वार्षिक प्रतिवेदन
Annual Report
2017-18

ICAR-Central Institute of Post-Harvest Engineering and Technology
Ludhiana-141004, Punjab, India
(An ISO 9001:2015 Certified Institution)

Annual Report 2017-18

ICAR-Central Institute of Post-Harvest Engineering and Technology

P.O.: PAU, Ludhiana-141 004 (Punjab), India

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(An ISO 9001:2015 Certified Institute)

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PREFACE

ICAR-CIPHET holds an exclusive position as a national institute for its research in the area of Post-Harvest Engineering and Technology with the potential to increase the profitability of the farmers and provide employment opportunities to the youth by value addition of main produce, reduction of post-harvest losses and utilization of agricultural by-products. The institute is contributing significantly along with two All India Coordinated research projects (AICRPs) and two consortium research platforms (CRPs). SFC of ICAR-CIPHET including its sub schemes was approved by the ICAR with a budgetary provision of Rs. 9356.46 lakhs for the year 2017-20.

The Institute showed appreciative research outcome in post-harvest machinery and equipment such as mini pilot plant for extraction of pectin from kinnow peel, device for detection and identification of insects in grains, continuous microwave popping system and a semi-automatic fish cleaning-cum-dressing system.

The process technologies were standardized for high nutritional, convenient and functional products such as micronutrients enriched reconstituted rice and wheat products, maize and millet based gluten free chapatti, groundnut milk powder, pasta from sprouted grains, anthocyanin rich pasta and ice-cream. Adulteration concerns of turmeric was addressed this year and detection methods for metanil yellow and lead chromate in turmeric powder were standarised.

The global visibility of the Institute was facilitated with programmes like International training Program on "Modern Storage Technologies in Agriculture" during 01-15 September, 2017 and National Conference on 'Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector' during March 16-17, 2018. Besides this, the Institute was actively involved in capacity building and organized three ICAR sponsored summer/ winter schools, one model training course, sixteen entrepreneurship development programs (EDP), nine farmers training and two officer's training. Institute technologies were showcased and demonstrated to various stakeholders during participation in *kisan melas*/ exhibitions.

Technology transfer and patents are the continuous effort to enhance the visibility of Institute research. In 2017-18, two technologies were licensed and three patents were granted. The academic excellence of Scientists was shown in form of research papers published in national and international peer reviewed journals and through prestigious awards received during 2017-18. I am thankful to Research Advisory Committee for its valuable guidance in research programmes.

Efforts were made to enhance the usage of hindi language in routine office work and to implement important schemes like *Swachh Bharat Mission* and *Mera Gaon Mera Gaurav.* ICAR-CIPHET will continue to work on research and development related to Post-Harvest Engineering & Technological innovations and interventions. I believe that, our team will keep its untiring efforts to showcase its excellence in Post-Harvest Research and Development. I invite all to browse through the ICAR-CIPHET website to learn more about us.

(R.K. Gupta)
Director

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आई सी ए आर–सीफेट कटाई–उपरांत अभियांत्रिकी एवं प्रौद्योगिकी के क्षेत्र में एक महत्वपूर्ण अग्रणी संस्थान है जो कृषि उत्पाद क्षेत्र एवं कृषि प्रसंस्करण उद्योगों के अनुकूल शोधकार्य करने के लिए निर्देशित है। वर्ष 2017–18 में, संस्थान ने कटाई उपरांत प्रौद्योगिकी के साथ–साथ कटाई–उपरांत उपकरण एवं मशीनरी, उत्पाद एवं प्रक्रिया प्रौद्यिोगिकी, खाद्य गुणवत्ता एवं सुरक्षा और इसके अलावा क्षमता निर्माण, प्रशिक्षण विस्तार गतिविधियों और लाइसेंसिंग के माध्यम से शोध तकनीको के हस्तांतरण के क्षेत्र में महत्वपूर्ण प्रगति की है। महत्वपूर्ण उपलब्धियाँ एवं प्रगति नीचे उल्लेखित की गई है।

संस्थान कटाई–उपरांत प्रौद्योगिकी के व्यापक क्षेत्र में काम करता है जिसमें कटाई–उपरांत प्रौद्योगिकी के उपकरण एवं मशीनरी, उत्पाद और प्रक्रिया, प्रोटोकॉल तथा खाद्य गुणवत्ता, सुरक्षा एवं प्रौद्योगिकी, लाइसेंसिंग तथा प्रशिक्षण एवं क्षमता विस्तार एवं निर्माण गतिविधियों के माध्यम से अनुसंधान निष्कर्षों का हस्तांतरण भी शामिल है। 2017–18 में, संस्थान वित्त पोषित कुल परियोजनाएं 45 है और नई परियोजानाएं सहित बाहर से वित्त पोषित कुल 14 परियोजानाएं चल रही हैं। वर्ष 2017–18 के दौरान चिह्नित महत्वपूर्ण उपलब्धियों पर चर्चा की नीचे की गई है।

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पेक्टिन के निष्कर्षण के लिए छोटा पायलट संयंत्र 5.0 किलो/घंटा कच्ची सामाग्री प्रसंस्करण (किन्नू छिलका पाउडर) की क्षमता का बनाया गया है। अनाज में कीड़ों का पता लगाने एवं पहचाने के लिए एक स्मार्ट यन्त्र को रूपांकण और विकसित किया गया है। वजन के आधार पर टमाटर का स्वचालित छँटाई यन्त्र विकसित किया गया है। सतत् माइक्रोवेव पॉपिंग संयत्र, माइक्रोवेव ऊर्जा/विकिरण के लिए उपयुक्त सामग्री का उपयोग कर संरचित और विकसित किया गया है। मशीन की क्षमता लगभग 1 किलो/घंटा है। मानवीय कठनाई के मुद्दों को हल करने के लिए, महिला अनुकूलित मछली ड्रेसिंग–व–सफाई स्टेशन विकसित किया गया। कम वसा वाले मांस का उपयोग करके 10–12 किलो/घंटा की क्षमता वाले मांस बॉल बनाने की मशीन के लिए एक आधरूप (प्रोटोटाइप) विकसित किया गया है।

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सूक्ष्म पोषक तत्वों के समृद्धिकरण हेतु (फोर्टिफिकेशन) एफएसएसएआई मानकों का पालन करने हुए चावल समृद्धिकरण के लिए सूक्ष्म पोषक तत्वों से युक्त पुनर्निमित चावल विकसित किया गया। काले चावल में एंथोसायनिन के निष्कर्षण की विधि का अनुकूलन किया गया एवं प्राप्त एंथोसायनिन से आइसक्रीम को संवर्धित भी किया गया। इसके अतिरिक्त एंथोसायनिन समृद्ध पास्ता बनाया गया जो एंटीऑकसीडेंट से परिपूर्ण पाया गया। अंकुरित रागी, चना एवं सूजी के उपयोग से भी पास्ता बनाया गया है। इसके अतिरिक्त करक्यूमिन को घी में मिलाया गया और माइक्रो इनकैप्सूलेट करक्यूमिन को शीतलन प्रक्रिया के अंत में, कुल्फी में मिलाया गया। मूँगफली दूध पाउडर के उत्पादन के लिए अनुकूलित स्प्रे विधि से सुखाने के पैमाने निर्धारित किए गए। इन अनुकूलित परिस्थितियों के तहत उत्पादित पाउडर को टिन के धातु डब्बे और अल्युमिनियम थैली में रखा जा सकता है।

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हल्दी में पीले रंग के मेटानिल के परिमाणन के लिए दृश्य स्पेक्ट्रोस्कोपी का उपयोग करके विधि विकसित की गई जिसमें पता लगाने और परिमाणन की सीमायें क्रमश: 0.053 और 0.16 माइक्रोग्राम/मिलीमीटर थी। हल्दी में लैड क्रोमेट की मात्रा का आकलन करने की विधि विकसित की जिसकी पता लगाने की सीमा 0.1–0.2% थी। किन्नू, अंगूर और नारंगी के छिलके से मेथॉक्सिल पेक्टिन के निष्कर्षण और उपयोग के लिए एक प्रक्रिया विकसित की गई है।

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कटाई–उपरान्त अभियान्त्रिकी एवं प्रौद्योगिकी (पीएचईटी) पर ए आई सी आर पी के अन्तर्गत विभिन्न मशीनों, उत्पादों और प्रक्रिया संलेखों (प्रोटोकॉलों) जैसे इमली डीहलर और पोंगामिया डिकोर्टिकेटर, हल्दी ड्रायर और धूल मुक्त हल्दी पॉलिशर, बांस के डंठल में पकाए हुये चावल, छोटे आकार के सूखे झींगो का चटनी चूर्ण, मधुकोश छत्ता पैकेजिंग सामग्री उत्पादन मशीन, चिरोंजी विवल्कनित्र (डिकोर्टिकेटर) मशीन आदि विकसित की गयी है। प्लास्टिक अभियान्त्रिकी एवं प्रौद्योगिकी (पीईटी) पर ए आई सी आर पी की उपलब्धियाँ इस प्रकार है–संरक्षित माहौल में गैर मौसमी भिंडी की खेती के लिए कृषि तकनीक, पहाडियों के लिए सौर कैबिनेट ड्रायर, श्रीनगर क्षेत्र के लिए पॉलीहाउस में जैविक टमाटर की खेती, गर्मियों के मौसम में गुच्छा प्रकार की मूंगफली की खेती, रायचुर क्षेत्र में टपकन (ड्रिप) सिंचाई के साथ रंगीन प्लास्टिक मल्च से अरहर की खेती, प्राकृतिक रूप से हवादार पॉलीहाउस के नीचे ककड़ी और टमाटर की खेती, पहाडियों के लिए हस्तचालित मल्च बिछाने व रिटाइवल मशीन, जलीय कृषि में कम लागत वाले एक्वापोनिक्स सिस्टम, फल और सब्जियों के परिवहन के लिए चरण परिवर्तन (फेज चेंज) सामग्री आधारित मोबाइल कूल चैम्बर।

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संस्थान क्षमता निर्माण में सक्रिय रूप से संलग्न था जिसमें तीन आई सी ए आर प्रायोजित ग्रीष्म/शीतकालीन विद्यालय, एक मॉडल प्रशिक्षण, सोलह उद्यम शीलता विकास कार्यक्रम (ईडीपी), नौ किसान प्रशिक्षण, दो अधिकारियों का प्रशिक्षण, आयोजित किये। इस अवधि के दौरान कुल 162 छात्रों को भी प्रशिक्षित किया गया। संस्थान ने देश भर में कई प्रदर्शनियों में भी भाग लिया जैसे पीएयू, लुधियाना में "किसान मेला", सीआईआईआई एग्रो टेक का 13वां संस्करण, चंडीगढ़; कृषि उन्नति मेला, आईएआरआई, नई दिल्ली। किसान मेला/प्रदर्शनी में भाग लेने के दौरान संस्थान की प्रौद्योगिकियों को किसानों, उद्यमियों और शोधकर्ताओं जैसे विभिन्न हितधारकों के समक्ष प्रदर्शित किया गया।

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सत्र 2017–18 में, आई सी ए आर–सीफेट ने 01–15 सितंबर 2017 के दौरान ''कृषि में आधुनिक भण्डारण प्रौद्योगिकियों'' पर एक अंतराष्ट्रीय प्रशिक्षण कार्यक्रम आयोजित किया गया। इस प्रशिक्षण कार्यक्रम के तहत 11 देशों के (अफगानिस्तान, बोत्सवाना, कंबोडिया, घाना, केन्या, लाइबेरिया, मलावी, मंगोलिया, म्यांमार, सूडान और युगांडा) प्रतिभागियों ने भाग लिया। 16–17 मार्च, 2018 के दौरान खाद्य प्रसंस्करण क्षेत्र में परिवर्तनात्मक दृष्टिकोण के माध्यम से 'उद्यमिता विकास को बढ़ावा देने' पर एक राष्ट्रीय सम्मेलन आयोजित किया।

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शोध परिणामों को विभिन्न लाइसेंस उपयोगकर्ताओं के लिए प्रौद्ययोगिकी लाइसेंसिग और व्यावसायीकरण के रूप में प्रसारित किया गया। दो प्रौद्योगिकियों, पौष्टिक कार्यात्मक चपाती आटा और स्ट्रॉबेरी लेदर की तकनीक (स्ट्रॉबेरी बर्फी) का लाइसेंस दिया गया। इस दौरान तीन पेटेंट; मिश्रित अमरूद लेदर/पट्टी बनाने की प्रसंस्करण तकनीक, त्वरित उपयोग योग्य मखाना खीर मिश्रण और अनार के दाने निकलने की मशीन, को स्वीकृती प्रदान की गयी।

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इस अवधि के दौरान, वैज्ञानिकों ने पर्याप्त संख्या में शोध पत्र (राष्ट्रीय एवं अंतर्राष्ट्रीय सहकर्मी समीक्षा पत्रिकाओं), पुस्तक अध्याय, तकनीकी एवं लोकप्रिय लेख प्रकाशित किए और उन्हें राष्ट्रीय एवं अंतर्राष्ट्रीय स्तर के विभिन्न संगोष्ठियों/सम्मेलनों/कार्यशालाओं में प्रस्तुत किया गया।

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संस्थान के वैज्ञानिकों ने विभिन्न कार्यक्रमों, सम्मेलनों, संगोष्ठियों के दौरान जवाहरलाल नेहरू पुरस्कार, युवा अभियंता पुरस्कार, युवा वैज्ञानिक पुरस्कार, सर्वश्रेष्ठ वैज्ञानिक पुरस्कार और सर्वश्रेष्ठ पोस्टर पुरस्कार जैसे विभिन्न प्रतिष्ठित पुरस्कार प्राप्त किए।

EXECUTIVE SUMMARY

ICAR-CIPHET is a pioneer institute mandated to undertake lead research in the area of post-harvest engineering and technology suitable to agricultural production catchment and agro-processing industries. During the reported period (2017-18), the Institute executed its multidisciplinary research through various in-house and externally funded projects including CRPs on Health Foods and Secondary Agriculture. The Institute worked in broad areas of post-harvest technology including post-harvest equipment and machinery, products and process protocols, food quality & safety, including transfer of research findings through technology licensing, trainings, capacity building and extension activities. In 2017-18, institute funded projects are 45 and externally funded projects are 14 including new projects, ongoing and completed projects. The significant achievements marked during the year 2017-18 are discussed below.

