



Central Institute of Post Harvest Engineering & Technology Ludhiana

OUR SLOGAN: PRODUCE, PROCESS AND PROSPER

**CIPHET E – Newsletter for December 2010
Vol. 5 No. 12**

Director's Column



Dear All

An important event this month was a meeting called by Hon DG to develop a road map for rainbow revolution (second green revolution) in north-eastern states. These states offer great promise and potential in meeting food security concerns of the country in near future if their production potential is fully exploited with modern technological interventions.

Similarly attention was paid for accelerating the research and technology development in secondary agriculture to harness the full potential of the bio mass produced by extracting the bioactive compounds and modernizing the value chain to suit these industries. A brainstorming meet was held for this purpose under the chairmanship Hon'ble DG, ICAR on December 13, 2011.

The biggest asset of ICAR for effective transfer of technologies is KVK set up spread across the country. A National Conference on KVK-2010 KVK discussed on technological development in all sectors of agriculture which could be taken up by KVK's including the modernization efforts of value chain of nutritionally important crops under NAIP. The progress and success of these value chains were presented which could be replicated by KVKs either partially or fully based on specific problem.

Three national training programmes and an international training were organized at CIPHET. A national training programme on 'Agro Process Equipment Design' was for Research Engineers/Principal Investigators of AICRP on PHT centres. The NAIP Sponsored Training on Value Addition to Ginger was for scientists, Research Associates (RA's), socials workers and Seven-day Training Programme on Post Harvest Technology for Rural Catchments for Farmers from Bihar and International Training for Participant from AARDO Member Countries

CIPHET also participated in the exhibitions namely CII AGRO-TECH 2010 at Chandigarh and KVK Conference exhibition at Udaipur. We transferred Ready-to-eat Makhana Kheer Mix Technology to entrepreneur from Bihar and Microencapsulator Technology to AP based Biotech Company

Another Major event was Celebration of Foundation Day of CIPHET Dec 29, 2010. Dr. Anil P Joshi, from HESCO and Padam Shree Awardee was chief guest. On the occasion, CIPHET released its publications and cultural event was also organized to mark the day. We got an important project on "Microencapsulation methods for bacteriocins for their controlled release" about Rs. 2 Crores with Dr. K.Narsaiah, Sr. Scientist as the project leader. Our scientists attended International Conference on Traditional Foods 2010 and Annual Conference of the Association of Microbiologists of India

Technology flashed this month is for production cereal-soy tempeh. Tempeh is a very versatile product and can be used in combination with many different recipes and dishes.

With best regards

**R.T. Patil
Director**

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Rainbow Revolution (Second Green Revolution) in North-Eastern States

An interaction meeting of ICAR officials, Directors and State Govt. officials to suggest a road map for rainbow revolution (second green revolution) in north-eastern states was organized during December 11-13, 2010 at ICAR Research Complex for Eastern Region, Patna under chairmanship Hon. DG, ICAR. From the various issues discussed the research needs were identified sector-wise, namely, Natural Resource Management; Field Crops; Horticultural Crops; Animal Science; Fisheries; Farm Machinery; and Post Harvest Technologies.

Brain Storming Meet on Post Harvest Technology and Value Addition (Secondary Agriculture)

A brainstorming meeting on Post Harvest Technology and Value Addition (secondary agriculture) was held under the chairmanship Hon'ble DG, ICAR on December 13, 2011. Director CIPHET made the presentation on "Status, Emerging Challenges and Strategies on Post Harvest Technology and Value Addition for Different Commodities" which was a basis for further discussions. The aim of the brainstorming session was to identify the key projects on which research needs to be accelerated. The session was attended by ICAR DDGs, National Director NAIP and Directors of most of the commodity and engineering institutes. The major points emerged during the session included research on production of high ended secondary agriculture products can be taken up without affecting the need and necessities of Indian agriculture. Many important areas such as use of livestock processing waste and fish processing waste for bioactive compound extraction, use of natural fibers for bio plastics and bio composites, culled potato and tapioca for bio plastics, extraction of pectin's from peels of fruits, production of bio ethenol, exaction of vitamins and dietary fibre from vegetable waste taking place in bigger markets like Azadpur Mandi in Delhi along with the use of spent material as animal feed were discussed in length. Experts Dr. Alam, Dr. Pathak and Dr. Kachru also shared their experience and appreciated the accelerated efforts of ICAR to strengthen the post harvest sector in the country. A committee was set up under the chairmanship of Dr. M.M Pandey, DDG (Engg.) consisting of Dr. Srinivasan, Ex Director, Central Institute for Research on Cotton Technology (CIRCOT), Dr. Chandra, Director Central Institute of Agricultural Engineering (CIAE) and Dr. Patil, Director CIPHET, to collect and screen the projects from different institutes and prepare a proposal for submission to planning commission.

