# Bio Sketch of Professor Hari Niwas Mishra

## डा. हरि निवास मिश्र


***Emeritus Professor (Food Technology), IIT Kharagpur***
***Professor I/c & Nodal Officer (P) Agri Business Incubation Centre, IIT Kharagpur***
***Director, Agri Business Incubation Foundation IIT Kharagpur***
***Trustee, International Life Science Institute (ILSI-India), New Delhi***
***Director, Prasan Solutions (India) Pvt. Ltd. Cochin, Kerala***
***Scientific Advisor, Vitaliz Biosciences Pvt. Ltd. Bengaluru, Karnataka***
***AICTE Mentor, BVB College of Engineering & Technology Hubli, Karnataka***
***AICTE Mentor, Ramgarh Engineering College, Ramgarh (Jharkhand)***
***President (Past), Association of Food Scientists & Technologists (India)***
***Chairman & Head (Former), Post Harvest Technology Centre, IIT Kharagpur***
***Chairman (Former), Hall Management Centre, IIT Kharagpur***

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Professor HN Mishra, having over 37 years of professional experience in teaching, research and administration, has many laurels and awards to his credit. He has published 625 research papers including 267 in peer reviewed international journals & 358 in conference proceedings. He has written 4 books, 4 e-books, 35 book chapters, 7 lecture compendium & laboratory manuals, 4 technology manuals, and several popular articles in newspapers and magazines and has 14 Indian patents to his credit. Besides, he is on the editorial boards of several reputed journals. He has supervised more than 286 student research projects including 12 PDF and 50 Ph D research scholars including 2 PMRF & 7 GYTI awardees. Professor Mishra has handled several international and national sponsored research & industrial consultancy projects. He has created stat-of-the art research laboratory and pilot plants for food processing and preservation. Dr Mishra has received several awards & honours such as AIFPA Presidents' Award, GYTI Award, NRDC Award, Best Teacher Award, Dr JS Pruthi Award, etc for his outstanding contribution in the field of food processing in the country.

Professor Mishra has worked in different capacities on various academic and administrative committees of IIT Kharagpur and many other institutions in the country. He has visited several countries abroad including Taiwan, Singapore, Thailand, Malaysia, Australia, Turkey, UAE, France, Switzerland, Denmark, Germany, Sweden, Norway, Ireland, UK, Belgium, USA and Canada.

Professional details of Professor HN Mishra are briefly summarized as follows. It can also be seen at http://www.iitkgp.ac.in/department/AG/faculty/ag-hnm or http://www.fctliitkgp.co.in or https://scholar.google.co.in/citations?user=I3Tfd5oAAAAJ&hl=en

## EDUCATION

| Degree | University/ Institute | Year | Specialization/ Subjects | Class | Distinctions |
|---|---|---|---|---|---|
| Doctoral | IIT, Kharagpur, India | 1988 | Post Harvest Technology | --- | Awarded IIT Research Scholarship |
| Master's | GBPUA&T, Pant Nagar, India | 1980 | Food Technology | First | Awarded Research Assistantship |
| Bachelor's | University of Gorakhpur, India | 1976 | Maths, Physics, Chemistry | First | Received National Scholarship |
| High School | Intermediate Board, UP, India | 1972 | English, Hindi, Maths, Science, Biology | First | Distinction in Maths & Science |

## PROFESSIONAL TRAINING

| | | | | |
|---|---|---|---|---|
| Training on Computer Basics & Programming | Institution of Engineers (I) Ltd. | 1985 | Computer Hardware & Programming Languages | Aug 1 - Sep 25 Host: IIT Kharagpur |
| Training on Packaging Design and Engineering | Asian Productivity Organization Tokyo, Japan | 1997 | Various Aspects of Food Packaging | Nov 18-26 Host : China Productivity Centre, Taiwan |

## PROFESSIONAL EXPERIENCE

Teaching & Research Experience of over **36 Years** excluding **4 years** of Ph D Research.

| University/ Institution | Designation | From | To | Nature of Duties |
|---|---|---|---|---|
| Indian Institute of Technology, Kharagpur, India | Professor (HAG) | 08/2010 | 06/2023* | Teaching, Research & Consultancy in Food Science & Technology |
| -do- | Professor | 08/2004 | 08/2010 | -do- |
| -do- | Associate Professor | 08/2000 | 08/2004 | -do- |
| -do- | Assistant Professor | 01/1994 | 08/2000 | -do- |
| -do- | Lecturer | 04/1991 | 12/1993 | -do- |
| GB Pant University of Agric. & Tech., Pant Nagar, India | Assistant Professor | 08/1987 | 04/ 1991 | Teaching, Research & Extension in Food Science & Technology |

- Continuing with IIT Kharagpur as Emeritus Professor w.e.f. 01 July 2023.

## RESEARCH PORTFOLIO AND PUBLICATIONS

During my last over 39 years of research career I have made remarkable contribution in the growth of knowledge in science, engineering & technology of food. My research responsibilities included the planning, organization and implementation of on-going programmes of applied food research and product development. My research has been focused on developing, enhancing and commercializing food processing technologies by collaborating with industry to promote product diversification and enhancement, increase market growth and aid competitiveness. I have handled several sponsored research & industrial consultancy projects. A few remarkable food products & process technologies, quality evaluation methodologies developed by my research team and my significant research achievements, patents, publications, etc. are summarized as follows.

### Research interests

- Formulation & processing RTE / RTC / RTD fortified health foods & beverages
- Non-thermal processing of high value perishables foods & beverages
- Extraction & microencapsulation of food bioactive
- Shelf life extension of foods through modified atmosphere packaging & controlled atmosphere storage
- Food safety & quality control

### Publications

- Number of papers in Scopus listed journals : 267
- H- index : 48
- i-10 Index : 144
- Number of citations as per google scholar : 8328
- Number of papers in seminar / conference proceedings & souvenirs : 358
- Number of technology manual published : 04

***List of research publications & presentations is attached as ANNEXURE – 1.***

https://scholar.google.co.in/citations?user=I3Tfd5oAAAAJ&hl=en
https://www.researchgate.net/profile/Hari_N_Mishra
https://vidwan.inflibnet.ac.in/profile/1550

### Research guidance

| *Level of research guidance* | *Completed* | *In progress* |
|---|---|---|
| • Post-doctoral Fellow (PDF) | 10 | 02 |
| • Doctoral (Ph D) | 43 | 07 |
| • Masters by Research (MS) | 06 | -- |
| • Master of Technology (M Tech) | 100 | 05 |
| • Bachelor of Technology Hons. (B Tech) | 67 | 01 |
| • Project Research Fellows & others | 45 | -- |
| • Total | 271 | 15 |

**Indian patents**

- Process technology for production of tomato powder (Granted, No. 162 / Cal/ 98)
- Process technology for instant (soluble) tea manufactures (Granted, No. 63/Cal/ 2000).
- Process technology for preparation of dahi powder (Granted, No. 1374 / Kol / 2008).
- Process technology for mango-milk based fruit bar (Granted, No. 19310)
- Microencapsulation of oil blends and preparation of shelf-stable oil powder (Granted, 403632).
- Process technology for gluten free rice based bread (Granted, No. 824 /Kol /2012).
- Formulation and process technology for production of ready-to-eat therapeutic food for management of SAM children (No. 750/KOL/2014)
- Oat milk based instant soluble (effervescent) tea tablets and a method for its production (Ref: 201631000107)
- Reconstituted rice grains and its process of manufacture (Ref: 699/KOL/2015)
- Edible oil based coating material and methodology for extension of shelf life of tomatoes (Ref: PAA2017-2486).
- Cereal based carbonated beverage / mix and a process thereof (Ref: 281031039706).
- Shelf life extension of sugarcane juice using ozone assisted cold sterilization technology (Ref: 2019310228607).
- Storage stable instant soluble milk tablets, system and process technology thereof (Ref: 2019310333700).
- Processed Aonla (*Phyllanthus emblica*) with enriched nutrient retention and method for manufacture thereof (Ref: 2019310330172).