Post-harvest equipment and machinery

A mini pilot plant for extraction of pectin from kinnow peel has been fabricated with a capacity of 5.0 kg/h raw material. A smart device for automatic detection and identification of insects in grains has been designed and developed. Continuous microwave popping system with a capacity of approximately 1 kg/h was designed and developed with material suitable for microwave energy/radiation. For reducing the drudgery of women fish vendors a semi-automatic fish cleaning-cum-dressing system has been developed. A prototype for meat ball making machine with capacity of 10-12 kg/h was designed and developed using low fat meat.

Process Protocols and Products

Micronutrients enriched reconstituted rice and wheat product for rice and wheat *dalia* fortification, respectively were developed as per FSSAI standards. Process protocol was standardized for development of maize and millet flour based gluten free chapatti using their extruded flour along with whey protein isolate. Technology for extraction of anthocyanin from black rice has been optimized on lab scale and products like pasta and ice-cream were developed using black rice bran and anthocyanin extract respectively. Pasta using sprouted pearl millet, sprouted green gram and semolina was developed. Functional curcumin Kulfi was also prepared by adding free curcumin in ghee (free curcumin) and curcumin MCs (microencapsulated curcumin) at the end of cooling of Kulfi mix. Process for spray dried groundnut milk powder was optimized which can be safely stored in metal tin cans and aluminium foil pouches.

Food Quality & Safety

Method for quantification of metanil yellow from turmeric sample was developed using visible spectroscopy with the limit of detection and quantification 0.053 and 0.16 µg/ml respectively. Method for qualitative estimation of lead chromate from turmeric was developed with a detectable limit of 0.1-0.2%. An optimized process was developed for extraction and utilization of low methoxyl pectin from citrus fruit residue (kinnow, grapefruit and orange peel).

AICRPs

The AICRP on Post-Harvest Engineering & Technology (PHET) developed various machines, products and process protocols such as Tamarind dehuller and pongamia decorticator, Turmeric dryer and dust free turmeric polisher, Bamboo stalk cooked rice, chutney powder from small sized dried prawns, honeycomb packaging material production machine, *Chironji* decorticator machine etc. The achievements of AICRP on Plasticulture Engineering and Technology (PET) included agro-techniques for cultivation of Okra in off-season under protected environment, solar cabinet dryer for hills, organic tomato cultivation in polyhouse for Srinagar region, bunch type groundnut cultivation in summer season, pigeon pea cultivation under colour plastic mulch with drip irrigation in Raichur region, soil less cultivation of cucumber and tomato under naturally ventilated polyhouse, manual mulch laying cum retival machine for hills, low cost aquaponics system in aquaculture, phase change materials based mobile cool chamber for transportation of fruits and vegetables.

Training, Capacity Building and Extension

Institute was actively involved in different capacity building programmes and organized three ICAR sponsored summer/ winter schools, one model training course, sixteen entrepreneurship development programs (EDP), nine farmers training, two officer's training. A total of 162 students were also trained during this period. The institute also participated in several exhibitions across the country such as *"Kisan Mela"* at PAU, Ludhiana; "13th edition of CII Agro Tech", Chandigarh; *"Krishi Unati Mela",* IARI, New Delhi. Institute technologies were showcased and demonstrated to various stakeholders like farmers, entrepreneurs and researchers during participation in kisan melas/exhibitions.

Important Events

During 2017-18, ICAR-CIPHET has organized an International Training Program on "Modern Storage Technologies in Agriculture" during 01-15 September, 2017. Under this training program 20 executives from 11 countries (Afghanistan, Botswana, Cambodia, Ghana, Kenya, Liberia, Malawi, Mongolia, Myanmar, Sudan and Uganda) participated.The institute has organized a National Conference on 'Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector' during March 16-17, 2018.

Technology licensing and Patents

The research outcomes were disseminated in the form of technology licensing and commercialization to various end users. Two technologies were licensed *viz.* nutritious functional *chapatti* flour, and strawberry fruit leather technology (Strawberry Fruit Barfi). Three patents were granted during the period for process technology for preparation of blended guava leather/bar, Ready to constitute makhana kheer mix, Pomegranate aril extractor.

Publications

During 2017-18, scientists have published substantial good number of research papers (national and international peer reviewed journals), book chapter, technical/popular article and presented papers in various symposia/seminars/ conferences/workshops of national and International level.

Awards and Recognition

Scientists of the Institute received various prestigious awards like Jawaharlal Nehru Award, Young Engineer Award, Young Scientist Award, Best Scientist Award, and Best Poster Award during various programmes, conferences, seminars and symposia.

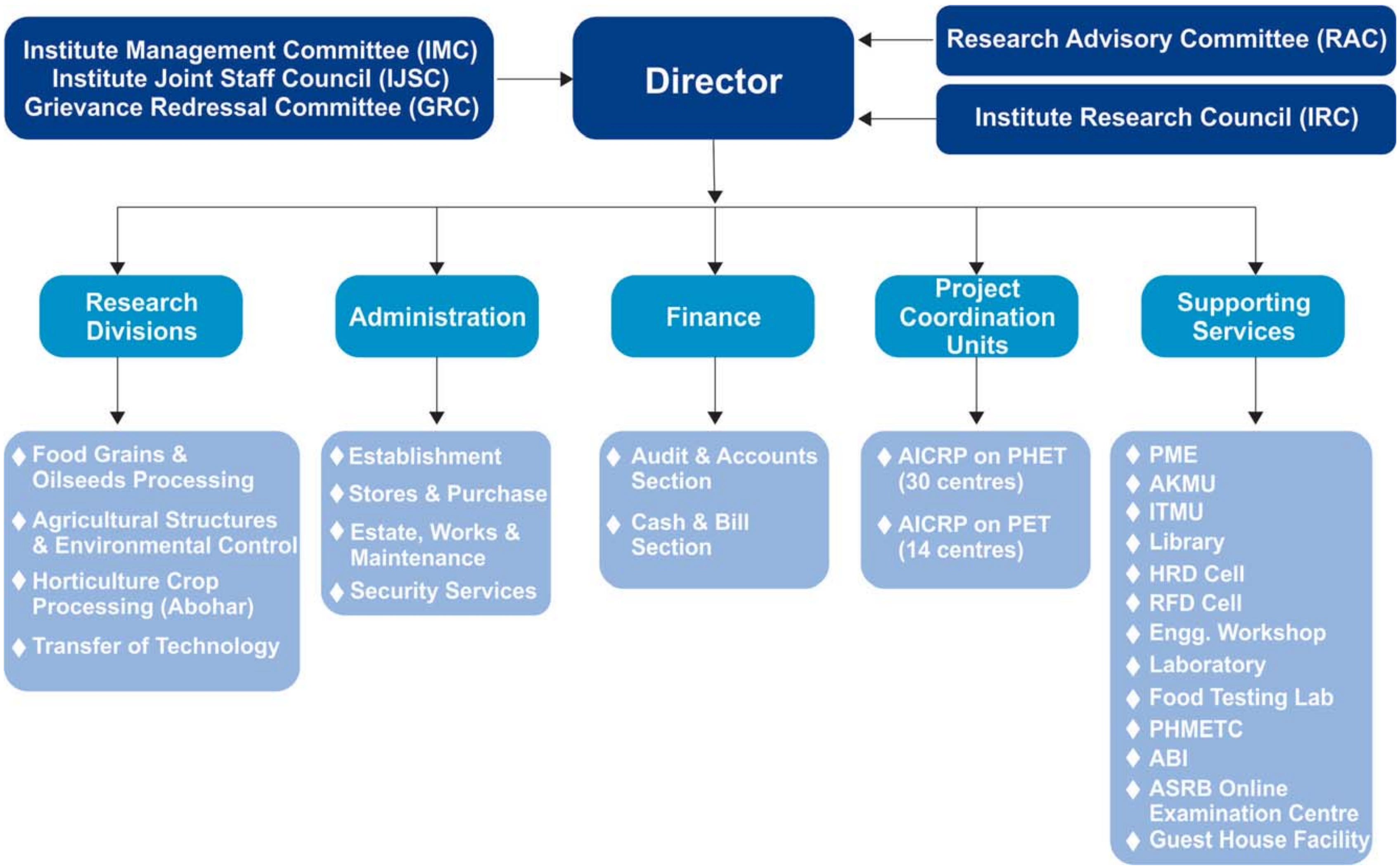
Vision

Higher profitability of agricultural production systems ensuring better income to farmers and increased employment opportunities in rural sector through efficient post-harvest engineering and technological interventions for loss reduction and value addition to agricultural produce and by-products resulting in high quality and safe food and feed at competitive prices for domestic and export markets.

Mandate

- Research for solving problems and identifying technologies related to post-harvest loss assessment and prevention, processing, value addition and storage of agricultural, horticultural, livestock and aquaculture produce targeted to achieve food safety and quality assurance.
- Human resource and entrepreneurship development in post-harvest engineering and technology.

ORGANIZATIONAL STRUCTURE



OVERVIEW

The ICAR-Central Institute of Post-Harvest Engineering and Technology (ICAR-CIPHET) was established on December 29, 1989 at Ludhiana, Punjab (India); as a nodal institute to undertake lead researches in the area of the post-harvest engineering and technology appropriate to agricultural production catchments and agro-industries. The institute's second campus was established on March 19, 1993 at Abohar, Punjab and is primarily responsible for conducting research and development activities on horticultural crops. ICAR-CIPHET is also headquarter to two All India Coordinated Research Projects (AICRPs) *viz.* AICRP on Post Harvest Engineering & Technology (PHET) with 30 centres and AICRP on Plasticulture Engineering & Technology (PET) with 14 centres spread across the country.

Research Divisions

Ludhiana Campus

1. Agricultural Structures and Environment Control
2. Food Grains and Oilseeds Processing
3. Transfer of Technology Division

Abohar Campus

4. Horticultural Crops Processing

Consortium Research Platforms (CRPs)

1. CRP on Secondary Agriculture
2. CRP on Health Food

Infrastructure

Workshop

The workshop at ICAR-CIPHET, Ludhiana and Abohar manage fabrication and modification of post-harvest machinery, designed and developed institute facilities/ work etc. from time to time. Workshops have necessary facilities such as lathe machines, drilling machine, gas welding set, arc welding set, sheet bending machine etc. to deliver its services. Besides, various measuring instruments are also available in the workshops, which are used frequently for various research purposes.

Agro Processing Centre (APC)

The main objective of establishing agro-processing centres is to process the agricultural produce in production catchment with a view to enhance employment and augment income opportunities in rural areas. At ICAR-CIPHET, state-of-the-art agro-processing centre has been established for processing of bengal gram, green gram, pigeon pea, maize, black pepper, turmeric,coriander etc. The processed products are regularly being sold to the customers in and around Ludhiana.