National Conference on KVK-2010

National Conference on KVK-2010 was held during December 22-24, 2010 at Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan. Director CIPHET, Dr. RT Patil was a panelist in the session for presentation on the progress of value chain projects funded by NAIP. The chairman of the session was Dr. S.L. Mehta and Co-chairman Dr. Bangali Baboo. Other panelist was Dr. M.M. Anwar, Director, NRC on Seed Spices. Following value chain were presented which could be replicated by KVKs either partially or fully based on specific problem.

1. Value chain in Coconut
2. Value chain in major seeds, spices for domestic and export promotion
3. Protected cultivation of high value vegetables and cut flower-a value chain approach
4. Flowers for domestic and export markets
5. Value chain on Ginger and Ginger products
6. Value chain on Mango and Guava for domestic and export market
7. Value chain on high value shellfish from Mariculture Systems
8. Value chain on composite dairy food with enhanced health attributes
9. A value chain on commercialization of maize and maize products
10. A value chain on enrichment and popularization of potential food grains for neutraceutical
11. Value chain on Creation for Demand for Millet Foods through PCS Value-Chain
12. A value chain on utilization of banana pseudo stem for fibre and other value added products
13. value chain on biomass-based decentralized power generation for agro enterprises
14. Bio-pesticide mediated value chain for clean vegetables
15. Success Story on Kashmir Apiaries Exports, Ludhiana

Training Programme on Agro Process Equipment

A training programme on 'Agro Process Equipment Design' was jointly organized by TOT Division and PHT Coordinating Unit, CIPHET Ludhiana from December 27, 2010 to Jan 7, 2011. The purpose of training was two fold. First was, to refresh scientific acumen of Research Engineers/Principal Investigators of AICRP on PHT centres, and to provide them the basic and comprehensive understanding pertaining to fundamental areas in post harvest sector so that they can



tune their research proposals in a more scientific manner. Secondly, RE/PI could get an opportunity to expand their horizon on non engineering aspects such as microbiology; prediction modeling, etc. Nonetheless, RE/PI and scientist took a good stock on engineering particularly design aspects and formulation of value added products. Around 34 participants from almost all cooperating centres actively participated and also shared their experiences. More than 40 lectures on diverse topics related to extrusion processing, product formulation and quality attributes of extruded products; Design of thresher, grader, and expeller; innovative mechanical designs by common men; biochemical and microbiological aspects of food including livestock produce (isolation techniques, application of enzymes); gadgets and safer techniques for pest control of stored grains; prediction modeling, and cost estimation of post harvest equipments, etc. were delivered. Moreover, hands on practice on media preparation, and softwares such as Pro-E, Sixpap (Linear Programming), Agriventure, Response Surface Methodology were done. CIPHET faculty and eminent personalities invited from MERADO, PAU, GADVASU, PU, and some of the centres of AICRP on PHT delivered the lectures. Besides learning, New Year 2011 celebration with the fraternity of post harvest engineers and scientist of the country was unique in itself. The training was successfully completed on Jan 7, 2011 with concluding session and distribution of the certificates by Dr. R. T. Patil, Director, CIPHET.

Application of Plastics in Agriculture

Dr. P. R. Bhatnagar, PC (APA) visited to College of Agricultural Engineering and Post Harvest Technology, Gangtok centres during 3-8 December, 2010. At this centre research on



Visit to NRC for Orchid, Gangtok

low cost bamboo polyhouse and package of practices for Gerbera and vegetable cultivation is going on. He also visited NRC for Orchids to see growing of orchids in polyhouses. Several varieties of Orchids were grown in the polyhouses. They have more than 25



Visit to farmer's field in village Karanj jani, Dapoli

polyhouses having different shapes and sizes.