**Technology transferred to industry**

- Process Technology for Tomato Powder (MoU signed).
- Formulation & process technology for manufacture of RTE therapeutic food paste for SAM children (MoU signed).
- High energy RTE food paste for malnourished children (MoU signed).
- Manufacturing process for fortified rice noodles (MoU signed).
- Manufacturing process for micronutrient fortified rice (MoU under negotiation).

**Technology manuals developed**

- Tomato Powder: International Technology & Business Opportunities Ref. ID: APC-7018-TO.
- Ready-to-Eat (RTE) Therapeutic Food for Severely Acute Malnourished Children: Formulation & Pilot Scale Manufacturing Unit
- High Energy Food Paste for Malnourished Children: Formulation & Pilot Scale Production.
- Iron Fortified Rice: Process Technology & Pilot Scale Unit.

**Doctoral (Ph D) thesis research supervised**

- Studies on manufacture of micronutrient fortified rice kernels (FRK) using extrusion technology.
- Technology for manufacture of FRK from broken rice mixture (raw & parboiled) and its quality studies.
- Development of process technology for micronutrient fortified low glycemic rice noodles.
- Design, fabrication and testing pf a prototype for cold sterilization of sugarcane juice.
- Development of process technology for protein-energy rich RTE snack food.
- Studies on EHD drying of food grains.
- Development of process technology for mycelium based vitamin $D_2$ enriched meat analogue.
- Development of process technology for the manufacture of grain based carbonated beverage premix.
- Structuring of PUFA rich edible oil blend into liposomes.
- Shelf life extension of sugarcane juice using non-thermal (membrane & ozone) technology.
- Development of process technology for the preparation of essential amino acid balanced nutria dal.
- Microencapsulation of probiotics and bioactives using exopolysaccharides for food applications.
- Microencapsulation of probiotics and bioactives using exopolysaccharides for food applications.
- Drug development from natural product in type 2 diabetes.
- Studies on mechanical damage of banana fruit during handling.
- Development of a process technology for production of tomato powder using foam-mat drying technique.
- In vitro detoxification of aflatoxin $B_1$ by horseradish peroxidase enzyme.
- Soy fortified paneer: Formulation, processing and storage.
- Soy fortified yoghurt powder: Formulation, processing and storage
- Green tea powder and granules: Process technology, storage and quality evaluation.
- Development of methods for detoxification and rapid detection of aflatoxin $B_1$ in red chilli powder.
- *Dahi* (Curd) Powder: Process technology, storage and utilization.
- Optimization of growth condition, biochemical extraction and development of RTS beverage from *Spirulina plantesis* biomass.
- Development of process technology for preparation of bael (*Aegle marmelos*) pulp powder.
- Studies on safe storage of green gram (*Vigna radiata*) seeds.
- Development of a dehuller for barnyard millet (*Echinochloa frumentacea*) and

formulation of millet-wheat composite flour.

- Preparation of millet-legume ready-to-eat antidiabetic snack food using extrusion technology.
- Preparation of rice based gluten free pasta using twin screw extrusion technology.
- Process technology for preparation of low cholesterol dairy cream.
- Process technology for preparation of oat milk and oat milk based frozen dessert.
- Process technology for the preparation of probiotic vegetable beverage.
- Preparation of curcuminoids enriched powder from turmeric (*Curcuma longa L*) rhizome and its efficacy as a natural antioxidant.
- Development and characterization of rice based gluten free bread.
- Development of rapid and non-destructive methods for quality analysis and disinfection of stored wheat grain.
- Shelf life extension of guava and banana fruits using active packaging and modified atmosphere storage.
- Evaluation and process optimization for production of RTE therapeutic food past in pilot scale unit.
- Antioxidant potential and stability of oleoresin rosemary and its use as bio-preservative in sunflower oil.
- Extraction and characterization of xanthophylls from *Chlorella vulgaris* biomass and its use in fortification of pasta.
- Synbiotic soy yoghurt: Process technology, quality characteristics and storage stability.
- High pressure processing of pineapple (*Ananas comosus. L.*) puree: Effect on quality attributes and shelf life.
- Preparation of sweet potato based ready –to-eat therapeutic food paste for severely acute malnourished children.
- Shelf Life Extension of Light red color tomatoes (*Lycopersicon esculentum* Cv. *Vaishali*) using active Packaging and edible coating technologies.
- High pressure processing of mango ( *Mangifera Indica*) pulp: quality changes, process optimization and shelf-life evaluation.
- Formulation of stable PUFA rich edible oil blend and preparation of oil powder
- Development of protein and fibre rich ready-to-eat snack food using twin screw extruder.
- Studies on manufacture of micronutrient fortified rice kernels using extrusion technology.
- Spray dried *misti dahi* (Sweetened yoghurt) powder: Process technology, encapsulation of bacterial cells, texture improvement and sorption studies.
- Development of process technology for the preparation of extruded snack food for diabetics.
- Quality appraisal and shelf life extension of khoa-jalebi.

**Sponsored research & industrial consultancy projects handled**

- Principal Investigator of R & D Project on Long Term (2 years) Efficacy of Indigenously Developed Micronutrient Fortified Rice (Fortified With Iron, Vitamin $B_{12}$ and Folic Acid) in Improving Iron Stores in School Children and their Mothers; Process Standardization to Match the Physical Characteristics of Fortified Rice Kernels (FRK) with Commercial Rice Varieties and Storage Stability, sponsored by Department of Biotechnology, Govt. of India. (Ongoing)
- Principal Investigator of R & D Project on Development of Processing Technology and Prototype Unit for Manufacture and Shelf Life Extension of Sugarcane Juice, sponsored by Ministry of Food Processing Industries, Govt. of India.
- Principal Investigator of R & D Project on Development of Functional Food Products From Mycelium of Medicinal Mushrooms, sponsored by Ministry of Food Processing Industries, Govt. of India.
- Principal Investigator of R & D Project on Liposomes for Control Release of Health Promoting Factors such as Multivitamins (Vit D, A, $B_9$ & $B_{12}$), Omega-3 Fatty Acids and Bioactives (Bacosides), sponsored by Ministry of Human Resource Development, Govt. of India. (Ongoing)
- Principal Investigator of R & D Project on Formulation and Pilot Scale Unit for Production of Iron Fortified Engineered Health Rice, sponsored by Department of Biotechnology, Govt of India.
- Principal Investigator of R & D Project on Microencapsulation of Synergistic Blend of Sunflower & Sesame Oil into Oil Powder & its Use In the Formulation of Frozen Dessert Mix sponsored by Council of Scientific & Industrial Research, Government of India, New Delhi.
- Principal Investigator of R & D Project on Lactic Acid Bacteria Based Biorefineries For Converting Agro And Food Based Biomass Into PLA and High Value-Added Products sponsored by National Agriculture Sciences Fund, Indian Council of Agricultural Research, New Delhi.
- Prrogramme Coordinator, Enhancing Research Capacity and Initiating Integrated M Tech & Ph D programme in Food Science & Technology sponsored by Department of Biotechnology, Government of India, New Delhi for 7 years .
- Principal Investigator of R & D Project on Development of Technology and Prototype Facility for Enhancement of Shelf life of Fruits and vegetables through Active Packaging and Modified Storage sponsored by Department of Biotechnology, Govt of India.
- Principal Investigator, Enzymatic approach to control celiac disease to an alternative treatment strategy sponsored by Department of Biotechnology, Govt of India.
- Principal Investigator of R &D Project on Development of Quality Control and Management System & Protocols for Stored Food Grains sponsored by MHRD, Department of Higher Education, New Delhi.
- Co-Principal Investigator, Development of Process Technology for the Extraction and

Purification of Ergothionein from Dried Oyster Mushroom (*Pleurotus ostreatus*) (PDO), sponsored by Department of Biotechnology, Govt of India, New Delhi.