Staff Position (2017-18)

Category	Sanctioned Strength	Filled		Total Filled	Vacant
		Ludhiana	Abohar		
Scientific	76 #	31	11	42	34
Administrative	21	15	03	18	04
Technical	29	16	08	24	05
Supporting	05	02	01	03	02
Total	131	64	23	87	45

Excluding Director

Discipline-wise distribution of scientific strength (2017-18)

Discipline	Pr. Scientist	Sr. Scientist	Scientist	Total
Agricultural Process Engineering	2*	2	12	16
Agricultural Structures & Environmental Management			3	3
Soil Water Conservation Engineering	1			1
Food & Nutrition	1			1
Food Technology	1		4	5
Agricultural Microbiology			2	2
Biotechnology (Plant Science)			1	1
Chemical Engineering	1			1
Biochemistry (Plant Science)		2	1	3
Electronics & Instrumentation			1	1
Horticulture	1		1	2
Home Science			1	1
Agricultural Extension			1	1
Fish Processing Technology		1	1	2
Livestock Product Technology			2	2

*Excluding Director

During the reported period, the total revenue generated was Rs. 1,21,903/- against the sale of processed products like *dal, besan,* ground spices etc. Besides, the APC facilities are also used for imparting hands-on-training to prospective small rural entrepreneurs.

Food Testing Laboratory

Food Testing Laboratory established at the Institute houses basic and some of the most advanced equipment for food analysis and evaluating the safety aspects of food products.

This laboratory particularly caters to the food testing and quality analysis requirements of different stake holders, entrepreneurs in getting their samples tested. Testing protocols for certain parameters like water quality, fat, protein and fibre analysis, mineral contents etc. have been validated. This facility enable the institute to answer the need based test requirement of processers, entrepreneurs, small and medium enterprises and industry at affordable testingcharges.

Post-Harvest Machinery & Equipment Testing Centre

The institute has been authorized for testing all types of post-harvest machinery and equipments by Mechanization & Technology Division, Department of Agriculture & Co-operation, Ministry of Agriculture & Farmers Welfare, Govt. of India to ensure supply of quality post-harvest equipments and machinery by the manufacturers to the end users. This testing facility at ICAR-CIPHET is one of its kind in the country for testing of post-harvest machinery.

Agri-Business Incubation (ABI) Centre

Agri-Business Incubation (ABI) facility is also available at the institute. The centre is established with the financial help of ICAR, New Delhi under National Agricultural Innovation Fund (NAIF). The main objective of this centre is to encourage, nurture and support techno-logists, scientists and innovative agribusiness ideas to turn their innovations into sound commercial ventures. This helps in initiating technology-led and knowledge-driven enterprises. It is now well-proven that such mechanisms help not only in the growth of technology-based new enterprises but also in improving their survival rate substantially. The main objectives of the centre are

- Providing technology, skill up-gradation and incubation leading to promotion of viable enterprises and generation of employment opportunities to entrepreneurs
- To undertake last mile scale-up from pilot level of value chain in collaboration with stake holders.
- To impart training and capacity building to prospective entrepreneurs in agribusiness ecosystem.

Library

ICAR-CIPHET library act as a rich repository of knowledge and information related to institute's mandate. It has good collection of books and journals in the area of post-harvest engineering, food processing, engineering, microbiology, biochemistry, biotechnology etc. During the reported year, the total number of books and standards in the library were 4230. The library as a member of Consortium for e-Resources in Agriculture (CeRA) is getting access to online full text journals and e-books. In addition of these, a number of national and international serial publications, annual reports, newsletters and research bulletins were received on gratis. Wi-Fi facility is available in the library for the users to access internet services. Current content service of journals and list of new arrivals is also being circulated among the ICAR-CIPHET staff.

Guest House

Both Ludhiana and Abohar campus has guest house facilities for providing accommodation to ICAR/SAUs/Govemment employees and farmers. One International Training Centre with 08 AC rooms and dining hall with kitchen is also available at Ludhiana campus.

Units

Prioritization, Monitoring and Evaluation (PME) Cell

Prioritization, Monitoring and Evaluation concept is the key management tool in R&D system to enhance scientific productivity. It helps in setting a unified priority and monitoring of externally funded and in-house projects. PME cell of the institute conducts Institute Research Council meeting and maintains the record of research projects. The monthly, quarterly, half yearly performance review reports of individual scientist are collected and compiled into progress reports of the institute. It also acts as link between various regional committee meetings, directors' conferences etc. and the institute scientists. The exchange of information takes place through PME cell. The database of parliament questions and their answers, action taken reports and issues related to scientific activities of the institute are managed by PME cell. The research information related to ongoing and completed research projects is uploaded through Project Information and Management System (PIMS) and MIS-FMS to avoid duplication in research.

Institute Technology Management Unit (ITMU)

The Institute Technology Management Unit is responsible for Intellectual Property (IP) protection, management and transfer/ commercialization of technologies developed by the institute. ITMU plays a crucial role in management of technologies. The role of ITMU is to encourage and accelerate the efforts towards development of technologies in the field of post-harvest management and to facilitate the transformation of ideas, inventions and technologies developed by the institute into commercial ventures to serve the society. ITMU since its inception has been involved in protection, management and commercial-ization of intellectual property generated by the institute. A total of 53 patent applications have been filed through ITMU out of which nine patents have been granted. Rigorous efforts of ITMU have lead to the commercialization of 45 technologies developed by ICAR-CIPHET.

Agricultural Knowledge Management Unit (AKMU)

The institute has an Agricultural Knowledge Management Unit (AKMU) for the scientists and staff for data analysis and electronic communication. The unit has latest configuration desktop computers including three servers. More than 100 desktop computers of the institute are well connected through Local Area Network (LAN). Wi-Fi connectivity is available through 100 mbps line provided by National Knowledge Network (NKN). Internet is provided to different nodes through proxy server Nebero. The Nebero facility provides the information of internet bandwidth user details firewall security and stability on the network. Besides, AKMU houses a number of analysis and design software such as Design Expert Software, Creo Parametric, Corel draw graphics Suite, Adobe Professional, Network anti-virus, Unique code (Hindi Software) etc. The institute's website www.ciphet.in is also being maintained by AKMU.

Project Coordination Units

AICRP on Post-Harvest Engineering and Technology (PHET)

The All India Coordinated Research Project on Post-harvest Engineering and Technology was launched by the Indian Council of Agricultural Research in September 1972. The project is currently operating from 30 centres covering almost all states and agro-climatic zones of the country.The aim is to develop location and crop specific post- harvest technologies and equipment to minimize quantitative and qualitative post-harvest losses and to produce value added products from agricultural crops including livestock and their by-products.The major activities are: (i) Adoption/development of equipment/technologies for reduction in post-harvest losses in critical stages/operations, as well as crop/commodity-wise (ii) Development of need based agro-processing centres (APCs) in different production catchments for income augmentation and employment generation (iii) Value added products from agricultural crops/ commodities (iv) Prototype production and process refinement with a view to develop appropriate complete packages for post- harvest utilization of crops/commodities and their by-products (v) Multi-location trails and demonstration of the post-harvest technologies.

AICRP on Plasticulture Engineering and Technology (PET)

AICRP on Plasticulture Engineering and Technology is operating with 14 cooperating centres in the country in different agro-climatic zones with coordinating unit at ICAR-CIPHET, Ludhiana. The sanctioned budget of the scheme for 2017-18 was 339.00 lakhs. Currently, total 45 projects are ongoing in which 14 were approved as new projects in the 13th annual workshop, 2017 of the scheme and 23 projects concluded. The role of PET has been instrumental in the development or modification of technologies related to Plasticulture in horticulture, irrigation, intensive fish culture and animal housing as per the mandate of the centres.

Statement of Budget Estimates and Expenditure (2017-2018)

Sr. No	Account Head	Budget	Expenditure
1.	Institute	1472.00	1364.36
2.	AICRP on PHET	1997.00	1996.82
3.	AICRP on PET	339.00	339.00
4.	CRP on Secondary Agriculture	106.00	71.31
5.	CRP on Health Food	106.00	68.87
	Total	**4020.00**	**3840.36**

Revenue Generation

During the year 2017-18, the institute generated revenue of Rs. 45.33 lakhs.

RESEARCH ACHIEVEMENTS

Post-Harvest Equipment and Machinery Developed

Important progress was made in the area of post-harvest equipment and machinery develoment during the reporting year. Many technologies were fully developed and tested and few are under testing. Overall significant achievements and progress are mentioned below.

Fabrication of pectin pilot plant

A small capacity (5kg dried kinnow peel powder per batch) was developed for extraction of pectin from kinnow peel (Fig. 1). The plant consists of cabinet dryer, hammer mill, reaction vessel (50L) with temperature control & stirring filtration system, precipitation vessel, and

Fig. 1. Fabricated plant for pectin extraction

distillation assembly for ethonol recovery. The citrus peel is dried to 10% moisture content followed by pulverization. The dried powder is placed into reaction vessel and water is added. The mixture is heated at 95ñC for 90 minutes and then filtered. Then the supernatent is placed into the percipitation tank and organic solvents are added at normal temperature. After the precipitation of pectin, the material is filtered again to separate pectin in crude form. The pectin so obtained is purified by washing with organic solvents and then dried into tray dryer. The supernatent is fed to the solvent extraction system for recovery of ethonol. The plant is bring modified to improve its efficiency.

Performance evaluation of pectin pilot plant

The individual units of pilot plant were evaluated. The boiling time of material was reduced to 1.5 h with parallel alignment of heating element as compared to its series arrangement which took almost 3.0 hour to boil the mixture. Aqueous mixture of peel powder (1:10) took 40 minutes to reach the boiling temperature whereas it was reduced to 30 minute when the mixture was used in the ratio of 1:8. Pilot plant fed with 4 kg of raw material yielded 9.5-10 % pectin in a single run and process time was found to be 8 h when heating element of 2 kW was used. However, enhancing the feeding capacity to 5 kg of peel powder in 1: 8 ratio of mass to liquid yielded 10.5 to 11.0 % (518 g) of pectin with a process time of 7 h.

Automatic color sorter model for fruits

Color sorter model was developed to know the basics of color sorting mechanism, working

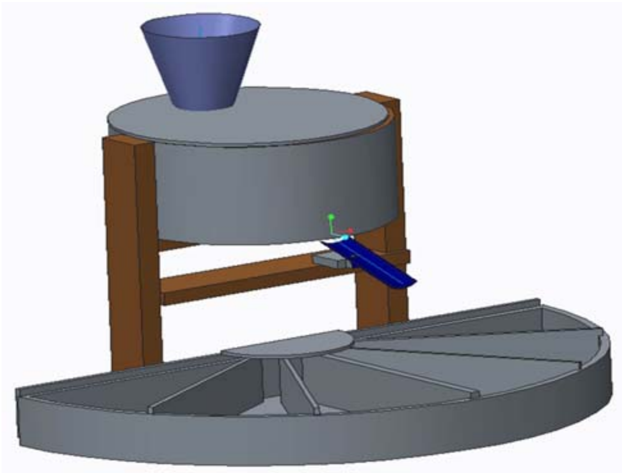


Fig. 2a. CAD drawing of Color sorter

of microcontroller and sensors. Six different color balls of diameter 7 cm size sorted through sorter using color sensor (TCS3200). The balls gets sorted out with maximum accuracy. Microcontroller unit is programmed using Arduino Integrated Development Environment (IDE) such that, first it initializes all peripherals i.e., both servo motors and color sensor. Program is written in a loop so that top servo motor continuously rotates the conveyor plate having circular hole for ball i.e. from position at bottom of the hopper to position at below the color sensor and from position at

Fig. 2b. Prototype of Color sorter

below the color sensor to the hole from which the conveyor tube starts. When top servo brings the conveyor plate below the color sensor and waits for fraction of time for measurement of color frequencies in R, G and B channel, the color sensor reads the colors in red, green and in blue channels and sends it to the microcontroller unit, then on the basis of color value, microcontroller sends the signal to the bottom servo motor to rotate the conveyor tube in specified degree as per values of colors. This process will continue in loop till objects to be sorted are finished. The model will help the development of small scale fruit and vegetable sorting automated machines with some advanced sensors like camera and actuators.

Automatic sorter for tomato on weight basis

For well managed handling, transportation and marketing, grading and sorting of fruits and vegetables is necessary. Generally, sorting of fruits and vegetables is done according to their geometry and shape either by visual inspection or using image processing technology. Size of

Fig. 3. Automatic sorter for tomato on weight basis

fruits depend on cell division and cell expansion while weight of fruit depends on total solid (water soluble and insoluble) content present in it. So, there is lack of precision in sorting of fruits and vegetables only by considering their geometry and shape. Therefore, a model for automatic sorting of tomato was developed. Microcontroller, HX711 weight sensor amplifier, load cell and servo motor were used as electric control segment. Tomatoes of different weight were sorted in five grade. Range of weight for grading was taken as more than 150g (1st grade), 120-150g (2nd grade), 80-120g (3rd grade), 40-80g (4th grade) and less than 40g (5th grade). With the help of two servo motor, tomatoes were dropped in their respective compartment according to their weight. Automatic sorter on weight basis provides precision in sorting (~ 100% accuracy), minimize error (mean error = 1.53g) and speeds up the process time.