He also visited BSKKV, Dapoli to see horticultural and plasticulture activities in Konkan region and nearby areas during 11-17 December 2011. At Agriculture Research Station of BSKV at Palghar, they have polyhouses in which off-season vegetables were being grown. He also visited 2-3 progressive farmers at village Pamali, Kelwa and Bhilar (Pachgani) adopting plasticulture technology.



Visiting strawberry growing area in Mahabaleshwar

He also gave presentation in the CAET and interacted with collage faculties, final year student and M. tech students.

Visited collage of fishery, Ratnagiri where FRP tubs and polythene lined ponds were used for nursery of marine fishes and also visited Konkan Bamboo & Cane Development Centre, Kudal for observing the equipments used for pressure bamboo treatment.



Bamboo Treatment plant at Konkan Bamboo and Cane Development centre, Kudal (District Sindhudurg, Maharashtra)

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CIPHET participated in CII AGRO-TECH 2010

Technologies like rotary maize sheller and banana comb cutter attracted heavy rush of visitors to the stall of Central Institute of Post Harvest Engineering and Technology during the CII AGRO-TECH 2010 going on at Chandigarh during Dec 2-6, 2011. Indian Council of Agricultural Research (ICAR) institutes including Central Soil and Water Conservation Research and Training Institute, Dehradun and Central



Institute of Agricultural Engineering, Bhopal also displayed their technologies.

“We have participated in various exhibitions but never saw such a rush of people inquiring about technologies of CIPHET,” said, Technical Officer of CIPHET O.P Moondan, adding that farmers/entrepreneurs were especially interested to know about post harvest technologies as they think that it could be only way to help increase their income substantially. Saying that thousands of visitors are arriving every day, O.P Moondan said that farmers were more inquiring about rotary maize sheller, banana comb cutter, evaporative cooled room, basket centrifuge and value added ready to eat vegetable blended meat products. CIPHET on the occasion also displayed mechanically operated Pomegranate Aril Extractor (PME) and hand held PME. While hand held PME is useful for separating pomegranate at small scale, mechanically PME is useful for extracting arils at commercial scale. Any size and variety of pomegranate could be processed with extraction capacity of 90 to 94 percent. Mechanical damage to arils is reported as less as 3 to 4 percent during processing.

CIPHET Offered NAIP Sponsored Training on Value Addition to Ginger

The National Agricultural Innovation Project is a unique world bank supported activity of Indian Council of Agricultural Research (ICAR). Under this project the value chain for nutritionally rich and economically important crops of India are being modernised using the modern scientific techniques developed by ICAR institutes and SAUs. As a part of this activity CIPHET has been recognised as knowledge provider in the area of post harvest management and value addition. To provide hands on experience in production of various products from ginger, Central Institute of Post Harvest Engineering and Technology conducted a nine-day long training on Post Harvest Management and Value Addition of Ginger for participants from Orissa University of Agriculture and Technology (OUA&T). Training programme, in which scientists, Research Associates (RA's), socials workers and agriculturist took part, concluded on December 8, 2011.



Dr R.T Patil, Director CIPHET and staff with participants of training programme on ginger processing at CIPHET

Ginger, which is consumed as spice as well as for medicinal value, is mainly grown in southern and north eastern states of the country. Kerala, which is largest producer, accounts for 25 percent production of ginger crop in the country. Recently, use of ginger flavor has increased in a number of products by food processing industry, while its medicinal properties are known for ages in India. The aim of training programme was to give exposure to participants in production of various value added products of ginger so as to increase their shelf life and export potential. For providing practical exposure, participants were taken to industrial visits covering Markfed and Nijjer Agro-Tech Amritsar. The major areas of training programme included processing of ginger into powder, extraction of oleoresin and, preparation of pickle, packaging and storage of the products,, micro-biological quality evaluation of ginger products, extraction of bio-molecules from ginger, nano-composties for packaging of ginger, operation and maintenance of dryers, low cost storage of ginger etc. Dr. Dhingra and Dr. Indu Karki coordinated the training.

CIPHET Transferred Ready-to-eat Makhana Kheer Mix Technology

CIPHET transferred the ready to constitute Makhana Kheer Mix technology to a Bihar based woman entrepreneur. Memorandum of Understanding has been signed in this regard.