- Principal Investigator, Formulation and Pilot Scale Unit for Production of Therapeutic Food in Ready-to-Eat Form (TF-RTE) for Management of SAM Children sponsored by Department of Biotechnology, Govt of India and M/s GCPL New Delhi,
- Principal Investigator, High rate Algal Biomass production for Food, Feed and Fuel, Indo-Denmark Collaborative Research Project, Department of Biotechnology, Govt of India, New Delhi.
- Co-Principal Investigator, Studies on High Pressure Processing of High Value Perishable, National Agri Innovation Project, Indian Council of Agricultural Research (ICAR), Government of India, New Delhi
- Co-Principal Investigator, Bio$CO_2$: An integrated multidisciplinary project using solar energy for production of renewable hydrogen combined with $CO_2$ capture, Indo-Norwegian-Swedish Collaborative Research Project.
- Principal Investigator, Development of Process Technology for invitro enzymatic detoxification of food infected with aflatoxin $B_1$ using horse radish peroxidase enzyme, Sponsored by the Department of Science & Technology, New Delhi.
- Principal Investigator of All India Coordinated Research Project on Post Harvest Technology, Sponsored by Indian Council of Agricultural Research, New Delhi.
- Principal Investigator of R & D Project on Development of Process Technology for the Production of RTE Snack Foods & Energy Drinks sponsored by the Ministry of Food Processing Industries, Govt of India, New Delhi.
- Co-Principal Investigator, Food Process Engineering Mission Project on Development of Process Technology and Machinery for Low and Intermediate Moisture Foods sponsored by the Planning Commission, Government of India.
- Principal Investigator of PDF Research Project on Enzymatic Detoxification of Aflatoxin in Food sponsored by Council of Scientific & Industrial Research (CSIR), New Delhi.
- Co-Principal Investigator of the sub-project on Development of Process Technology on Honey Candy (Main Project: Rural Industrialization of West Bengal) Sponsored by the Khadi & Village Industries Commission, Mumbai.
- Co-Principal Investigator of the sub-project on Integrated Rural Food Processing & Training Centre, under IIT Mission Project on Technology Travels to Villages.
- Investigator, Sub project on Micro Capital Generation & Micro Credit Facility Scheme under IIT Mission Project on Technology Travels to Villages.
- Evaluation of Antioxidant Potential, Synergistic Behaviour and Stability of Rosemary& Sage Extracts (Client: M/s Synthite Industries Ltd., Kolenchery, Kerala.
- TPIA for Creation of Teaching Labs for NIFTEM (Client: Ministry of Food Processing Industries, Govt of India.

**Some products & process technologies / methodologies developed**

- Fruit juice powders & bars (Ginger powder, Mango - milk fruit bar, apple powder, stone apple powder, tomato juice powder, etc), Honey powder & candy
- Instant soluble tea (green & black) powder & granules
- Spirulina based health drink & Probiotic vegetable beverage
- A foaming device for bael (stone apple) pulp
- High energy RTE food paste for malnourished children
- Micronutrient fortified rice, noodle, EAA balanced dal & nutri *khichadi*
- Protein rich bar for pregnant women & lactating mothers
- Gluten free bread & pasta
- Dehydrated soy fortified paneer cubes, Mango soy fortified yoghurt powder
- Curcumin fortified peanut butter
- RTE snack food for diabetic persons (Herbal *kurkure*)
- Health / energy drink, Non-dairy (oat milk) yoghurt
- Full fat soy flour & soy fortified bread, biscuit, & *chapaties.*
- Cereal-millet based composite flour for production of health bread and carbonated grain beverage
- Enzymatic detoxification of aflatoxin $B_1$ in ground nut meal and red chili powder
- MAS (AP/EC) system & methods for banana, tomato, guava & mushroom
- Microencapsulated oil powder & oil powder based frozen desert
- FT-NIR based rapid methods for quantification of polyphenols, caffeine & moisture contents in green tea, Aflatoxin $B_1$ in groundnut meal & chilli powder, moisture content in yoghurt (*dahi*) powder
- FT-NIR based rapid method for detection of adulteration in milk,

**Dissertation (Self)**

- Mishra H N 1988 Full-fat soy flour: A study in process technology, storage and utilization, Ph D thesis, Indian Institute of Technology Kharagpur (India).
- Mishra H N 1980 Studies on preservation of buffalo milk with hydrogen peroxide, Masters' thesis, GB Pant University of Agriculture & &Technology, Pant Nagar (India).

## TEACHING PORTFOLIO

Professor H N Mishra has been actively engaged in teaching Bachelors, Masters' and Doctoral students of food engineering & technology at two premier universities of international repute for the last 35 years. Besides, he has delivered several invited lectures in various short term courses / training programmes organized by several universities and other professional bodies in India and abroad. My teaching profile including subjects taught, books & book chapters authored, lecture compendium & laboratory manuals developed, etc. are briefly narrated as follows. My students are holding top positions in universities, research institutions, food industry and government organizations in India & abroad. He has also taught under National Programme of Technology Enhanced Learning (NPTEL) of the Ministry of Education (erstwhile Ministry of Human Resource & Development), Government of India.

### Subjects taught

#### Undergraduate level courses

- Food Science & Technology (Theory & Practical)
- Chemistry & Physical Properties of Food (Theory & Practical)
- Food Process Technology (Theory)
- Industrial Processing of Food and Beverages (Theory)

#### Postgraduate level courses

- Food Chemistry & Microbiology (Theory & Practical)
- Food Process and Product Technology (Theory)
- Dairy & Food Products Technology (Theory)
- Processing of Horticultural & Plantation Crop Products (Theory & Practical)
- Non Thermal Processing of Foods (Theory)

### Books, e-books, Lecture compendium, Laboratory manual and Book chapters authored

- Number of books & e-books authored / edited : 08
- Number of lecture compendium / lab manual authored / edited : 07
- Number of book chapters authored : 34

### Books

1. Food Product & Process Innovation : Vol. 1 (2018). Editor - Mishra H N. New India Publishing Agency, New Delhi (ISBN 9789386546159).
2. Food Product & Process Innovation : Vol. 2 (2018). Editor - Mishra H N. New India Publishing Agency, New Delhi (ISBN 9789386546159).
3. Functional Foods (2016). Authors - Mishra H N, Kapur R, Deora N S & Deswal A. New India Publishing Agency, New Delhi (ISBN 9789383305988).

4. Food Process Engineering and Technology (2016). Editors - Mishra, H N, Shrivastava S L, Srivastav P P, Tripathy P P, Mitra J. Excel India Publishers, New Delhi (ISBN 978-93-86256-30-0).

**E-books**

1. Active packaging - An approach to minimize post harvest loss of banana (2012). E-book, Editors: Sen C, Srivastav P P & Mishra H N. LAP Academic Publishing, Germany (ISBN 978-3-659-51874-8).
2. Functional Food and Beverages: Recent Trends (2012). E-book, Editors: A Deswal, N S Deora, H N Mishra. LAP Academic Publishing, Germany (ISBN 3848440474).
3. Gluten Free Bread: A Technological Approach (2012). E-book, Editors: by Dwivedi M, Deora N S & Mishra H N. LAP Academic Publishing Germany (ISBN 13:9783659287336).
4. Strawberry Enzyme Inactivation by HPP: Models & Contours (2012). E-book, Editors: Chakraborty S, Mishra H N & Knorr D. LAP Academic Publishing, Germany (ISBN 13: 9783659287336).