Automatic data-logger for measuring real time temperature and humidity

Pertinent information about the temperature and humidity during a certain time period is very important in the scientific, medical and industrial fields. For retrieval of this information, various methods can be used. Either it can be done manually, or devices such as chart recorders or data loggers can be used. Efforts were made to build a low cost, automatic, smart real time embedded Arduino based data-logger to meet the purpose (i.e. read temperature and humidity with respect to time). The Arduino Microcontroller board is used which has an inbuilt ADC and other peripheral circuit components (i.e. DHT 22, 16*2 LCD I2C Display, SD card and RTC module) necessary for its working. The physical parameters are sensed by the sensors and then are converted to analog signal. This analog signal is then fed into the Arduino board ADC pins which is then converted to an equivalent digital quantity and is further processed in the microcontroller.

Fig. 4. Overall setup of the designed data-logger

The processed signal from the microcontroller can then directly be displayed on the serial monitor or recorded on the LCD screen or it can be saved to the SD card for further research.

Smart device for automatic detection and identification of insects in stored grains

Stored grain insects destroy and contaminate around 10-15% of stored grains with undesirable odors and flavors in India. Improper detection methods and practices lead to mis-predict the need of fumigation thus causes more damage of food grains. An effective method to detect and identify the stored grain insects can overcome the problems of existing method of detections which may lead to on time fumigation and ultimately reduces the food grain wastage. Hence, the aim was to develop a smart device for automatic detection and identification of insect

Fig. 5. Isometric view of device for automatic detection and identification of insect infestation and level of infestation

infestation and level of infestation etc. A table top device with shade free imaging chamber, slow moving conveyor assembly, linear vibrating feeding assembly with imaging device platform was designed. According to the design, conveyor assembly was fabricated with conveyor base frame of size 55X20X4cm with food grade PVC seamless belt (990x150x3 mm) in three colours viz. White, Green and Black. The power

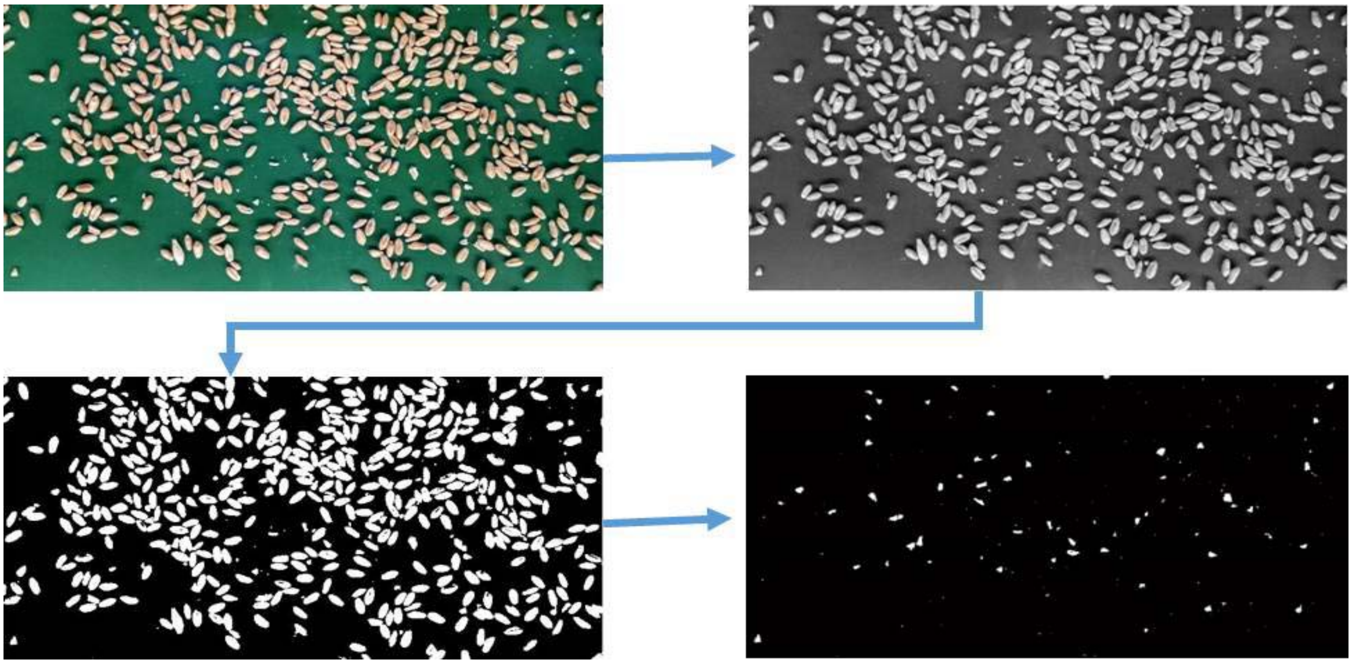


Fig. 6. Image processing of infested grains

transmission assembly was made with 240V AC synchronous motor with suitable gear reduction to obtain 10 RPM finally. Linear vibrating slow feeding chute along with feed hopper was fabricated to hold 2.5-3 kg of wheat.The feeding assembly was fabricated, tested and remodified according to the need and design. The imaging chamber was fabricated with 12V DC light source able to provide 5W power with the provision of adjustable imaging device platform. Wheat grains were taken in different batches and infested with *Rhizopertha dominca* (Lesser Grain Borer) at different levels. The infested samples were incubated for nurturing the insects. Image acquisitions of infested wheat grains were taken at frequent interval.

Continuous microwave popping system

Continuous microwave popping system (capacity-1 kg/h) was designed and developed with overall dimension 70 × 50 × 30 cm made with material suitable for microwave energy/ radiation to replace batch type popping machine. The suitability of several machine components was defined with microwave cabin volume of 30 litre to pop the food grains. The machine is fitted with two DC motors with drive to regulate feed and residence time of food grains for popping.

Fig. 7. Continuous microwave popping system

The machine is mounted on table top with dimension 50 × 50 × 30 cm base frame made of cast iron.

Mechanized system for fruit bar manufacturing

A batch type refractance window drying system was evaluated for drying of strawberry, sapota and guava pulp of 3-5 mm initial thickness at water temperatures of 89-93^{0}C. The drying for guava pulp of 25ñB initial TSS were 30-35 min, 75 min and 120 min respectively. Strawberry pulp of 5mm thickness and 27^{0}B initial TSS took 70 min to reach 15-18% moisture content. The developed RW system was evaluated for drying of sapota pulp at five different water temperature (WT) (84.3, 87, 91, 95, 97.7°C), initial pulp thickness (PT) (3.3, 4, 5, 6, 6.7 mm) and pectin concentration (PC) (0.3, 1, 2, 3, 3.7 %). Optimum conditions of sapota bar preparation were found at 91°C WT, 5 mm PT and 2% PC with a drying time of 146.3 min. The moisture content, AA, L value, hardness, cohesiveness, gumminess and chewiness were 16±1 g H_2O/100g sample, 10.66 mg/100g, 25.72, 26.24 kgf, 0.21, 5.37 kgf and 3.12 kgf, respectively. The conceptual drawing of continuous fruit bar manufacturing system is finalized and accordingly internal frame of stainless steel (157×25×16 inch) was prepared. Polyester sheet (clear, 250µ) of width of 600 mm has been procured to be used as a key component of the continuous RW system.

Composite peeler cum juice extractor for sweet orange and kinnow

The feeding system of peeling machine was mechanized to make the feeding continuous. A single wire mesh guide channel was made for feeding the fruit to the fruit holder. This channel was connected with a slide made of SS to convey the fruits towards holder. A wooden roller was also made to place the fruits for feeding. These assemblies work in tandom to make the system continuous. Further, the spatial dimension of kinnow were determined. The average values of major, intermediate and minor intercept were 78.19±2.91 mm, 77.43±2.89 mm and 63.41±2.23 mm, respectively. Average weight of fruit was 198.97±16.93 g and average volume was 227.55±19.68 cm^3.

Fig. 8. Semi-automatic peeler

Technology for de-poding of green pea and cow pea

Physical and textural analysis (pod and seed) of three green pea (*Arkle, AP-3 and Bio seed - 10*) cultivar and cow pea (Desi) in vertical and natural rest position was evaluated for design consideration. Angle of static friction of pea pods against mild steel (MS) and stainless steel (SS) was measured, *Arkel* cultivar- 43.6° against MS & 43.2° against SS, *AP-3* cultivar- 48.3° against MS & 55.2° against SS, *Bioseed-10* cultivar- 41.6° against MS & 43.2° against SS respectively.

Different mechanisms such as roller combination (two rollers set of 25mm dia; a 2 roller set of diameter, knurling on the roller surface, stationery roller and moving roller, separate roller material (SS, nylon and PU rubber), variable speed combination were evaluated for depodding of green pea.

Prototype dimensions- Frame: 1220 x 915 x 610 mm, feed hopper: 480 mm x 500 mm, Channelized feed tray (900 × 500 mm) with V shaped channels of 14 mm depth, Counter rotating roller: 480 mm, 25 mm and 32 mm, Roller gap variations: 4-7 mm, spur gears: 16 and 22 teeths, Speed variation using: VFD (0.75 kW,1 phase), Bearings: 15 mm.

Live-fish carrier system

Live Fish Carrier System (LFCS) was refined and modified for better survival of fish with alternate energy source including solar energy. The electric vehicle was revamped with DC power supplied by 4 lead-acid batteries of 12 V and 120 Ah. The vehicle had a capacity 200 kg per container per trip with a water to fish ratio of 1:1. The metabolite separator, aerating-cum-filtration-cooling assembly, splash protector, cover & ammonia absorbents were the systems to provide better dissolved oxygen (DO) in water, less ammonia and less metabolite concentration in water used for transportation. A solar photovoltaic (PV) cell was fixed on the roof of the vehicle for running the aerator pumps which conserved power in order to extend the journey period after every full charge of batteries. The PV cell used was of 20 V, 5.1 Ah and 100 watt capacity. It has an efficiency of about 100% i.e., there was no fish mortality with live fish (carps) of individual weight 0.5 kg to 2.0 kg in journey time 4-5 hrs.

Testing with common carp (0.5-2 kg/fish) was done and 100% fish survived after 1 month storage and transport with 25% water renewal at alternate days and no feeding, and water having temperature 15-20^{0}C, DO 5-6 mg/L, ammonia <0.01 mg/L. Testing with Silver Carp (0.5-1.5 kg/fish) and Catla (0.6-1.75 kg/fish) was done and 94-96% and 89-92% fish survived respectively after 15 days storage. Water temperature 18-20 ^{0}C, DO 5-6 mg/L, ammonia <0.01 mg/L.

Fig. 9. Live Fish Carrier System with PV Cell

Woman-friendly semi-automatic fish cleaning-cum-dressing system

The prototype of fish cleaning station was developed which can be operated either manually by foot or by electricity. It consists of

i. Dressing table (100x48x120 cm)
ii. Round cutter, made of SS with diameter 25.4 cm)
iii. Water spraying system
iv. Motor (1/10 HP, 9400 rpm) and pvc pulley (dia 20 cm)
v. Foot rotor and pulley (dia 53 cm)

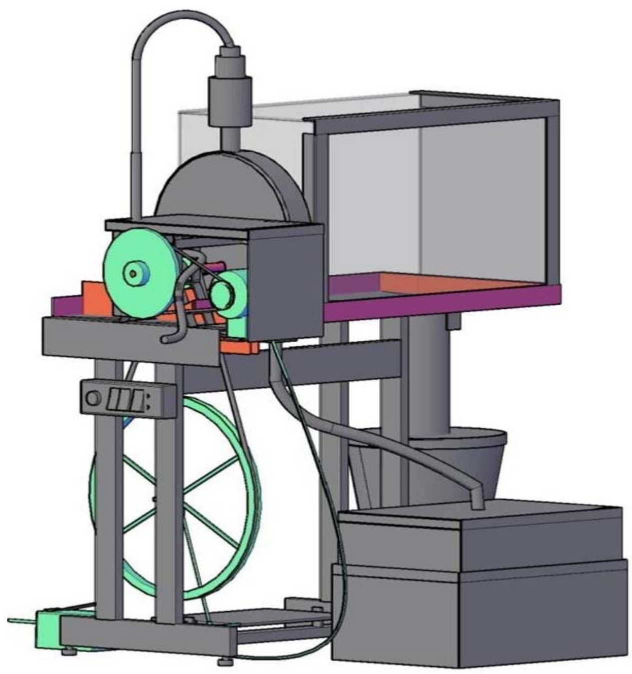


Fig. 10a. Drawing of Fish Cleaning Station

vi. Liquid waste disposal and filtration system
vii. Solid waste disposal system.

The machine is useful for steak cutting in fish retail shops and processing plants. The capacity of the machine is 2-3 kg fish (carps)/minute.