Project Coordinator Dr S.K Nanda transferring the technology

The developed Makhana kheer mix has longer shelf life and just a hot water is added in mix and stir for consuming ready to eat makhana kheer mix. Transferring the technology, Project Coordinator (PHT) Dr. S.K Nanda said that technology had lot of potential for successful adoption even at small scale. Dr. Patil, Director CIPHET while explaining the scope of Makhana processing informed that Makhana is a produce of Bihar and is grown in leased ponds by mostly landless people.

"The processing of Makhana in to value added products at production catchment definitely will help increase the income of this population. CIPHET has also been working in collaboration with Bihar based institute for developing a makhana popping unit to mechanize this operation and reduce drudgery of the people engaged in Makhana popping industry.

Gouri Mahto, entrepreneur from Bihar who got technology, said that they were already in business of selling cleaned Makhana in packets. "Adoption CIPHET makhana kheer mix technology would help us to enter in new markets," she said, adding that was getting full support from her husband.

Seven-day Training Programme on Post Harvest Technology for Rural Catchments for Farmers from Bihar

Farmers of India could only be happy when they are able to get substantial share of the amount minted by middlemen before product finally reaches in hands of consumers, said Dr. R.T Patil, Director of the Central Institute of Post Harvest Engineering and Technology, during inaugural of seven-day training on "Post Harvest Technology for Rural Catchments" for participants from Kaimur, Bihar. Around twenty participants including farmers, Subject Matter Specialists and agricultural university students from Maharashtra took part in the training programme. Saying that adoption of food processing and direct marketing could pave way of progress for farmers, Dr Patil, said that farmers of Thailand and Malaysia were far ahead in terms of tapping opportunities in value addition in fast globalizing world. "MacDonald every year imports dried tomatoes worth Rs 280 crore from these countries for its franchisees in India," he said, adding that local farmers with little investment could easily become suppliers for them.

Stressing on increasing processing at rural catchments, Dr. Patil, said that this would help in overall up-liftment of villages and would make them more self reliant. "Many farmers from Bihar have already started their processing industry after getting their training from CIPHET.

The programme covered areas of processing and value addition of technologies for soyabean, processing and value addition of beetroot and carrot, concept of agro processing center for rural production catchments, food packaging for rural catchments, processing and

value addition of groundnut, meat processing technologies, post harvest processing of minor fruits and vegetables, low cost storage of fruits and vegetables, minimal processing of fruits and vegetables and energy efficiency in food processing industry etc. On the occasion of valedictory function, Project Coordinator Dr. S.K Nanda distributed certificates to farmers participated in the training programme. Assuring all possible assistance, he hoped that farmers would be increasing their income by adopting novel technologies of CIPHET.



Dr Deepak Raj Rai distributing certificates to Bihar farmers at CIPHET

Transfer of Microencapsulator Technology to AP based Biotech Company

CIPHET licensed the microencapsulation technology for encapsulation of food ingredient/enzymes to Andhra Pradesh based M/s Unique Biotech Ltd., Hyderabad. The technology is highly useful for biotechnology and nutraceutical industries. As per the MoU, M/s. Unique Biotech Ltd. would be getting non-exclusive rights for droplet generator of microencapsulator developed by the CIPHET. The technology was jointly developed by Senior Scientists Dr. K. Narsaiah and Dr. H.S. Oberoi.

Celebration of Foundation Day of CIPHET

“Judging growth of country by increasing GDP is not correct. The growth of country should be judged from fact how much better we have moved in terms of environment from previous years and how much more food we are able to make available to poorest of poor,” this was stated by Dr. Anil P Joshi, who got Padam Shree Award in year 2006, for his outstanding service in rural upliftment and environmental conservation. He was a chief guest for the foundation day celebration of Central Institute of Post Harvest Engineering and Technology (CIPHET) on Dec 29, 2010.



Dr Anil Joshi addressing CIPHET Staff on the occasion of institute's foundation day

Taking different line for GDP as growth indicator, Dr. Anil P Joshi said that it was only an indicator of growth of already prosperous people in the country. “Gross environmental productivity should be taken as an indicator for the growth of the country. Every year we are polluting and reducing our natural resources. Most of our rivers are getting dried up, air got polluted, soil is getting infertile due to excessive use of chemical fertilizers,” he said, adding that if corrective steps were not taken results would be disastrous in near future.