**Edited volumes / lecture compendium & laboratory manuals**

1. Novel Technologies for Food Product Manufacturing and Shelf Life Extension by Mishra H. N. (Published by: Indian Institute of Technology Kharagpur, 2017).
2. CII-IIT Food Professional Course: Lecture Compendium & Laboratory Manual *by* Dr. H. N. Mishra (Published by: IIT Kharagpur, 2016, 2015, 2014, 2013).
3. AICTE-QIP Short Term Course: Innovative Food Processing Technologies *by* Dr. H. N. Mishra and Dr. P. P. Srivastav (Published by: IIT Kharagpur, 2004).
4. NPTEL Lecture video & CD on Novel Technologies for Food Processing and Shelf Life Extension (Published by Ministry of Education, Government of India).

**Book chapters**

1. Mishra. In: Food Product & Process Innovation (Vol. 1) edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
2. Rice Based Gluten Free Bread and Pasta Products by N S Deora, M Dwivedi, H N Mishra. In: Food Product & Process Innovation (Vol. 1) edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
3. Engineered Health Rice and Nutri Dal by A Mishra, R K Raigar, H N Mishra. In: Food Product & Process Innovation (Vol. 1) edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
4. Ready-to-Eat Health Foods for Malnourished Children by R K Raigar, Danie Shajie A, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).

5. Ready-To-Eat Extruded and Puffed Snack Foods by G Ramanna, R M Shukla, H Pandey, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
6. Mango Soy Fortified Yoghurt Powder and Synbiotic Yoghurt by P Kumar, S Mishra and H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
7. Dahi (Curd) Powder and Dahi Powder Based Energy and Health Drink Mixes by V K Shiby, D Seth, W Routray, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
8. Fermented Functional Foods and Beverages by S Mishra, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
9. Ready-To-Drink Fermented Vegetable Beverages and its Preservation by V Sharma, M Bhattacharya, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
10. Oat Based Beverages and Desserts by A Deswal, N S Deora, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
11. High Pressure Processing of Fruit Juice and Puree by S Chakraborty, N Kaushik, H N Mishra. In: Food Product & Process Innovation (Vol. 1), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
12. Extraction, Characterization and Food Utilization of Algal Biomass and Bioactives by A Mazumder, P Prabuthas, Apurba Giri , H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
13. Instant Soluble Tea Powder and Ready-To-Use Tea Products by V R Sinija, S M Behera, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
14. Functional Fruit Toffees & Candies by S Sehwag, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
15. Low Cholesterol Dairy Products by J Chitra, M Ghosh, I Dey Paul, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
16. Baked and Fried Dairy Products by S K Bag, R Kumari, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
17. Safe Storage of Food Grains: Structures & Methods by R Pande, G Mishra, S Srivastava,

H N Mishra. In: Food Product & Process Innovation (Vol. 2) by HN Mishra (Published by: NIPA, 2018) ISBN 9789386546159.

18. Natural Antioxidants and Colors by R Upadhyay, S Halder, M Bhattacharya, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
19. Extension of Shelf Life of Fruits and Vegetables by S Billoria, S Biswas, C Sen, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
20. Product Formulation and Shelf Life Evaluation Models by A Danie Shajie, R Upadhyay, S Chakraborty, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
21. Rapid Methods for Food Quality Analysis by S Tripathi, V R Sinija, S Bag, V Shibby, R Pande, A Deswal, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
22. Enzymatic Detoxification of Aflatoxin B1 in Foods by C Das Mukhopadhyay, S Tripathy, H N Mishra. In: Food Product & Process Innovation (Vol. 2), edited by H N Mishra, published by NIPA New Delhi, 2018 (ISBN 9789386546159).
23. Grain-Based Beverages by Deswal A, Deora N S and Mishra H N. In: Innovative Technologies in Beverage Processing, edited by Aguilo-Aguayo I and Plaza L, published by Willey Blackwell, 2017 (ISBN 9781118929377).
24. Rapid determination method for insect infestation in stored wheat grain by Mishra G., Mishra H. N. in Food Process Engineering and Technology, (Published by: Excel India Publishers, New Delhi, 2016)
25. Modified Atmosphere Packaging of Banana for Shelf Life Extension by Murmu S. B., Mishra H. N. in Food Process Engineering and Technology, (Published by: Excel India Publishers, New Delhi, 2016)
26. Optimization of Fermentation of Vegetable Juice by Lactobacillus plantarum by Sharma V., Mishra H. N. in Food Process Engineering and Technology, (Published by: Excel India Publishers, 2016)
27. Recent Developments on Algae as a Nutritional Supplement by H N Mishra , A Mazumder, P Prabuthas. In: Algal Biorefinary an Integrated Approach, published by Springer, 2015 (ISBN 978-3-319-22813-6).
28. Functional Foods by Mishra S, Pandey A and Mishra H N. In: Food Science edited by Bawa A S, Raju P S and Chauhan O P, Published by NIPA New Delhi, 2012 (ISBN 13 9789381450147).
29. Role of entomopathogenic fungi (Beauveria bassiana) in stored food grain safety by Pande R, Mishra S, Mishra H N and Singh M N. In: Recent Advance in Microbiology, published by Nova science publisher, New York, 2012 (ISBN 565-574

32).

30. Production of probiotic bitter gourd juice by lactic acid bacteria by Sharma V, Mishra H N. In: Traditional Foods: Recent Trends and Future Perspectives, published by Puducherry Cooperative Book Society, 2012.
31. Application of Membrane Technology in Soybean Processing by Mittal B K and Mishra H N. In: Production and Utilization of Defatted Soymeal by Agrawal Y C, Mittal B K, Singh B P N and Ali N, published by G B Pant University of Agri. & Technology, Pantnagar, India, 1989.
32. Quality Characteristics of Soy Protein Products by Mishra H N and Mittal B K. In: Production and Utilization of Defatted Soymeal by Agrawal Y C, Mittal B K, Singh B P N and Ali N, published by G B Pant University of Agri. & Technology, Pantnagar, India, 1989.
33. Engineering Properties of Soybean by Bal S and Mishra H N. In: Soybean Processing and Utilization in India by Ali N, Gandhi A P and Ojha T P, published by Central Institute of Agricultural Engineering, Bhopal, India, 1988.
34. Full-Fat Soy Flour - Processing Technology, Storage and Utilization by Mishra H N and Mukherjee R K. In: Soybean Processing and Utilization in India by Ali N, Gandhi A P and Ojha T P, published by Central Institute of Agricultural Engineering, Bhopal, India, 1988.
35. Seth D, Mishra HN & Deka SC (Jan 2019). Process Technology of Sweetened Yogurt Powder. In Applied Food Science and Engineering with Industrial Applications (pp. 159-178). Apple Academic Press.

**Editorial board members of international journals**

Professor Mishra has actively worked as editorial board member or reviewer of research manuscripts, book chapters, books etc. Names of a few journals for which I have worked as editorial board members are narrated below.

- LWT - Food Science & Technology
- International Journal of Food Science & Technology
- Fresh Produce
- Focusing Modern Food Industry
- Foods
- Indian Food Packer
- Journal of Food Science & Technology
- Indian Food Industry

## EADERSHIP AND ADMINISTRATIVE ASSIGNEMENTS

As a Professor of Food Technology in the Agricultural & Food Engineering Department and former Head & Chairman of the Post Harvest Technology Centre (PHTC), Indian Institute of Technology Kharagpur (India) and Former President of the Association of F ood Scientists & Technologists (India), I have contributed significantly to advances in food technology research & innovation at international level and also to the growth of food processing profession in India which is evidenced by the wide coverage of his R & D activities in the print and electronic media and overwhelming response from the food industry. My leadership qualities and administrative capabilities and capacity to transfer knowledge is evident from the undermentioned positions held and administrative works done as well as awards, honours, recognition and membership of the national and international committees.

