Renuka S

Vijayalakshmi S



#### **Administration**

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Administrative Officer Mahendra Singh (AO)

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Kavyashree L

Sanaboyina Sudhakar

Establishment - III/IV

Jyothi S (SO)

Basavaraju C Nataraja C

Niveditha D

Radha

Establishment - V Padmini M *(SO)* 

Malini TS Ramesh S

Usha Kiran KA

Establishment - VI

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Bhuvaneshwar P

Chanchala Kumari N

Santhosh G

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Savitha K (SO)

Velu V (Coordinator)

Mohd. Shakeb (Coordinator)

Gangadharappa KC Hemantha Krishna M Mohammed Shauib

Nanjunda R

Rangaswamy SK

Suresha S

Establishment - VII

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Pradeep R

**Establishment - VIII** 

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Bushra Masrur

Jyothi S

**Hindi Implementation Unit** 

Anitha S (Hindi Officer)

Abhilasha Singh Kashyap

Canteen

Mahesh S

Palakshan B Veeranna

Velu M

**IFTTC Guest House** 

Satheesh P (In-charge)

Agri-horticulture

Anil Kumar K (Coordinator)

Vittal Rao

**Security** 

Randhir Singh (Security Officer)



#### **Finance & Accounts**

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Anil Kumar (FAO)

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Vasantha UR (SO)

Chikkabasave Gowda

Divya MV Komala HC

Masthamma M

Prashanthi P

Raghavendra TK

#### Stores & Purchase

Suneetha William M (CoSP)

Sanjay Suman (SPO)

Lakshmi Nath Thakur (SO)

Ravikumar C (SO)
Savitha MP (SO)

Lalitha HJ Lawrence A

Shiva Kumar CR

Somaiah PT Somalatha B

**Health Centre** 

Kala R Swamy (Chief Medical Officer)
Avilash Sumithra Rani C (Lady Medical

Officer)

Jayalakshmi MB Naveen Kumar AV

Papanna

Poornima N

Shivamallappa VM

**Agri-horticulture** 

Anil Kumar K (In-charge)

Ganesh Prasad PS

Vittal Rao

Security

Chandra Shekar (Sr. Security Officer)

#### **CSIR-CFTRI** Resource Centres

**RC Hyderabad** 

Vijayendra SVN (Head)

Madhusudhan Rao D

Nagender A

Narsing Rao G

Prabhakara Rao PG

Sathiya Mala B

Sridhar Rachakonda

Srinivasulu Korra

Sulochanamma G

Yadaiah M

**RC Lucknow** 

Gothwal PP (Head)

Rajdeep Singh Rathour

**RC Mumbai** 

Ahuja DK (Incharge - Extension)

Khadka Deo Bahadur Sher Singh

Nandkishor Sahu

Santhanam PSPM





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Director

**CSIR-CFTRI** 

#### **External Member**

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Director

**CSIR-CLRI** 

Chennai

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#### Shri Umesh Hebbar H

Chief Scientist, CSIR-CFTRI

#### Dr. Meera M S

Chief Scientist, CSIR-CFTRI

#### Dr. Pushpa S Murthy

Sr. Principal Scientist, CSIR-CFTRI

#### Dr. Gnanesh Kumar BS

Scientist, CSIR-CFTRI

#### Dr. Ramesh G

Technical Officer, CSIR-CFTRI

#### Dr. Sreerama YN

Sr. Principal Scientist, CSIR-CFTRI

### Controller of Finance & Accounts / Finance & Accounts Officer

CSIR-CFTRI

#### **Member Secretary**

**Shri Ramaprasad BS** 

COA, CSIR-CFTRI

#### Research Council

#### Chairperson

#### Dr. S. Ayyappan

Former Secretary

Department of Agricultural Research and

Education and

**Director General** 

Indian Council of Agricultural Research

(ICAR)

#### **External Members**

#### Prof. J.S. Thakur

Professor

Department of Community Medicine and

School of Public Health, Postgraduate

Institute of

Medical Education and Research

Chandigarh - 160 012

#### Dr. Anil Dutt Semwal

Director

Defence Food Research Laboratory

Ministry of Defence, Siddarth Nagar

Mysore - 570 011



#### Shri Jagdeep Singh Marahar

Director

R&D Centre, Nestle India Ltd. Nestle House, Jacaranda Marg M Block DLF City Phase II, National Highway 8 Gurgaon - 122 002

#### Dr. Sudhir Nema

Chief Development & Quality Officer Britannia Industries Ltd Whitefield, Main Road Bengaluru - 560 048

#### **Agency Representative**

#### Sri. Atul Saxena

Joint Secretary
Government of India
Ministry of Food Processing Industries
Panchsheel Bhawan
New Delhi - 110 049

#### **Sister Laboratory**

#### Dr. Sudesh Kumar Yadav

Director
CSIR-Institute of Himalayan Bioresource
Technology
Post Box. No. 06
Palampur - 176 061

#### Director

#### Dr. Sridevi Annapurna Singh

Director

CSIR-Central Food Technological Research Institute, Mysuru - 570 020

#### **DG's Representative**

#### Dr. Meenakshi Singh

Chief Scientist
Technology Management Directorate
Council of Scientific & Industrial Research
New Delhi - 110 001

#### **Secretary**

#### Dr. Vikas Singh Chauhan

Chief Scientist & Head
Plant Cell Biotechnology Department
CSIR-Central Food Technological Research
Institute
Mysuru - 570 020



## www.cftri.res.in



Contact Details (STD Code: 0821)

#### **Technical Services**

Technology Transfer & Business Development

- **2514534**
- © 2515453
- ttbd@cftri.res.in

#### **Human Resource Development**

Ph. D (AcSIR)

- 2514310 / 2514760
- 2517233
- acsir@cftri.res.in

M.Sc. Food Technology

- 2416028
- 2517233
- hrd@cftri.res.in

**Short-term Courses** 

- 2514310 / 2514760
- © 2517233
- stc@cftri.res.in

Ph. D (University)

- 2514310 / 2514760
- © 2517233
- phduniv@cftri.res.in

CSIR Integrated Skill Inititaive

- **2515320**
- pmc@cftri.res.in

**ISMT Course** 

- 2517730
- **2517233**
- ismt@cftri.res.in

Incubation Centre (NPIC-CIF)

- **2416030**
- p npic-cif@cftri.res.in