“Few decades back nobody would have imagined that water would be sold in bottles. It might be possible that in near future there might be centers for taking fresh oxygen in highly polluted areas,” he added. Dr. Joshi said that prosperity in villages could return through self-dependency only. “Earlier, most of the village necessities used to be fulfilled at local level only. Now, they are getting things from cities which otherwise could be processed and grown in villages only. The self-sustainability models implemented by Dr. Joshi in few villages and showed that it is possible to produce 75 percent of their requirements at village level only,” he said, adding that farmers need to take role scientists to make agriculture

sustainable and scientists need to take role of farmer to produce acceptable and appropriate technology. On the occasion, CIPHET released its publications and cultural event was also organized to mark the day.

CIPHET Cotton Ginning Plant put on Operation

Cotton ginning plant available at CIPHET Abohar was made available for ginning of cotton on custom hiring basis to the farmers as well as entrepreneurs of Abohar region. It was evaluated for ginning of cotton produced at CIPHET, Abohar Farm. The capacity of plant was observed to the tune of 4-5 quintal per hour. The ginning plant separates the cotton in to lint and seed. Ginning trials of the Variety *HH-123 Desi* cotton was evaluated in which 33 % lint and 66 % cotton seeds were obtained. However, the losses due to dust and other impurities were around 1.0 percent.



CIPHET Cotton Ginning Plant in operation

International Training for Participant from AARDO Member Countries

International training course on Post Harvest Management & Technology for Loss reduction and Value addition of Horticultural Produce for AARDO member countries was sponsored by Ministry of Rural Development, Government of India at CIPHET, Ludhiana/Abohar during 24th November to 07th December, 2010. Prof. Dr. Mustafa Saleh Emam from Egypt participated in the training programme. The course included lectures, practical and field visits. The training covered information on small scale fruit processing equipment developed in India, Low cost poly houses for production of off season vegetables, Minimal processing of fruits and vegetables, role of cold chain in post harvest management of perishables, Non-destructive technique for quality evaluation of fruits, Texture analysis and quality of fruits and vegetable, Dehydration of fruits and vegetables, Nutritional and Sensory quality evaluation of Food products, Food regulations and international standards, Low cost storage structures for on-farm storage of fruits and vegetables, Osmosis and membrane technology, Basic unit operations in fruits and vegetable processing etc. hand on training also imported for preparation of value added products Aonla, shrink wrapping, vacuum packaging etc. Dr. R. K. Gupta, HOD, HCP and Er. R.K. Vishwakarma, Scientist were Course Coordinators.



Participant observing preparation of value added products from Aonla

Annual Conference of the Association of Microbiologists of India

Dr. Harinder Singh Oberoi, Senior Scientist, delivered an invited talk on “Evaluation of soft carbohydrates in enzymatic saccharification of rice straw and bagasse” at the 51 st annual conference of the Association of Microbiologists of India (AMI) held at Birla Institute of

Technology, Mesra, Ranchi. During his presentation, Dr. Oberoi stressed upon the need of enzymatic extraction of soft carbohydrates such as starch, β -1,3-1,4-glucan, sucrose, free glucose and free fructose, which otherwise get degraded by harsh pretreatments. The soft carbohydrates have the potential for production of value-added products, such as ethanol, organic acids and platform chemicals through fermentation. The use of crude enzyme extracted from a newly isolated strain of *Aspergillus niger* were also discussed during the presentation. In addition to the invited talk, Dr. Oberoi and his team presented three posters on “Enzymatic hydrolysis of alkali-pretreated sugarcane bagasse by crude enzyme produced by a newly isolated strain of *Aspergillus niger*”; “Hydrolysis of alkali- and ozone-treated cotton stalks with cellulolytic and pectinolytic enzymes” and “Statistical optimization of hydrolysis process for Kinnow Mandarin (*Citrus reticulata*) peel using crude enzyme consortium obtained from newly isolated *Aspergillus oryzae*”. Association of Microbiologists of India is the largest and oldest scientific association/ society with over 3000 life members.