The machine was tested with catla (0.5-2 kg), rohu fish (0.4-1.5 kg), and bighead carp (0.5-1.8 kg) for descaling and slicing operation powered by electric motor or by manual operation with foot separately. The automatic operation was comparatively easier and less time consuming for steak cutting for all the fishes.The efficiency of the newly developed machine was 20-30% more efficient than the traditional method. Hygienic status of the cleaning-cum-dressing machine in terms of microbial load was $<10^3$ cfu/g compared to the traditional method ($>10^5$ cfu/g). Bacterial load was 1.63×10^4 cfu/g in fish dressed by the machine while the load was 4.84×10^5 cfu/g in the market dressed fish. The bacterial count in washing water used in the market was found to be very high i.e. 4.33×10^6 cfu/ml

Fig. 10b. Final Prototype of Fish Cleaning Station

Meat ball making machine

Designed and Developed Meat ball making machine for preparing meat balls from low fat meat. The main working components are two horizontal rollers fixed on a frame powered by electric motor and rotated by four differential diameter pulleys. The frame is made of mild steel angle, the height of the main frame is 65 cm, and length is 50 cm with a width of 30 cm. The rollers are made of nylon material, one feet in length, with teeth to teeth spacing of 2.5 cm. The height of the teeth is 1.25 cm from the roller perimeter. The Teflon rollers are 1 feet long with 2.7cm diameter in which the teeth are engraved. The rollers are fixed on a MS shaft supported on the frame by two housing bearings (UC 204) attached through long shaft with gear box operated by 0.5HP motor.

Fig. 11. Meat ball making machine under fabrication

A screw was fabricated to press the low fat high fiber meat in the shape of a cylinder through a circular opening having dimension about one inch. Mechanism to cut the batter automatically in cylindrical shape of about one ft long was fitted above the rollers rotating in the same direction with different speed. The speed ratio of 1:2.6 was found suitable for making meat balls. It takes about 30 secs to make 10 balls each weighing 15-17 g. Both shafts rotates in clockwise direction with different speeds. First roller rotates at a speed of 364 rpm and other at speed of 144 rpm. These both roller rotates with the help of the shaft which is connected with the gear box. The capacity of the machine was 10-12 kg/h.

Lab Scale hermetically sealed storage structure for pulses with Carbon dioxide injection

A 25 kg capacity hermetically sealed storage structure has been developed at lab scale level to study the effect of carbon dioxide injection on insect mortality and quality of stored pulses. 15% of Carbon dioxide concentration was found to attain 100% mortality rate on adult *Callosobruchus* insect. The setup will be upscaled to 1 tonne capacity on-farm storage structure for pulses.

Fig. 12. Hermetically sealed storage structure

Process Protocol and Products

Process optimization for production of spray dried groundnut milk powder and shelf life study of powder

Experiments were carried out according to the experimental plan prepared (RSM-Box Behnken Design) with the following independent (three) parameters: Inlet air temperature: 180°C-220°C, feed pump rpm: 24-36 and atomizing air pressure: 2-3 bar with blower speed fixed at 2400 rpm. Optimized spray drying parameters for groundnut milk (GNM) powder production were determined. Considering only the quality of powder, the optimized spray drying parameters were Inlet air temperature: 194.5°C, Feed pump rpm: 24 and Atomizing air pressure: 3.0 bar. The powder thus produced under these optimized conditions was used for conducting shelf life study of the powder in metal tin cans and aluminium foil pouches. Periodic observations were recorded for fresh product and at the end of 1st, 2nd, 4th, 8th and 12th week of storage. Moisture content, water activity, free fatty acid, dispersibility, and insolubility index were determined at the end of each storage period while temperature and relative humidity were recorded daily. Variations with an increasing trend were found in case of moisture content (1.69-3.82% and 1.69-3.33%), water activity (0.44-0.56 and 0.44-0.52) and free fatty acid (0.48-1.86% and 0.48-1.57%) in aluminium foil packages and metal tins cans, respectively. Dispersibility of powder varied between 96.10-91.77% and 96.10-92.58% while the Insolubility Index varied between 0.75-4.56 ml and 0.75-4.23 ml in aluminium foil and metal tin can, respectively. Similar observations were also recorded during the same storage period for the dairy milk powder of a reputed brand. Results confirm that GNM powder can be safely stored in both the packaging materials for three months and metal tin can packaging is marginally better than aluminium foil packaging. The reconstituted milk from spray dried powder was subjected to organoleptic evaluation leading to overall mean sensory score of 7.53 as compared to 7.67 for the freshly prepared groundnut milk on nine point hedonic scale.

Products from powder obtained from spray drying chamber

Two products namely condensed milk and *Peda* (an Indian sweet) were prepared utilizing the spray dried groundnut milk powder. The overall scores from organoleptic evaluations (4.64/5 for condensed milk and 4.25/5 for Peda) indicated very good acceptability among the sensory panelists.

Fig. 13. Condensed groundnut milk

Extraction of anthocyanins from black rice

Black rice, a special variety of rice, is deep black in color which turns into a purple hue when cooked. The black rice varieties are power packed with bioactive components predominantly anthocyanins. Extraction of anthocyanins from whole black rice using existing pilot plant facility for protein isolate preparation at ICAR-CIPHET, Ludhiana was carried out. The paddy husk was removed using dehusker and the rice was converted into grits to facilitate extraction process. In a batch, 5kg (half load) rice grits were extracted with solvent (Methanol with 1% hydrochloric acid) in a ratio of 1:10 with continuous agitation at 60 rpm for 1 hour at room temperature. The extract was then removed and centrifuged at 1000 rpm to remove solids. The solids weighed 4kg approx. The extract was then evaporated using rotary vacuum evaporator at 60°C temperature and 25 mm of Hg pressure to obtain crude extract. The crude extract (1 litre approx.) thus obtained was then lyophilized to obtain powdered crude extract (anthocyanins, antioxidants, other flavonoids and sugars) which weighed 550 gm with 1.3-1.5% purity of anthocyanin in case of whole rice in the pilot plant study, while a purity of 13-15% had been observed in laboratory investigations on bran based on spectrophotometric pH differential method. The above results indicated that the pilot plant facility for protein isolate production could be effectively utilized for extraction of anthocyanins from black rice.

Anthocyanin rich pasta using black rice bran

Anthocyanin rich black rice bran (BRB) fraction was utilized for preparation of pasta, a convenient food. Durum wheat semolina was supplemented with BRB (var. Chakhou Poreiton; concentration range 5-25%), optimum quantity of water and were mixed for 10 minutes to achieve uniform mixing and distribution of water throughout the flour particles. The moist flour aggregate was then extruded in a pasta extruder. Pasta samples were dried at 50°C for about 4–5 h to attain a M.C of 5%. The samples were packaged in HDPE pouches for subsequent quality analysis (color index, proximate composition, free fatty acids, cooking quality, bioactive compounds and sensory parameters). Pasta samples supplemented with BRB showed improved nutritional value (protein, fat and ash content) in comparison to control sample. The anthocyanin content of pasta varied from 62.64–303.12 mg/100g. The free fatty acids were found within permissible limit in range. The cooking quality analysis depicted water absorption in range of 79.2-90.5%, a decrease in water absorption with increase in bran content was noted. Cooking time and gruel loss expressed an increasing trend with increasing bran level. The antioxidant activity showed increasing scavenging activity with increasing bran level. The quality and sensory parameters showed highest acceptability for pasta sample with 15% BRB. Addition of anthocyanin rich BRB in pasta products in a long way may improve the nutritional status of health conscious population.

Fig. 14a. Pasta with 15% Black rice bran

Fig. 14b. Control

Anthocyanin rich functional ice-cream using extracted anthocyanins

With the evolution of functional foods and increased consumer’s response towards natural bioactive component rich foods, the exploration of non-conventional food sources for their bio-functional compounds extraction and their use in preparation of functional or health foods showed potential applications. In continuation of this fact, the black rice variety (Chakhou poreiton) which is power packed with bioactive components was explored for extraction of anthocyanin rich extract. The extracted anthocyanin rich extract was added during preparation of ice-cream at different concentrations of 0.2g, 0.8g, 1.4g and 2.0g.With increase in the concentration of crude anthocyanin extract in ice-cream value of colour, anthocyanin, phenol content and ABTS and FRAP activity increased. No anthocyanin content was observed in control ice cream samples. Based on sensory evaluation of ice-cream samples, the sample with 1.4g extract was selected which expressed anthocyanin content of 100µg/g, phenol content of 175µg/g, Ferric reducing ability (FRAP) value of 76.42µg/g with L, a, b value of 75.42, 1.86, 1.96, respectively. The above results indicated that the anthocyanin extracted from black rice could be utilized for preparation of function ice-cream.

Pasta using combination of sprouting and extrusion technology

Sprouting parameters namely sprouting time and temperature of drying was standardized for green gram, bengal gram, moth bean, wheat and pearl millet on the basis of physical appearance, organoleptic properties, length of sprouts, water absorption of sprouted flour, protein, fat, ash content, color index and *in-vitro* protein digestibility. The standardized time of sprouting for green gram and moth bean was found to be 24 h while, in case of bengal gram, wheat and pearl millet, it was 36 h at 28-30°C and 88-90% RH in presence of light. The temperature found optimum for drying of sprouts was 70°C. Sprouting parameters were standardized at 28-30°C and 88-90 % RH in presence of light.

Pasta using sprouted wheat, sprouted bengal gram and semolina

Convenient food products, preferred by urban population, are generally high in starch but low in dietary fiber, minerals, vitamins, phenolic compounds, etc. Therefore, there is a need to formulate nutritionally balanced, energy- dense, easily digestible foods with functional benefits. Germinated cereals and legumes are receiving increasing attention due to their enhanced palatability and flavor, better nutritional qualities (due to increased bioavailability), reduction in antinutritional factors (through the breakdown of certain antinutrients, such as phytate, and flatulence factors) and increased digestibility. Germination along with other processing technologies such as extrusion would result in a convenient food product with advantages of both types of technologies. Sprouted bengal gram and sprouted wheat were utilized for preparation of pasta, a convenient food. Wheat semolina supplemented with sprouted bengal gram and sprouted wheat flour in varied ratio Sprouted wheat: Sprouted Bengal gram: Semolina (25:25:50, 20:30:50, 30:20:50, 10:40:50, 40:10:50, 50:50:0) were sieved together, optimum quantity of water was added and then mixed for 10 minutes to achieve uniform mixing and distribution of water throughout the flour particles. The moist flour aggregate was then extruded in a pasta extruder. Pasta samples were dried at 50°C for about 4–5

Fig. 15a. Pasta with sprouted bengal gram and wheat

Fig. 15b. Control

h to attain a M.C of 5%. The samples were packaged in LDPE pouches for subsequent quality analysis (color index, proximate composition, in-vitro protein digestibility, cooking quality and sensory parameters). Pasta samples supplemented with sprouted bengal gram and sprouted wheat flour showed improved nutritional value (protein, fat and ash content) in comparison to control sample. The protein, fat and ash content varied from 11.5-13.6 %, 2.2-4 % and 1.1-2.4 %, respectively. The *in-vitro* digestibility expressed increased protein digestibility of pasta when added with sprouted flour. The cooking quality analysis depicted water absorption in range of 97.2-122.67%, a decrease in water absorption with increase in sprouted flour content was noted. Cooking time did not vary significantly among various combinations of sprouted flour. The gruel loss expressed an increasing trend with increasing sprouted flour level and ranged between 0.07 to 0.1 %. The sensory scores for all the samples were above 7 (7.1- 7.6) on hedonic scale in all combinations, however, the pasta with 30% sprouted wheat flour and 20 % sprouted bengal gram flour and 50 % semolina was found to be optimum in terms of overall quality parameters.

Pasta using sprouted pearl millet, sprouted green gram and semolina

Durum wheat semolina supplemented with sprouted green gram and sprouted pearl millet flour in varied ratio. Sprouted pearl millet: Sprouted green gram: Semolina (25:25:50, 20:30:50, 30:20:50, 10:40:50, 40:10:50, 50:50:0) were sieved together, optimum quantity of water was added and then mixed for 10 minutes to achieve uniform mixing and distribution of water throughout the flour particles. The moist flour aggregate was then extruded in a pasta extruder. Pasta samples were dried at 50°C for about 4–5 h to attain a M.C of 5%. The samples were packaged in LDPE pouches for subsequent quality analysis (color index, proximate composition, in-vitro protein digestibility, cooking quality and sensory parameters). Pasta samples supplemented with sprouted green gram and sprouted pearl millet flour showed improved nutritional value (protein, fat and ash content) in comparison to control sample. The protein, fat and ash content varied from 11.3- 15.5 %, 3.0 – 4.25 and 1.7 – 2.4%, respectively. The *in-vitro* digestibility expressed increased protein digestibility of pasta when added with sprouted flour. The cooking quality analysis depicted water absorption in range of 103.4-118.1 %, a decrease in water absorption with increase in sprouted legume flour content was noted. Cooking time did not vary significantly among various combinations of sprouted flour. The gruel loss expressed an increasing trend with increasing sprouted flour level and ranged between 0.1 to 1.8 %. The sensory scores for all the samples were above 7 on hedonic scale in all combinations. The pasta with 25 % sprouted pearl millet flour and 25 % sprouted green gram flour

Fig. 16a. Pasta with sprouted green gram and pearl millet

Fig. 16b. Control

and 50 % semolina was found to be optimum in terms of overall quality parameters.