**Top administrative positions held at IIT Kharagpur**

- Professor In-charge, Agri Business Incubation Centre (ABIC)
- Director, Agri Business Incubation Foundation IIT Kharagpur
- Nodal Officer, Agri Business Incubation Centre (ABIC)
- Head / Chairman, Post Harvest Technology Centre (PHTC)
- Chairman, Hall (Hostel) Management Centre (HMC)
- Coordinating Warden (Mess) HMC, Warden MS & RK Halls of Students Residences

**Top positions held in professional society**

- President, Association of Food Scientists & Technologists (India)
- Vice President, Association of Food Scientists & Technologists (India)
- Secretary, Association of Food Scientists & Technologists (India), Kharagpur Chapter
- President, Association of Food Scientists & Technologists (I), Kharagpur Chapter

**Different academic / administrative works done at IIT Kharagpur**

- Chairman, Career Development Centre, Agricultural & Food Engineering Department
- Secretary, Department Academic Committee (PG & R), Ph D Coordinator, Faculty Advisor for M Tech (Post Harvest Engineering) & M Tech (Dual degree programme in Food Process Engineering).
- Member, Doctoral Scrutiny Committees (DSC) of Research Scholars & Undergraduate Committee.
- Member, Departmental Administrative Committee DAC) & Departmental Purchase Committee (DPC).
- Organising secretary, International Conference Emerging Technologies in Agricultural & Food Engineering (ETAE) 2016 and Member Steering Committee for ETAE 2004.
- Member, Advisory Committee, IIT Hindi Cell, Standing Consultative Committee for Community Issues, Campus Maintenance & Development Committee and Technology Market Committee.
- Chairman of the Consumers' Forum of IIT Students
- Coordinator, National Youth Parliament Competition at IIT Kharagpur

**Professional society memberships**

- President (P), Association of Food Scientists & Technologists (India)
- Life Member, Association of Food Scientists & Technologists (AFST), India
- Secretary & Treasurer of the AFST (I) Kharagpur Chapter
- Member, Institute of Food Technologists (IFT), USA
- Member, Agricultural Engineering Society, IIT Kharagpur
- General Secretary / Joint Secretary, IIT Teachers' Association

**Professional awards / honours / recognition**

- Gandhian Young Technological Innovation (GYTI) Award (3) & GYTI Appreciation Awards (4) to supervised student research projects
- NRDC Innovator Award to my research team
- IIT Young Innovator Award (05) to supervised M Tech students
- Dr. J. S. Pruthy award of the All India Food Processors Association (AIFPA) for New Product/Process Development.
- AIFPA President Award for Significant Contribution to the Growth of Food Processing Industries in India.
- Food Technology Best Teacher Award for the Year 2015 by AFSTI (Kolkata Chapter), Jadavpur University, Kolkata, West Bengal, India.
- Best Research Paper award of the AFST (T), AIFPA and other professional bodies.

**Membership of the academic / research council, board of studies (BoS) of academic institutions offering bachelors, masters & doctoral programmes in food technology**

- Chairman, DRDS Recruitment & Assessment Committee (RAC-2021) for Food Science.
- Chairman, BIS (Govt of India) Committee for Preparation of Indian Standards for Fortified Rice Kernels.
- Chairman, BIS (Govt of India) Committee for the Preparation of the Indian Standards for the Fortified Rice Kernel Manufacturing Machinery.
- Member, Expert Group on Improving Agriculture Supply Chains in North Eastern Region, NITI Aayog, Government of India.
- Member, National Committee to Access Requirements for Setting up of Incubation Centres under PM-FME Scheme, MoFPI, Govt. of India.
- Member, Research Advisory Committee, ICAR-Central Institute of Post Harvest Engineering & Technology Ludhiana, Punjab, India.
- Member, Research Advisory Committee, ICAR-Indian Institute of Natural Resins and Gums, Ranchi, Jharkhand, India.
- Member, Research Council, Indian Institute of Food Processing Technology (MoFPI), Thanjavur, Tamilnadu, India.
- Member, Research Advisory Committee, National Dairy Research Institute (NDRI), Karnal, Haryana, India.
- Member, Board of Studies in Food Science & Technology, BHU, Varanasi, India.

- Expert Member on Academic Council of the Indian Institute of Food Processing Technology, Thanjavur, Tamil Nadu, India.
- Member, Monitoring Committee, Mission REACH (Department of Science & Technology, Govt of India) in Food Technology at Techno India, Kolkata, West Bengal, India.
- Member, Board of Management of Institute of Professional Studies in Food Technology, University of Allahabad, Allahabad, Uttar Pradesh, India.
- Expert Member, University Grants Commission (UGC) Committee for the consideration of application of National Institute of Food Technology Entrepreneurship and Management for grant of Deemed University status.
- Member, Core Committee for the Development of the B Tech & M Tech Curriculum of the Institute of Food Technology Entrepreneurship and Management, Kundli, Haryana, India.
- Member, Board of Studies in Food Technology, Vignan University, Andhra Pradesh, India.
- Member, Steering Committee for Establishment of Punjab Institute of Technology (PIT) - An Institute of Food Technology & Research at Sanghera, Barnala, India.
- Member, Scientific Advisory Committee, Institute of Bioresources and Sustainable Development, Imphal, India.
- Member, Research Advisory Committee, National Agri-Food Biotechnology Institute, Mohali, Punjab, India.
- Member, Academic Council, National Institute of Food Technology Entrepreneurship and Management (NIFTEM) Deemed University, Kundli, Haryana, India.
- Member, Research Development Committee, National Institute of Food Technology Entrepreneurship and Management (Deemed University), Kundli, Haryana, India.
- Member, Technical Advisory Committee (TAG) of Bio Processing Unit (BPU - An Autonomous Institute under DBT, Govt of India), Mohali, Punjab, India.
- Member, Board of Post Graduate Studies in Food Engineering & Technology, Tezpur University, Assam, India.
- Member, Board of Studies in Food Technology, Haldia Institute of Technology (HIT), Haldia, India.
- Member, Board of Studies in Food Technology, Birla Institute of Technology (BIT), Mesra, ranchi, India.
- Member, Ph D Committee for Food Technology, W. B. University of Technology, Kolkata, India.

**Membership of industry committees / board of directors (BoD)**

- Trustee, International Life Science Institute (ILSI-India), new Delhi
- Director, Agri Business Incubation Foundation, IIT Kharagpur
- Directors, Prasan Solutions (I) Pvt. Ltd., Cochin, Kerala, India.
- Jury Member, CII National Award for Food Safety, CII Food & Agriculture Centre of Excellence, India.

**Membership of national committees / task force(s)**

- Chairman, Expert Committee to Review progress of the DBT sponsored programme on Creation of facilities for teaching and research of food science and technology and introduction of integrated course of M.Sc. – Ph.D in Guwahati University, Assam, India.
- Chairman, BIS (Govt of India) Committee for Preparation of Indian Standards for Fortified Rice Kernels.
- Chairman, BIS (Govt of India) Committee for Preparation of Indian Standards for Fortified Rice Kernels manufacturing machinery.
- Member, Technical Committee for Innovative/organic food products under PLI scheme for Food Processing Industry, MoFPI, Govt of India, New Delhi.
- Member, Technical Committee for Millet Based Food Products under PLI scheme for millet based food products, MoFPI, Govt of India. New Delhi.
- Member, Expert Committee for Indo-Swedish Joint call for research proposals on Circular Economy, Department of Biotechnology, Govt of India, New Delhi.
- Expert Member, Secondary Agriculture/Food Processing Entrepreneurial Network (SEAN): Bio-technology Industry Research Assistance Council (BIRAC), Government of India, New Delhi.
- Member, Expert Committee for Mission Programme on Health & Nutrition in Social Sector Programme Area, Department of Biotechnology, Govt. of India, New Delhi.
- Expert Member Expert Member, National Mission Steering Group (NMSG), Integrated Child Development Services (ICDS), Ministry of Women & Child Development, Government of India.
- Member of the Project Scrutiny Committee, Ministry of Food Processing Industries, Govt. of India, New Delhi.
- Member of the Project Evaluation Committee, Department of Biotechnology, Govt. of India, New Delhi
- Member of the Scientific Panel on Additives, Flavourings, Processing Aids and Materials in Contact with Food of the Food Safety & Standards Authority, Government of India.
- Member of the Specialized Products Sectional Committee, Bureau of Indian Standards, New Delhi, India.
- Member, Task force on CSIR mission on food and consumer safety solution: CSIR, New Delhi.
- Expert Member, Mission Programme on Health & Nutrition in Social Sector: DBT, New Delhi.
- Member, Broad Subject Matter Area (BSMA) Committee for formulating Academic (Masters & Ph D) Programmes in Food Science & Technology, Indian Council of Agricultural Research, New Delhi.
- Expert Member, Mission Programme on Health & Nutrition in Social Sector: Department of Biotechnology, New Delhi, India.
- Member, Task force on CSIR Mission on Food and Consumer Safety Solution: Council