The highlight of the conference was a presentation on Micro microscope developed by Mr. Ramendralal Mukhopadhyay. He is an Engineer by profession who left lucrative jobs and has set up a lab at his home. He has got fourteen patents on his name and has developed microscopes which can be carried to any place and fit into our trouser pockets with a fixed magnification of 50x. Another micro microscope developed by him can magnify the specimen by 750 times. He is coming up with a scanning electron microscope (SEM) and transmission electron microscope (TEM) in a couple of months time which he proposes to make available at a cost ranging from Rs. 40,000-50,000. The other microscopes mentioned above are available for a price ranging from Rs 700-Rs 2000 only. SEM and TEM can be connected to the computer and the image can be used for publications or any documentation or any other application as desired by the end user. It will have a great impact on educational and research institutions as the micro microscopes are handy, cheap with multiple uses. Mr. Mukhopadhyay has also developed such devices for eye surgeons, ENT surgeons and skin specialists and has won several awards for his work.

Technologies Licensed

1. Design of droplet generator of microencapsulator was licensed to M/S Unique Biotech Ltd, Hyderabad for trial run for production of micro capsules of probiotics on 13/12/2010
2. Process to manufacture ready to constitute makhana kheer mix for commercialization was licensed to M/S Vijay Raj and Company, Baheri, Darbhanga, Bihar on 22/12/2010.

Advisory consultancy members registered during December. 2010.

1. Mr. Munish Chawla 1149, Phase-I, Urban Estate, Dugri, Ludhiana (Mob.9814117591).
2. Mr. Bhogendra Lal, Executive Director, BIADA, Patna.

CIPHET gets a project titled “Microencapsulation methods for bacteriocins for their controlled release” under NBSFARA

Indian Council of Agricultural Research (ICAR) supports basic and strategic research of national and long-term importance to break yield and quality barriers and make India a global leader in research for development, through the partnership of all research organizations under national fund for basic, strategic and, frontier application research in agriculture (NBSFARA). Concept notes were invited with collaborative and multi-

institutional research based on innovative ideas for solving advanced scientific and technological problems in agriculture in open competitive mode and best ones are selected for grant of projects. CIPHET got an important project on “Microencapsulation methods for bacteriocins for their controlled release” about Rs. 2 Crores with Dr. K.Narsaiah, Sr. Scientist as the project leader. The project aims to develop simple as well as advanced microencapsulation systems and processes for encapsulation of food ingredients, nutraceuticals and biopreservatives.

International Conference on Traditional Foods 2010

Food is an integral part of all cultures and has been co evolving parallel to human civilisation. With rapid urbanisation and modernisation, some of the traditional foods have been either become extinct, marginalised or some others have been retaining their prominence in the society through adaptations. In the recent years, there has been increasing interest towards traditional foods throughout the world due to their importance in health, nutrition as well as their immense commercial potentials. In addition, there has also been an initiative to conserve the traditional foods before they become extinct. With the aim of bringing scientists and professionals working with or interested in traditional food to come together and discuss the recent advancements in the field as well as to discuss how to harvest the full potentials of traditional foods in the changing world scenerio, the Department of Food Science and Technology of the Pondicherry University will be organising a three day International Conference on Traditional Foods (ICTF-2010) here on December 1-3, 2010. Dr D N Yadav, Sr Scientist from CIPHET attended the conference and presented (Oral) research paper “**Development of pearl millet based instant halwa dry mix**” authored by D N Yadav, S Balasubramanian, Jaspreet Kaur and Tanupriya Anand.



Technology of the Month:

Development of a technology for home production of cereal-soy tempeh

Tempeh is traditionally a soy based fermented food produced by using a living fungus (*Rhizopus* spp. mostly). Tempeh can also be prepared from wide variety of other grains, beans and cereals with endless combinations which results in unique flavours. The main purpose of combining cereal e.g. rice to soybean for tempeh preparation was to enhance the nutritional value because of protein complementarity. Moreover, the fibre content of the cereals can be improved well by optimal mixing of the substrates upon removal of the sodium and antinutritional factors during fermentation process from cereals and soybeans respectively. The microorganism also adds valuable amino acids, vitamins to the end product in the form of tempeh.