These studies suggested that combination of traditional germination/sprouting technology with popular extrusion processing could present as a great medium for satisfying both the objectives of nutrition and convenience required by present population.

Standardization of process for gluten analogue

In order to find out gluten analogue, out of different proteins/ protein sources (zein, casein, moth bean flour, egg white protein, soy protein isolate, whey protein isolate) studied, zein and egg white protein (EWP) in *chapatti* gave bitter taste, soy protein isolate showed hardening effect on dough and *chapatti*, moth bean flour gave beany flavor which was not liked by all and softness in chapatti was comparatively more with whey protein isolate (WPI) than with casein and hence out of all these tested proteins/ protein sources, WPI was finally selected. Initially WPI was applied at 5, 10, & 15% levels, but 5% level was found optimum for further use, because higher concentration of protein reduced the dough strength and products developed were not of desired texture. It was observed that use of protein alone could not improve dough handling and requirement of gum/ hydrocolloid was necessary. Out of HPMC and xanthan gum, xantham gum gave good results. In order to avoid use of gum and to improve the functionality of maize flour, extrusion technology was applied. Extruded maize flour (water absorption of 6.35g/g) was prepared at optimized conditions of feed moisture 15%, barrel temperature of 110°C & screw speed of 340 rpm. Extruded flour at 5-20% level along with 5 % WPI was used to improve maize & millets flour. Incorporation of WPI and extruded flour modified the maize flour as evidenced from SEM analysis of flour sample (Fig. 17 a, b, c). The level of extruded flour was optimized for *chapatti* and cookies formulation.

Dough improvement for chapatti

Dough formation was drastically improved as evident from Mixograph (Fig. 18 a&b)and it was easy to roll dough with rolling pin on addition of 10% EF along with 5% WPI (Fig. 19a) as compared to control maize (Fig. 19b). Further increase in extruded flour level to 15% and 20% resulted in increased stickiness. Similar treatments were applied in sorghum and pearl millet flour and dough were developed. All doughs were used for *chapatti* formation. On the basis of organoleptic score, *chapatti* from maize, sorghum and pearl millet *with* 10% EF & 5% WPI showed desired taste and hardness was at par with control *chapatti* (2.4 kg). However, *chapatti* with 15% EF was also found acceptable. Further increase in extruded flour to 20% level increased *chapatti* hardness and taste of extruded flour

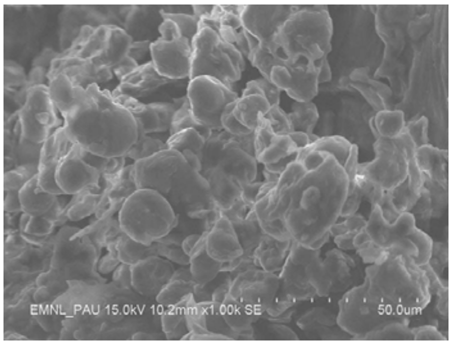


Fig. 17. a). SEM of Maize flour

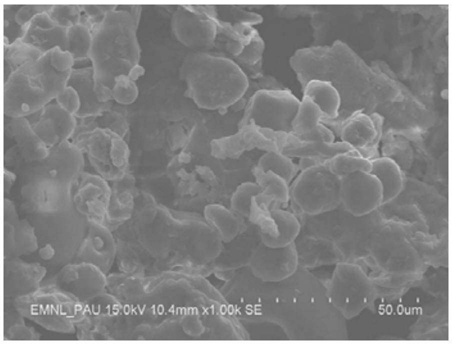


Fig. 17. b). SEM of Maize flour and WPI

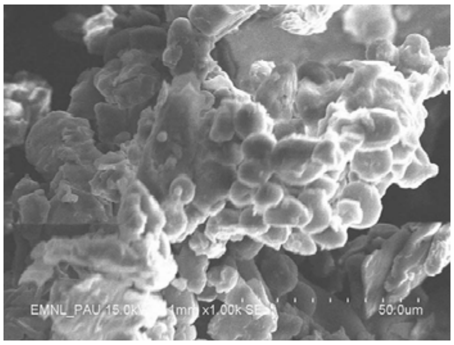


Fig. 17. c). SEM of Maize flour with WPI and Extruded Maize flour

became evident and hence not liked by the sensory panel.

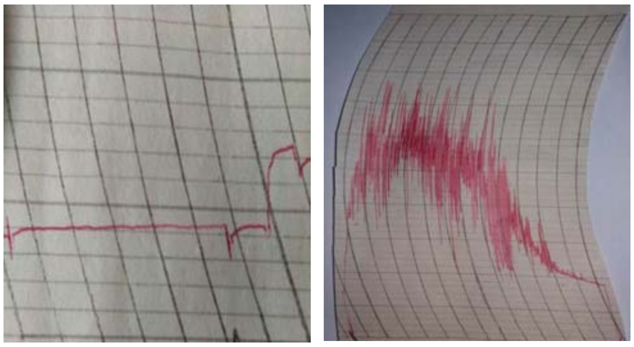


Fig. 18. a). Mixograph of control maize dough
b). Mixograph of maize, EF and WPI dough

Fig. 19. a). Control-maize dough
b). Maize, EF and WPI dough

Cookies Development

Maize flour based cookies were prepared and it was observed that addition of extruded flour increased the spread ratio value to 6.81 as compared to control value of 6.15. However, it also increased the hardness (kg) from 7.64 to 9.60.

Fig. 20. Maize based cookies

The cookies with 5% WPI and 20% extruded flour showed significant variation in colour (L-value-57.16) and were lighter than control (L-value-55.58). The cookies developed from 5% WPI and 5% extruded maize flour showed higher moisture (8.2% wb) and protein content (6.3%) as compared to control and were rated best (sensory score-8.0) followed by cookies with 10% extruded flour.

Process for extraction and utilization of low methoxyl pectin from citrus fruit residue

Pectin extraction from citrus peel

Citrus is the major fruit crop of India and it generates about 40-45% of fruit waste when processed into fruit juice. Peels constitute the major portion of fruit waste that can be utilized for pectin extraction owing to its substantial availability in citrus peels. Hence a process was designed to extract pectin from kinnow, grapefruit and orange peel using different aqueous extraction conditions (enzyme+ citric acid, only citric acid, only enzyme etc.), incubation temperature (60, 80 and 100^{o}C), pH level (native and acidic), and incubation time (20, 40, 60, 80 min); a final process protocol was devised for extraction of pectin from citrus peel. The highest % yield (10.33±0.27) was obtained for enzyme + citric acid combination with 60 min of incubation. This was nealy 36% higher than control treatment's highest pectin yield (6.60±0.21%). However, highest % yield (9.77±0.15) with only citric acid treatment for 60 min was also significant. In case of grapefruit among all treatment types, the highest % yield (14.75±0.19) was obtained for enzyme + citric acid combination with 60 min of incubation which was at par with only citric acid treatment (14.67±0.64) for 60 min incubation. The enzyme + citric acid combination was nealy 26% higher than control treatment whose highest pectin yield was 10.91±0.11. In case of orange, the highest % yield (14.50±0.53) was obtained for enzyme + citric acid combination with 60 min of incubation which was slightly higher to only citric acid

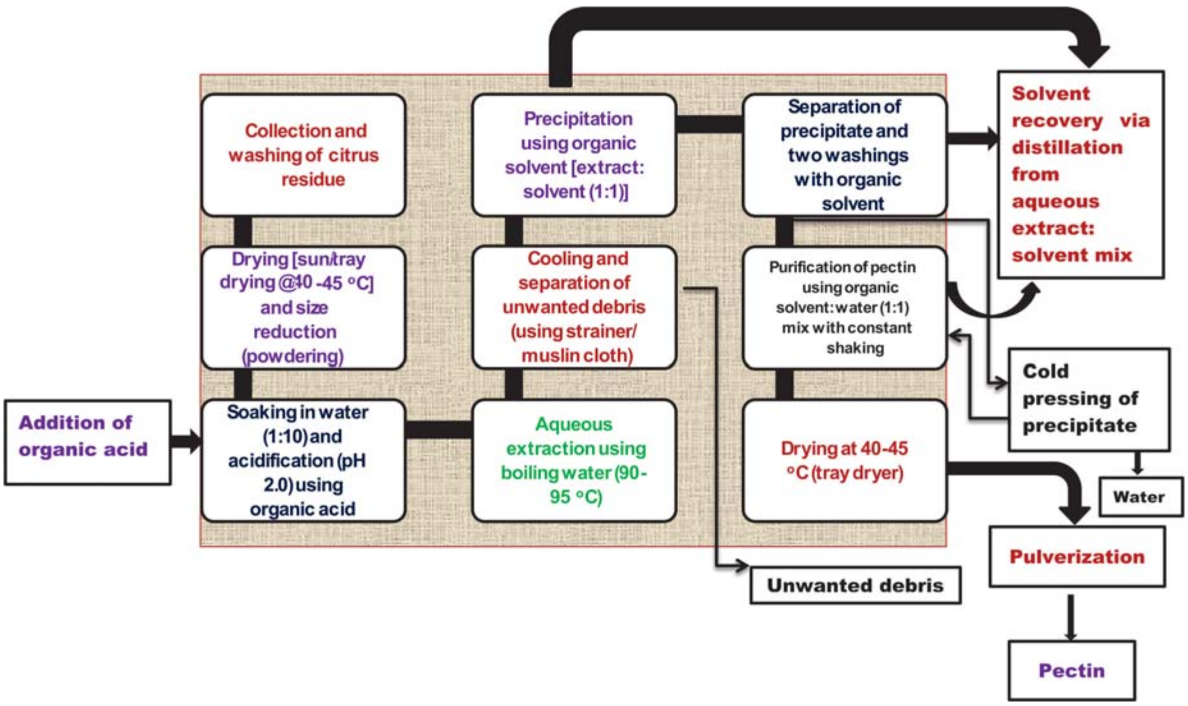


Fig. 21. Process flow chart for extraction of pectin from citrus peel

treatment (12.97±0.48) for 60 min incubation. The final extraction process protocol is elaborated in Fig. 21. The process comprised of washing and size reduction of peel, drying, powdering, and mixing with solvent, heating for a specific period, collecting aqueous extract, cooling, adding organic solvent for pectin precipitation, purification of pectin, straining extra liquid, drying at 40-45^{o}C overnight to obtain pectin flakes, powdering and storage. The process resulted in 10±1% purified pectin as compared to sulphuric acid mediated processing (6-7%). The process can be applied to any citrus peel with slight modifications. The water: organic solvent mix left after pectin precipitation can be subjected to fractional distillation to recover organic solvent for its re-use and to maintain economy of the process.

Preparation and evaluation jelly from extracted pectin

Prepared Jelly from pectin extracted from citrus peel with different proportion of calcium salt (0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5%) and the result showed that extracted pectin was found to have low methoxyl content and required a calcium salt concentration of 2.5 % and low methoxyl pectin of 2.0 in order to have good jel set but the jelly developed with addition of 2.5% extracted pectin has scored 8.5 for flavour, 8.2 for taste, texture, and colour and 8.3 for overall acceptability.

Process optimization for extraction of protein from mustard cake

Effect of temperature (ambient, 30^{0}C, 50^{0}C) with varying salts concentration (0.1N-1N NaCl; 0.1% Na_2SO_3) at pH 11 on extraction of protein

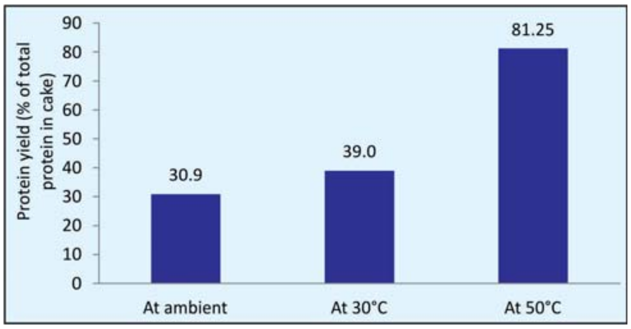


Fig. 22. Effect of temperature on extraction of protein from mustard cake at constant pH

from mustard cake was studied and found that on increasing temperature the recovery of protein increased. The protein was more soluble in NaCl as compared to Na_2SO_3 salt solutions. The optimized conditions for extraction of protein from mustard de-oiled cake was as: 0.1% NaCl aqueous solution, extraction temperature 50°C, duration of extraction 2 h at constant pH 11, cake: water ratio of 1:10 followed by iso-electric precipitation at pH 6.3 and subsequently 4.5. Using above conditions, the recovery of protein precipitate was maximum with protein content of 81.3 %.