for Scientific & Industrial Research (CSIR), New Delhi (India).

- Member, Plant Sciences Research Committee, Council of Scientific & Industrial Research, New Delhi, India.
- Expert Member, Techno Scrutiny Committee, Ministry of Food Processing Industries, Government of India, New Delhi, India.
- Expert Member (P), Approval Committee on Task Force on Food and Nutritional Security, Department of Biotechnology, Govt. of India, New Delhi.
- Member (P), Working Group on Food Processing, Analysis and Storage to Improve Availability and Bio-availability of Micronutrients from Food, Indian Council of Medical Research (ICMR), New Delhi, India.
- **M**ember (P), Scientific Panel for Method of Sampling and Analysis, Food Standards and Safety Authority of India, New Delhi, India.
- Member (P), Expert Committee on Post-Harvest Technology and Value Addition, Indian Council of Agricultural Research, New Delhi, India.

## INNOVATION, ENTREPRENEURSHIP AND EXTERNAL ENGAGEMENT

Professor H N Mishra, throughout my professional career, at Indian Institute of Technology Kharagpur have acquired competence in food product & process innovations which is evident from my books, publications, training programmes organized, etc. He has also acquired strong entrepreneurship skills in food process machinery and instrumentation which is visible in the form of 3 pilot scale units conceptualized and made into reality at Indian Institute of Technology Kharagpur with funding support from external agencies including food industry. His professional activities including current research in the development of novel approaches and innovative technologies for processing and production of food products demonstrate my innovation & entrepreneurship skills. Recognising his innovation & entrepreneurship skills, the Indian Institute of Technology Kharagpur has recently entrusted him with the responsibility to establish Agri Business Incubation Centre (ABIC) with external funding support and manage it as Professor In-Charge and Nodal Officer.

### Experience in institution building

- He was instrumental in the modernization of student hostel mesh kitchens and established two new Halls of Residences for student viz. (i) MS Hall of Residence - 200 rooms, as Warden, & (ii) Madan Mohan Malaviya Hall of Residence - 800 rooms, as Coordinating Warden (Mess) and Chairman of the Hall Management Centre (HMC) of Indian Institute of Technology Kharagpur.

- He introduced research & teaching in Food Technology at Indian Institute of Technology Kharagpur in particular and in IITs & NITs in general. I established world class laboratories & pilot plants with state-of-the-art food processing & quality testing & analysis facilities at IIT Kharagpur. Those are:
  - ✓ Food Chemistry & Technology Laboratory (FCTL)
  - ✓ Ready-to-Eat (RTE) Foods Laboratory

- ✓ RTE Food Pilot Scale Unit (Automated) for manufacture of High Energy RTE Food Paste for management of severely acute malnourished (SAM) children.
- ✓ Iron Fortified Rice Manufacturing Unit for manufacture of Micronutrient Fortified Rice to tackle the menace of anemia in the country.
- ✓ Multi Product Controlled/Modified (CA/MA) Atmosphere Storage Unit for post harvest management & shelf life extension of fruits, vegetables and other high value perishables.

- He was instrumental in establishing an *Integrated Rural Food Processing & Training Centre* at IIT Kharagpur for providing on-line practical training on processing of fruits & vegetables to rural women, unemployed youths and entrepreneurs.

- He significantly contributed in the establishment (since inception to the present form) of the three new National Institutes set-up by the Government of India for teaching, learning & research in food technology. Those are:
  - ✓ National Institute of Food Technology Entrepreneurship and Management (NIFTEM), a deemed university under de-novo category established by the Ministry of Food Processing Industries (MoFPI) at Kundli (Haryana).
  - ✓ National Agri-Food Biotechnology Institute (NABI) established by the Department of Biotechnology (DBT) at Mohali, Punjab.
  - ✓ Centre of Innovative & Applied Bioprocessing (CIAB) established by the Department of Biotechnology (DBT) at Mohali, Punjab.

**Computer software developed**

- User-friendly computer software package for balanced meal planning and IIT Halls mess management.
- Computer software packages for determination of thermal process schedule for foods and formulation & processing of soy fortified *panee*r 9 Indian cheese).

**Curriculum / syllabi development**

- Developed Curriculum & Syllabi for 4 years B Tech degree programme in Agricultural & Food Engineering at IIT Kharagpur.
- Developed Curriculum & Syllabi for 4 years B Tech in Food Technology & Management degree programme of the National Institute of Food Technology, Entrepreneurship & Management (NIFTEM), Kundli, India.
- Developed Curriculum & Syllabi for 4 year B Tech Food Technology degree programme at Techno india University, Kolkata.
- Developed Curriculum & Syllabi for 2 years M Tech degree programme in Food Process Engineering at IIT Kharagpur.
- Developed Curriculum & Syllabi for 2 years M Tech degree programme in Food & Fermentation Technology at Techno India University, Kolkata, India.
- Developed Curriculum & Syllabi for M Tech & Ph D programme in Food Technology courses in Indian Agricultural Universities.

**Conferences & symposium organised**

- Member, Organizing Committee. 19th IUFoST World Food Congress, Mumbai, India.
- Organizing Secretary, 2nd International Conference on Emerging Technologies in Agricultural & Food Engineering (ETAE 2016).
- Convenor, INAE National Symposium on Emerging Innovative Technologies for Assurance of Quality & Safety in Processed Foods (FoQSAT 2011).
- Chairman, National Seminar on Newer Advances in Food Science & Technology (NAFST 2011).
- Chairman, 17th Indian Convention of Food Scientists & Technologists (ICFoST 2007).
- Principal Coordinator, CII FACE-IIT Professional Course on Food Safety & Quality Management (4 Batches in 4 consecutive years).
- Principal Coordinator, QIP Short Term Training Programme on Innovative Food Processing Technologies (2004 & 2017).

**Countries visited**

- Visited The University of the West Indies St. Augustine Campus, Trinidad and Tobago for invited lecture and meeting during August 2019.
- Visited University of Wollongong, Australia as delegation team member deputed by Department of Biotechnology, Government of India, New Delhi to attend Indo-Australia Workshop on Functional Foods organised during March 2008.
- Visited University of Copenhagen, Denmark as delegation team member deputed by Department of Biotechnology, Government of India, New Delhi to attend Indo-Denmark meeting on Food Science & Nutrition organised during May & November 2008.
- Short term visits to USA, Canada, Germany, Norway, Switzerland, France, Australia, Denmark, Britain, Ireland, Singapore, Taiwan, Thailand, Indonesia Malaysia, Dubai and UAE for attending International Conferences & meetings and delivering invited lectures.