Kwashiorkor, the result of protein deficiency and marasmus due to both protein and calorie deficiencies are found in large numbers of children between the ages of 1 to 3 in India. Hence there is to search for a new and unconventional source of protein (to meet the requirement of the ever-expanding population), and tempeh products from rice-soy mix could definitely prove effective tall to supplement low protein staple diet in the country. Hence, a simple technology was developed for production of cereal-soy tempeh for home scale production.

Three tempeh producing microbial strains of *Rhizopus oryzae* has been isolated at CIPHET, Ludhiana. Among these strains *Rhizopus oryzae* ITCC 4698 proved to be the best for tempeh fermentation. Manoeuvring the perforation number of tempeh container optimally expedited the fermentation at room temperature. Ratio of rice-soy mix influences the textural and nutritional quality of the tempeh with the ratio 40:60 (w/w) registering the best chewiness feature. Standard kitchen container (5 x 9.5 cm) with 50-60 perforations was found to be a better utensil for rice soy tempeh production as compared to plastic pouches. The raw tempeh before frying contains about 32% protein, 14% fat, 13% carbohydrates. Rice soy tempeh has relatively high amount of protein and dietary fibre and low amount of sodium and energy as compared to white rice.

The process of making cereal soy tempeh mainly consists of blanching of rice and soy splits at ratio 40:60 (w/w) separately in water for 10 min and 30 min respectively. The water is drained and the substrates are cooled to 40°C and mixed. Upon inoculation of the substrate mix with fungal culture the material is packed in stainless steel container @ 150 gm (wb) with appropriate no perforations on the side walls and kept for incubation at 30 °C for 30-35 hrs. After harvest boiling in 2% brine solution and drying and / or deep frying are the various ways of consumption of tempeh. Dried tempeh at 5-6% moisture was found to be suitable for storage while freeze drying was more effective method of preservation.

Uses and Preparation of Tempeh

Tempeh is a very versatile product and can be used in combination with many different recipes and dishes. Tempeh can be served with grains and eggs for a breakfast item or in salads, sandwiches, burgers, sauces, or soups for a lunch or dinner. When using tempeh as an ingredient in recipes such as for salads, soups sauces, or casseroles, frying is a recommended step to ensure a crisp texture. Deep-fat frying and pan frying tempeh in vegetable oil or margarine yields a crisp, golden brown coloured product. Before frying, sliced tempeh can be dipped in soy or fish sauce, and a batter made from corn or rice flour and coconut milk. Furthermore, the fried tempeh can be served on a bun with tomato, onion slices, and lettuce.



Tempeh production in kitchen container



Tempeh harvested at 24-28 h



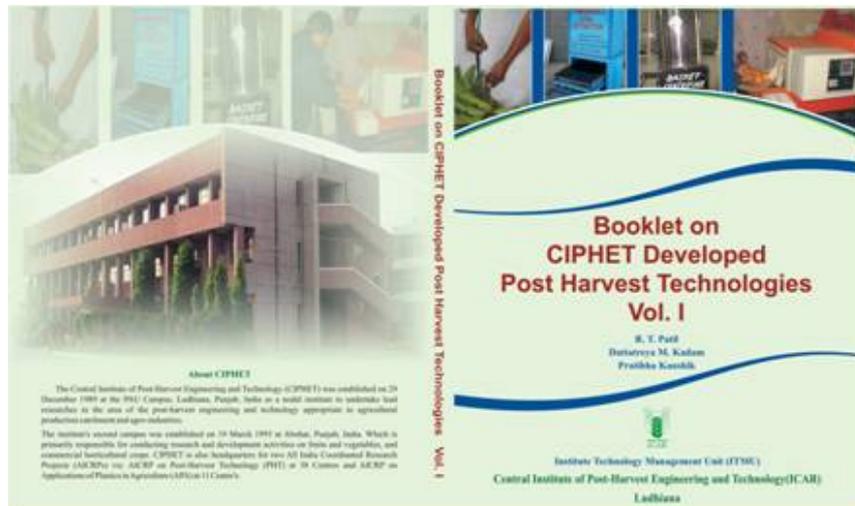
Rice soy (50:50) tempeh powder



Tempeh powder packed for preservation

Tempeh production, processing and packaging

Publication of the Month



Booklet on CIPHET Developed Post-Harvest Technologies Vol. I

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