Optimization of ultra-filtration parameters for recovery of protein from groundnut cake

Purification of protein was done using ultra-filtration method. The supernatant was passed through 5 micron filter and then fed to the membrane (Molecular size 30 kDa) at 2 psi pressure. The permeate was rejected and retentate was repeatedly fed to the membrane. The process was continued till 80% liquid was removed, thereafter the retentate was directly spray dried. This process yielded 5-8 % extra protein. Thus, by using this process for preparation of groundnut protein isolate about 65% of the protein was recovered against 58% (by isoelectric precipitation).

Soaking characteristics of paddy variety suitable for flaking

Soaking of paddy variety (MTU-1010) was carried out for 36 hours. The moisture content was determined after every 6 hours. The moisture content varied from 8.33 % wb (initial) to 35.26 % wb (final) after 36 hours. It was observed that the uptake of moisture initially was fast which gradually decreased with the passage of time. The saturation moisture content (SMC) of the paddy after 50 hours of soaking was found to be 37.10% (wb). Similarly, soaking of paddy variety (BB-11) was also carried out for 36 hours. The moisture content varied from 7.33 % wb (initial) to 32.23 % wb (final) after 36 hours. The saturation moisture content (SMC) of the paddy after 50 hours of soaking was found to be 35.33% (wb).

Preparation of hydrolysate plant protein (HPP) from mustard cake

The preparation of hydrolysate protein from mustard meal was developed with the spray drying of the filtrate Hydrolyzed plant protein obtained from treated mustard meal had less glucosinolate content (12.4 µmol/g) as compared

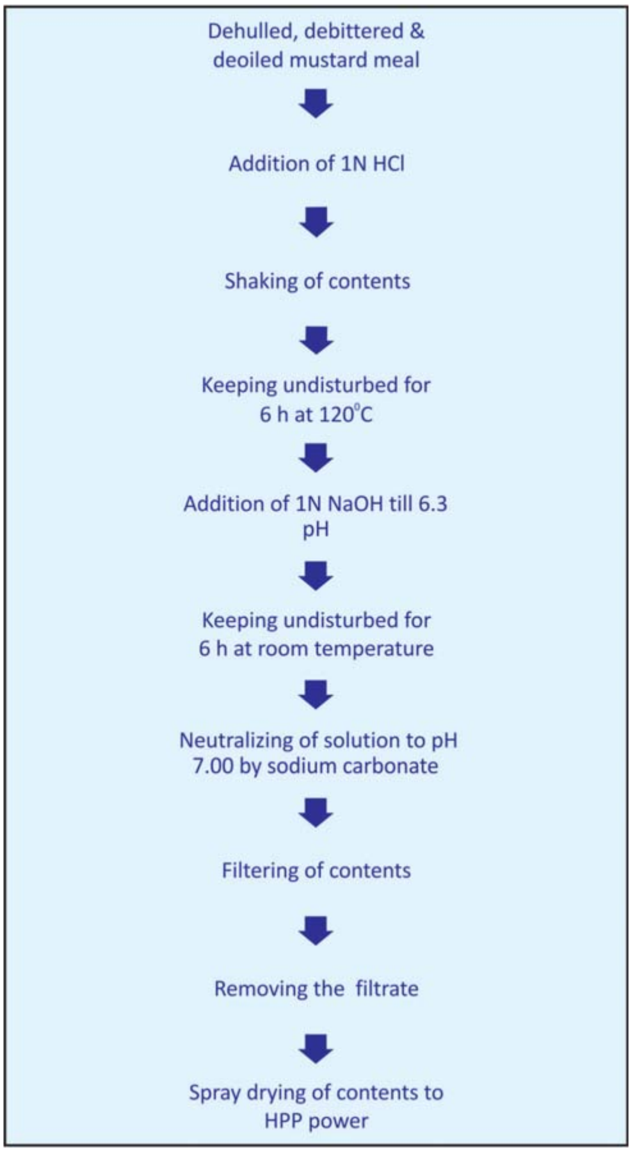


Fig. 23. Process Flow chart to get hydrolyzed plant protein (HPP)

Fig. 24. Hydrolyzed plant protein (HPP)

to that prepared from untreated samples of mustard meal (78.7 µmol/g) for use in taste enhancer.

Preparation of Taste Enhancer

Preparation of taste enhancer formulations was done using protein hydrolysate from dehulled deoiled debittered mustard meal along with different mixtures of spices such as turmeric, onion, sugar, coriander, garam masala, red chilli powder, black pepper, salt, cumin (Jeera), ginger. The concentration of ingredients was optimized to develop a masala premix . This masala and HPP in 7:3 ratio was used to develop taste enhancer. Shelf life of the developed taste enhancer was also studied.

Table 1. Standardized ingredients for preparation of taste enhancer

S.No	Ingredients	Quantity (g)
1.	Protein hydrolysate	3
2.	Mixture of spices (masala premix)	7
	Salt	1.7
	Red chili powder	0.25
	Onion powder	2.5
	Turmeric powder	0. 2
	Jeera powder	0.23
	Coriander powder	1.0
	Garam masala	0.3
	Black Pepper	0.3
	Ginger powder	0.25
	Sugar	0.7

Fish feed development from mustard seed

Three types of fish feed were prepared 1. Sinking compact pellets 2. Sinking pellets and 3. Floating extruded pallets. Stability in water of sinking pallets was about 24 hours, whereas the floating pellets had less stability (5-10 min) in water. The ingredients used were 1. Mustard deoiled cake 943g, fish meal 57 g, maize powder as binder 100 g for 1000 g feed. Using de-bittered mustard oil cake as one of the ingredients, two types of fish feed were prepared. Both feeds were tested for acceptability to the fish. The floating type feed was accepted by fingerlings of common carp about 60-70%. Fish feeds (pellets) were tested for acceptability to the fish. The floating type feed was fed to fingerlings of rohu fingerlings (15-20 cm in length) in plastic tanks with a density of 40 fish/tank (tank capacity 100 L). The acceptability was 65-72%, after excluding the residues as sediments.

Fortification of curcumin micro capsules (MC) in Kulfi

Functional Kulfi incorporated with micro curcumin (MC) was prepared by the method as shown below (Fig. 25). Initial volume of milk was taken 1.5 L for the preparation of functional Kulfi. Milk was stirred continuously to reduce it to half (750 mL) of its initial volume. Concentrated milk was then divided into three batches composed of 250 ml of milk. Powdered sugar (15%), SMP (10%) and mango pulp (5%) followed by sodium alginate (0.45 g) was then added to concentrated milk. Milk was then stirred (EUROSTAR, IKA, Germany) at 1600 rpm for 20 min to complete mixing of the ingredients and to avoid the lump formation (due to the presence of sodium alginate). After complete mixing of the ingredients, free curcumin with ghee and curcumin MCs (1%) was added to the Kulfi mix. Stirring was done continuously to make homogenous Kulfi mix and

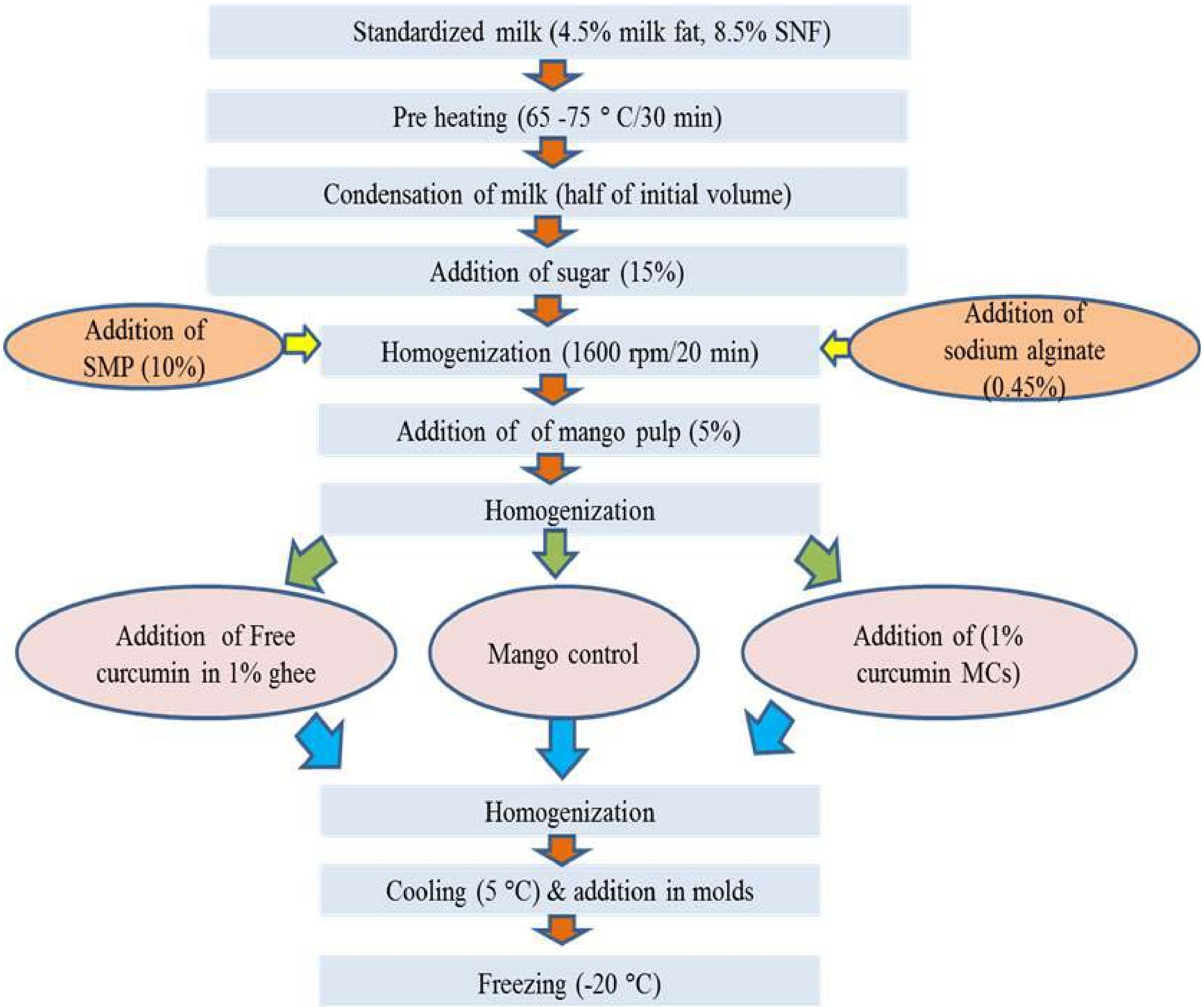


Fig. 25. Process flow chart for functional Kulfi incorporated with curcumin MCs

this mix was then transferred to mold. The molds containing Kulfi mix were then allowed to cool. They were then kept for freezing at (-20°C) for 24 hrs. Functional curcumin Kulfi was prepared by adding free curcumin in ghee (free curcumin) and curcumin MCs (microencapsulated curcumin) at the end of the cooling of the Kulfi mix. The product was optimized on the basis of sensory evaluation and further it was analyzed for physical (melting resistance, apparent viscosity), microbiological and sensory analysis.

Colour of fortified Kulfi

Total color differences (Δ E) of kulfi samples were calculated and shown in the Table 2. Δ E value for the Ghee+Free curcumin kulfiis much higher (28.21±5.55) than the kulfi fortified with curcumin MCs (11.86±2.34) as shown in the Table 2. According to the statistical evaluations, the samples showed statistically significant difference in terms of *b** value ($P< 0.05$). There is no statistical significant difference between control

Table 2. Colour measurements by Hunter lab colorimeter of curcumin fortified kulfi samples

Kulfi Samples	L	a	b	Δ E
Control Mango kulfi	73.2±2.57[a]	-0.88±0.18[b]	32.73±2.78[b]	-
Ghee+Free Curcumin kulfi	76.73±2.76[a]	-5.12±0.34[a]	60.12±2.75[c]	28.21±5.55[a]
Curcumin MCS kulfi	72.83±5.71[a]	-1.27±0.34[b]	22.33±0.88[a]	11.86±2.34[b]

mango kulfi and kulfi fortified with curcumin MCs in terms of *a** (intensity of red colour) value. The yellowness in the Ghee+Free curcumin kulfi is more due to the presence of free curcumin when compared to kulfi fortified with curcumin MCs (presence of encapsulated curcumin). There is no significant difference between for three kulfi in the value of *L**.Furthermore, the value of lightness represented that the highest value since light reflects on the surface of ice crystals before melting of the kulfi. In general, the color of the ice cream increased in whiteness as the fat content increased.