**YouTube link for pilot plant established and online NPTEL course taught**

- https://www.youtube.com/watch?v=dT1oWZZBY_U
- https://www.youtube.com/watch?v=YyTPLCfjTuM&t=63s
- https://www.youtube.com/watch?v=wuuEqZwLJrA
- https://nptel.ac.in/courses/126/105/126105015/#

**Link of selected media coverage on my research and innovation**

1. http://www.business-standard.com/article/news-ians/indigenously-developed-iron-fortified-rice-premix-to-address-anaemia-117011800781_1.html
2. https://www.ruralmarketing.in/industry/technology/dbt-iit-kharagpur-develop-rice-fortification-with-iron-technology
3. http://www.dst.gov.in/pressrelease/science-technology-service-society
4. http://www.fnbnews.com/Top-News/iitk-food-engg-dept-develops-technology-to-process-rtc-iron-fortified-rice-40295
5. http://agriexchange.apeda.gov.in/news/Newssearch.aspx?newsid=24838&Date=14Mar2017
6. http://mumbaimirror.indiatimes.com/news/india/to-fight-malnutrition-govt-may-boost-food-items-with-minerals-vitamins/articleshow/50676929.cms
7. http://www.himalayanmirror.net/upload/14859361815.pdf
8. http://timesofindia.indiatimes.com/india/DBT-scientists-develop-rice-fortification-technology-to-fight-anaemia/articleshow/54923525.cms
9. https://foodsafetynews.wordpress.com/2016/11/30/
10. http://naidunia.jagran.com/national-ironrich-rice-was-developed-by-iit-kharagpur-868034
11. http://www.thepeoplepost.com/news/health/indigenously-developed-iron-fortified-rice-premix-address-anaemia
12. http://vijayabheri.com/indigenously-developed-iron-fortified-rice-premix-to-address-anaemia/
13. http://www.windowtonews.com/news.php?id=17612&cat_id=10&p=33&search=
14. https://www.socialnews.xyz/2017/01/18/indigenously-developed-iron-fortified-rice-premix-to-address-anaemia/
15. http://www.indiainfoline.com/article/print/capital-market-economy-reports/requisite-technology-developed-for-rice-fortification-with-iron-for-addressing-incidence-of-anaemia-116112400399_1.html
16. http://odishatv.in/science/indigenously-developed-iron-fortified-rice-premix-to-address-anaemia-188952/
17. http://www.biovoicenews.com/rice-fortification-with-iron-to-address-incidences-of-anaemia/
18. http://www.andhravilas.net/en/Indigenously-developed-iron-fortified-rice-premix-to-address-anaemia
19. https://www.news18.com/news/lifestyle/food-indigenously-developed-iron-fortified-rice-premix-to-address-anaemia-1337510.html

20. http://www.ndtv.com/article/india/iit-researchers-develop-ready-to-eat-food-paste-for-malnourished-children-484068

21. http://www.siliconindia.com/news/general/IIT-Researchers-Develop-Therapeutic-Food-For- Malnourished-Kids-nid-161357-cid-1.html

22. http://news.oneindia.in/kolkata/iit-researchers-develop-therapeutic-food-for-malnourished-kids- 1396074.html

23. http://www.jagranjosh.com/current-affairs/researchers-at-iit-kharagpur-developed-readytoeat- food-paste-for-malnourished-children-1392610155-1

24. https://twitter.com/ndtv/status/434924035248386048

25. http://realtime.rediff.com/news/realtime/IIT-researchers-develop-readytoeat-food-paste-for-malnourished-children/8837c2189cec7f18?src=interim_alsoreadheadline

26. http://article.wn.com/view/2014/02/16/Indian_scientists_industry_link_up_for_therapeutic_food/

27. http://timesofindia.indiatimes.com/home/science/IIT-Kharagpur-develops-food-in-a-tube-for- malnourished-kids/articleshow/30567143.cms

28. http://top.adlesse.com/en/i/84271450378889825/iit-researchers-develop-ready-to-eat-food-paste-for-malnourished-children

29. http://naidunia.jagran.com/national-iit-researchers-develop-therapeutic-food-for-malnourished- kids-33528

30. http://www.newindianexpress.com/nation/IIT-Researchers-Develop-Therapeutic-Food-for-Malnourished-Kids/2014/02/16/article2059922.ece

31. http://defence.pk/threads/india-develops-high-energy-food-syrup-to-tackle-malnutrition-in-the- developing-world.299608/

32. http://indiatoday.intoday.in/education/story/iit-kharagpur-develops-fully-nutritional-food-paste/1/344205.html

33. http://thescience.co.in/iit-develops-food-in-tube-for-malnourished-kids/

34. https://www.jagran.com/news/national-special-vegetable-oil-of-iit-kharagpur-will-keep-your-heart-fit-20642762.html

35. https://bartamanpatrika.com/detailNews.php?cID=13&nID=243960&P=1

36. https://www.thekharagpurpost.in/iit-inovation-of-oil-powder/

37. https://www.abpeducation.com/news/iit-kharagpur-researchers-develop-award-winning-heart-healthy-vegetable-oil-1.1188642

38. https://twitter.com/pibkolkata/status/1293241666325737472?s=21

39. https://www.indiatoday.in/education-today/news/story/iit-kharagpur-awarded-for-developing-new-cholesterol-friendly-vegetable-oil-1711154-2020-08-14

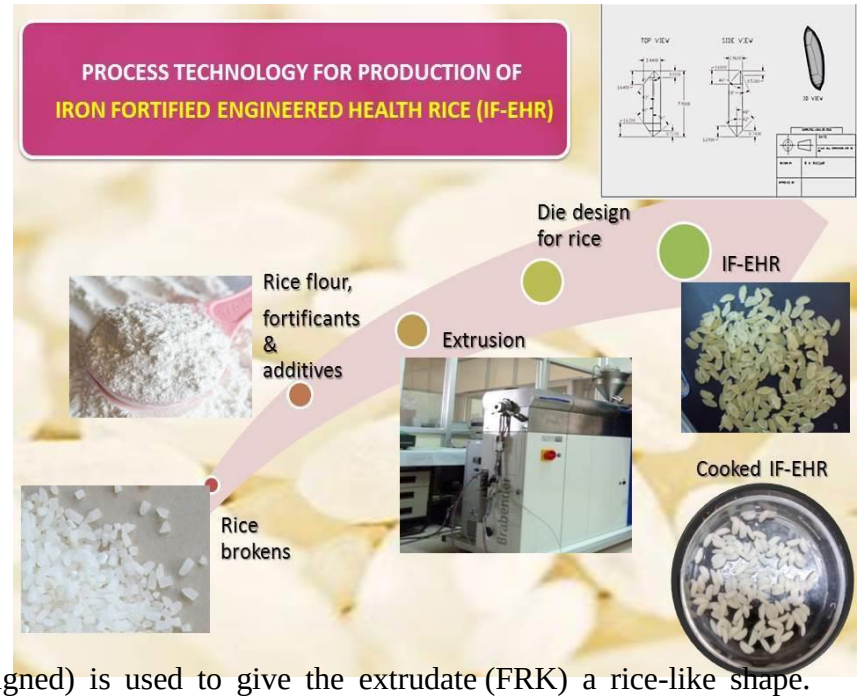
40. https://www.ndtv.com/education/iit-kharagpurs-vegetable-oil-for-healthy-heart-awarded

41. https://eisamay.indiatimes.com/west-bengal-news/others/healthy-vegetable-oil-award-winning-innovation-by-iit-kgp-researchers/articleshow/77508061.cms
42. https://news.careers360.com/vegetable-oil-powder-developed-iit-kharagpur-researchers
43. https://agronfoodprocessing.com/iit-kharagpur-formulates-unique-veg-oil-for-healthy-heart/
44. https://www.indiablooms.com/life-details/L/5278/iit-kharagpur-researchers-develop-low-cost-vegetable-oil-powder-with-health-benefits.html
45. https://indianarrative.com/health/iit-kharagpur-develops-novel-vegetable-oil-to-keep-heart-healthy-9198.html
46. https://indifoodbev.com/uncategorized/iit-kharagpur-researchers/
47. https://www.nuffoodsspectrum.in/news/42/7068/iit-kgp-develops-low-cost-vegetable-oil-powder.html
48. https://kgpchronicle.iitkgp.ac.in/vegetable-oil-for-healthy-heart-award-winning-innovation-by-iit-kharagpur-researchers/
49. https://www.anandabazar.com/lifestyle/iit-kharagpur-develops-novel-vegetable-oil-to-keep-the-heart-healthy-dgtl-1.1193378?ref=home-more-news-stry-large-image-1
50. https://www.daijiworld.com/news/newsDisplay.aspx?newsID=739934
51. https://www.facebook.com/IIT.Kgp/posts/10159044226980409
52. https://twitter.com/IITKgp/status/1294306459061116929?s=20
53. https://highereducationplus.com/iit-kharagpurs-new-invention-vegetable-oil-receives-an-award/
54. https://www.siasat.com/iit-kgp-develops-novel-vegetable-oil-to-keep-heart-healthy-1945023/
55. https://newsd.in/iit-kgp-develops-novel-vegetable-oil-to-keep-heart-healthy/
56. http://www.uniindia.com/iit-kharagpur-researchers-awarded-for-developing-novel-vegetable-oil-for-healthy-heart/east/news/2117274.html
57. https://timesofindia.indiatimes.com/home/education/news/iit-kharagpurs-ozone-and-ultra-filter-based-manufacturing-tech-to-extend-shelf-life-of-packaged-sugarcane-juice-without-heat-and-chemicals/articleshow/81718186.cms
58. https://www.msn.com/en-in/money/careers/iit-kharagpurs-ozone-and-ultra-filter-based-manufacturing-tech-to-extend-shelf-life-of-packaged-sugarcane-juice-without-heat-and-chemicals/ar-BB1f0V5V
59. https://hummingbirdnews.in/iit-kharagpurs-ozone-and-ultra-filter-based-manufacturing-tech-to-extend-shelf-life-of-packaged-sugarcane-juice/
60. https://isarkariresult.in/iit-kharagpurs-ozone-and-ultra-filter-based-manufacturing-tech-to-extend-shelf-life-of-packaged-sugarcane-juice-without-heat-and-chemicals/

**Formulation and Pilot Scale Production of Ready-to-Eat Therapeutic Food (TF-RTE) for the Management of Severely Acute Malnourished (SAM) Children**

Malnutrition is a global pandemic condition which holds its grip and its causes on various parts of India and abroad. One of the significant reasons for the prevalence of malnutrition is the inadequate supply of nutrition due to which over 5 million children die each year. In order to curb this grave condition and to provide adequate nutrition supply, food safety & security for the child health development, Government of India proposed to develop its own therapeutic food using locally available raw materials and indigenously developed technology. Accordingly, a project sponsored by Department of Biotechnology, Government of India was taken up with M/s Gattappu Chemicals Private Limited as industry partner. Five TF-RTE formulations (3 peanut based, 1 potato based and 1 Bengal gram based) were developed and the technology was patented and transferred to M/s GCPL, New Delhi and M/s Rashi Nutri Foods, Chennai (India). The development grabbed widespread media attention in country and abroad. As a part of the project, a pilot scale production unit was designed and constructed according to the GMP/GHP norms. The pilot plant facility is PLC controlled completely automatic unit with the production capacity of 100 kg / day. In the process of design and development of the pilot plant facility, factory/workshop personnel have been identified and trained for the fabrication and assembling of the production unit within India emphasizing honorable PM's **Make in India** scheme. This development, production & utilization of TF-RTE will address the grave issues related to malnutrition in the country and will go a long way in tackling the concerns of food safety and security in the Nation to a greater extent.

**Process Technology and Pilot Scale Manufacturing Unit for Micronutrients (Iron, Vitamin $B_{12}$ & Folic Acid) Fortified Rice (MFR) for Mitigation of Anemia**




A process to produce ready-to-cook (RTC) micronutrients (Iron, vitamin $B_{12}$ & folic acid) fortified rice (MFR) kernels from broken rice kernels has been developed in my laboratory at the Indian Institute of Technology Kharagpur. The broken rice is first ground into flour and then desired amounts of water and iron fortificant are uniformly mixed with this and conditioned in order to prepare rice flour & fortificant mixture. This mixture is then fed into a twin-screw extruder, designed and fabricated for the purpose; a rice shaped die (specially designed) is used to give the extrudate (FRK) a rice-like shape.


A pilot scale demonstration facility with a production capacity of 100 kg/day fortified rice kernels (FRK) and 10 MT/day MFR has been established at Indian Institute of Technology Kharagpur with the financial support from the Department of Biotechnology (DBT), Government of India, New Delhi. The twin screw rice extruder and other required machinery commissioned in the pilot scale unit are shown in Figure. The per kg fortification cost is estimated at Rs. 0.60. All the equipment are indigenously designed and fabricated; thus the project fits well into the Hon'ble Prime Ministers' 'Make in India' concept. The technology is ready for demonstration and transfer to the potential industry / entrepreneurs.

**Multi Product Controlled / Modified Atmosphere (CA/MA) Storage Unit for Post Harvest Management & Shelf Life Extension of Fruits & Vegetables**

India, which is the second largest producer of fruits and vegetables, is still struggling to achieve self-sufficiency to feed about 800 million people among its 1.2 billion populations. About 35% of the fruits and vegetables are wasted due to poor storage facility resulting in a revenue loss of Rs. 500 billion each year. Owing to these losses, shelf life extension along with sustaining the freshness and the nutritive value of perishables gains prime importance of post-harvest management of fruits & vegetables. In order to prevent these post-harvest losses, a multi-product CA/MA facility for storage of fresh fruits and vegetables was designed, fabricated and established by my research team at Indian Institute of Technology Kharagpur with financial aid from the Department of Biotechnology, Government of India. This unit has four chambers (capacity 250 kg each) and each chamber has provisions to separately control, monitor & measure the parameters like $O_2$ (0-21%), $CO_2$ (0.03-25%), $C_2H_4$ (0-10,000 ppm), temperature (0-50 °C) and relative humidity (10-95%). The CA/MA unit delays the ripening of the fresh produces by reducing its respiration rate achieved by maintaining the temperature, RH and concentration of gases in combination as needed for the respective produces. Studies on the CA storage of tomatoes, guava, mushroom and banana are undertaken in this unit. The synergistic effects of CA storage with the already developed process technologies of active packaging (extended shelf life 55 days) and edible coating (extended shelf life 48 days) for tomatoes are also evaluated.

***ANNEXURE - 1***

**Research Publications in Peer Reviewed International / National Journals**

1. Panigrahi C, Mishra HN, De S (2023). Combined ultrafiltration and ozone processing of sugarcane juice: Quantitative assessment of polyphenols, investigation of storage effects by multivariate techniques and shelf life prediction. Food Chemistry Advances, 2, 100214. https://doi.org/10.1016/j.focha.2023.100214

2. Thakur A, Panigrahi C, Mishra HN (2023). Formulation and characterization of a low-cost high-energy grain-based beverage premix: A multi-objective genetic algorithm approach. Food Chemistry Advances, 2, 100197.

3. Misra S, Mandliya S, Pandey P, Panigrahi C, Dalbhagat CG, Mishra HN (2023). Effect of Spray- and Freeze-Dried Microcapsules Containing Probiotics and γ-Aminobutyric Acid on Nutritional, Physicochemical, Textural, Pasting, Rheological, and Microstructural Characteristics of Composite Dough. Food and Bioprocess Technology, 1-15. https://doi.org/10.1007/s11947-023-03144-8.

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