All the data are mean ± standard deviation (n e" 3) for three independent batches of kulfi. Superscripts with a different letter in the same column are significantly different ($P < 0.05$) from each other.

Melting resistance or melt down time

Melting rate (ml/15min) of all treated kulfi samples are shown in Table 3. There was no significant difference in the melting rate was

Table 3. Meltdown time of curcumin fortified kulfi samples

Sample name	Meltdown Rate (ml/15 min)
Control mango Kulfi	12.57±1.53
Ghee+Free curcumin Kulfi	12.59±1.40
Curcumin MCs Kulfi	12.69±2.27

All the data are mean ± standard deviation ($n \geq 3$) of three independent batches of *kulfi*.

observed between control mango kulfi and fortified kulfi samples. The total soluble constituents have influenced melting resistance of kulfi. An increase in the total soluble constituents depresses the freezing point of milk. Only 1% of curcumin MCs and free curcumin in ghee (1%) did not caused any significant change in the total soluble content of the kulfi samples. Hence there was no significant difference observed in control mango kulfi and curcumin fortified kulfi samples.

Microbiological analysis of Kulfi

The average SPC, coliform and yeast and mold counts of the kulfi samples are given in the Table 4. When compared with control mango kulfi, both the curcumin fortified kulfi samples (kulfi fortified with curcumin MCs and Ghee+Free curcumin kulfi)showed one cycle reductions in the microbial counts for each microbial analysis (yeast & mold, coliform and standard plate counts). SPC reduced to one log in kulfi fortified with curcumin MCs ($14.16\times10^5\pm3.88$cfu/ml) and Ghee+Free curcumin kulfi ($18.33\times10^5\pm2.51$cfu/ml) when compared with the control mango kulfi ($16.5\times10^6\pm4.27$cfu/ml). This may be due to the antimicrobial effect of curcumin for various food borne pathogens and food spoilage microorganisms. Moreover, majority of the general type of organisms may not have survived at high heat processing conditions of the wet mixes. In general, Indian Standards Institute (ISI)prescribed the limits of the bacterial load particularly for coliform level is 100 cfu/g and for total bacterial count(TBC) is 2.5×10^5cfu/g. All the kulfi samples have the microbial load within the prescribed limits.

Table 4. Microbiological analysis of curcumin fortified kulfi samples

Sample names	Yeast and Mold (cfu/ml)	SPC (cfu/ml)	Coliforms (cfu/ml)
Control Mango Kulfi	$11.33 \times 10^5 \pm 2.08$	$16.5 \times 10^6 \pm 4.27$	$10.16 \times 10^3 \pm 1.25$
Ghee+Free Curcumin Kulfi	$12 \times 10^4 \pm 2.64$	$18.33 \times 10^5 \pm 2.51$	$6.66 \times 10^2 \pm 2.08$
Curcumin MCS Kulfi	$9.5 \times 10^4 \pm 1.32$	$14.16 \times 10^5 \pm 3.88$	$3.66 \times 10^2 \pm 1.15$

All the data are mean ± standard deviation ($n \geq 3$) of three independent batches of *kulfi*.

Hence these samples were safe for consumption. The microencapsulated curcumin was found to have more antibacterial and antifungal activities when compared with free curcumin.

Sensory evaluation of curcumin MCs incorporated Kulfi

There was no significant difference (P>0.05) observed in all the sensory parameters of the control mango kulfi and kulfi fortified with curcumin MCs as shown in Fig. 26. Moreover, slight gritty texture of the kulfi fortified with curcumin MCs was preferred by panelists, which may be due to the presence of microcapsules in the kulfi.

Significant difference (P < 0.05) was observed in colour and appearance, and flavour and taste parameters when Ghee+Free curcumin kulfi was compared with control mango kulfi and kulfi fortified with curcumin MCs. Due to the presence of free curcumin in the Ghee+Free curcumin kulfi, the sample scored lower in colour and appearance (7.30±0.23) parameters in hedonic scale when compared to control mango kulfi (8.02±0.13) and kulfi fortified with curcumin MCs (7.98±0.13). These results are corroborated with the visual appearance and colour of kulfi as discussed earlier in colour measurement parameter (Table 2).

Similarly, Ghee+Free curcumin kulfi scored lower in flavour and taste (7.37±0.15) when compared to control mango kulfi (8.03±0.17) and kulfi fortified with curcumin MCs (8.17±0.23). Slight dislike scores of flavour and taste in Ghee+Free curcumin kulfi was may be due to the presence of free curcumin. Higher scores of flavour and taste in kulfi fortified with curcumin MCs was due

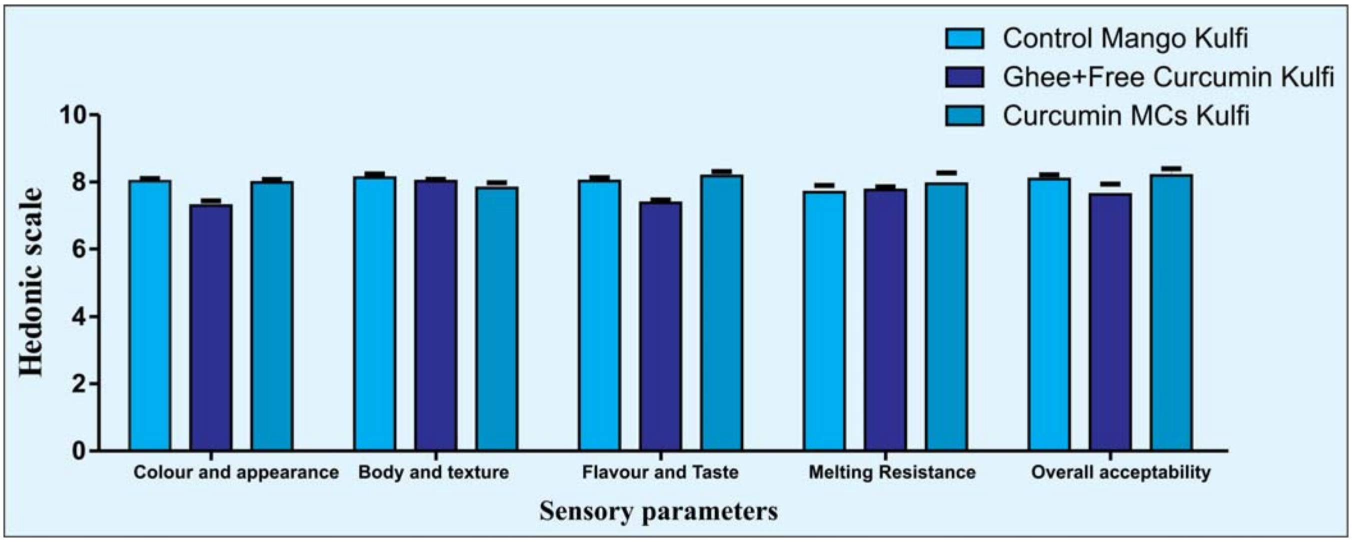


Fig. 26. Sensory analysis of curcumin incorporated *Kulfi*

Table 5. Purchase intentions for the fortified kulfi samples

Sample Name	Purchase Intention
Control mango kulfi	4.65±0.50
Ghee+Free curcumin kulfi	4.08±0.67
Curcumin MCs kulfi	4.32±0.64

All the data are mean ± standard deviation (n ≥ 3) of three independent batches of *kulfi*

to the presence of encapsulated curcumin in kulfi sample. Microencapsulation enhances the colour and appearance and flavour and taste of the fortified kulfi samples by encapsulating the fluorescent yellow bitter flavoured curcumin component.

With respect to purchase intention,all kulfi samples with microencapsulated curcumin scored well (above 4.0) which showed consumers would probably buy all the tested kulfi samples as shown in Table 5. Hence the samples were acceptable for consumption with nutraceutical profile.

Process protocol for development of high value green raisins

Efficacy of ascorbic acid treatments in production of green raisins was experimented and treatment (dip and spray treatment) effect on PPO activity and browning index was determined. Denominations of the treatments used in the study given in Table 6.The results of present study revealed that the application of ascorbic acid is helpful in retaining green color of raisins and improving drying rate of grapes. Different doses of ascorbic acid were recorded with reduced PPO activities during grape drying. Spraying of ascorbic acid during drying was found more effective than ascorbic acid dip.

Table 6. Denominations of the treatments

Ascorbic acid treatment	Treatment denomination					
	Concentrations of ascorbic acid solution					
	Nil	100 ppm	200 ppm	300 ppm	400 ppm	500 ppm
Dipping	D0	D100	D200	D300	D400	D500
Spraying	S0	S100	S200	S300	S400	S500

Table 7. Effect of ascorbic acid dipping and spraying treatments on PPO activity of raisins

Days	D0	D100	D200	D300	D400	D500
0	81.14±6.21g	80.12±4.52g	81.52±4.62g	81.28±7.45g	81.24±3.21g	80.14±5.25g
1	71.85±2.32f	72.14±4.21f	70.14±3.21f	75.58±2.36f	73.62±2.32f	71.28±3.33f
2	55.52±1.32e	60.21±1.25e	65.12±1.36e	62.14±6.32e	66.29±2.21e	59.85±2.31e
3	42.69±5.62d	51.23±3.21d	57.18±5.62d	53.25±1.25d	56.54±5.32d	45.21±2.31d
4	35.25±5.21c	45.14±5.21c	46.54±2.62c	42.14±5.26c	40.41±4.23c	37.48±1.25c
5	28.15±4.21b	29.25±5.32b	28.74±1.25b	30.95±6.25b	32.14±5.14b	26.58±1.26b
6	23.25±5.21a	21.86±1.62a	21.51±2.36a	22.14±2.35a	21.11±2.31a	20.21±13.21a

	S0	S100	S200	S300	S400	S500
0	81.23±3.21g	80.12±4.21g	80.25±2.36g	81.65±1.25g	81.11±9.62g	81.14±4.21g
1	72.21±5.84f	70.58±4.32f	71.10±2.12f	71.24±3.26f	70.14±1.21f	71.14±4.91f
2	59.2±51.54e	60.20±3.21e	61.16±1.35e	60.58±5.32e	61.62±5.23e	62.29±5.34e
3	41.10±2.45d	40.35±2.35d	42.45±4.62d	45.20±4.26d	40.17±2.32d	51.56±2.36d
4	32.15±6.20c	31.11±2.36c	3126±1.54c	30.85±5.20c	32.51±3.14c	43.26±2.15c
5	29.28±2.21b	26.84±1.36b	27.45±2.25b	27.74±4.36b	27.20±2.36b	32.26±2.32b
6	25.45±3.21a	22.15±5.62a	21.45±4.35a	20.81±1.32a	19.69±1.22a	19.86±2.31a

Table 8. Effect of ascorbic acid dipping and spraying treatments on browning index of raisins

Days	D0	D100	D200	D300	D400	D500
0	0.21±0.2a	0.21±0.2a	0.20±0.2a	0.20±0.2a	0.20±0.2a	0.20±0.2a
1	0.35±0.3b	0.30±0.1b	0.39±0.2b	0.39±0.3b	0.36±0.1b	0.33±0.6b
2	0.56±0.1c	0.41±0.3c	0.45±0.3c	0.45±0.2c	0.51±0.2c	0.45±0.2c
3	0.67±0.2d	0.51±0.3d	0.56±0.2d	0.59±0.1d	0.63±0.3d	0.63±0.5d
4	0.81±0.1e	0.60±0.1e	0.63=0.1e	0.74±0.6e	0.79±0.3e	0.80±0.3e
5	0.91±0.3f	0.73±0.2f	0.74±0.6f	0.81±0.2f	0.96±0.6f	0.95±0.6f
6	2.13±0.2g	1.14±0.1g	1.13±0.6g	1.21±0.7g	1.21±0.3g	1.24±0.7g
	S0	**S100**	**S200**	**S300**	**S400**	**S500**
0	0.20±0.2a	0.21±0.2a	0.20±0.1a	0.20±0.2a	0.20±0.2a	0.20±0.1a
1	0.32±0.2b	0.28±03b	0.37±0.2b	0.36±0.1b	0.37±0.1b	0.32±0.2b
2	0.51±0.1c	0.38±0.1c	0.48±0.3c	0.45±0.3c	0.47±0.3c	0.43±0.3c
3	0.62±0.3d	0.41±0.2d	0.52±0.5d	0.56±0.4d	0.60±0.5d	0.61±0.4d
4	0.75±0.2e	0.65±0.3e	0.67±0.6e	0.70±0.5e	0.78±0.6e	0.79±0.6e
5	0.98±0.1f	0.85±0.1f	0.87±0.6f	0.82±0.8f	0.93±0.4f	0.92±0.7f
6	1.98±0.3g	0.98±0.6g	0.96±0.8g	0.99±0.8g	1.12±0.8g	1.21±0.8g

Fig. 27. Raisins produced from S0 and S200 treatments

Extraction of natural color from black carrots and its utilization in product development

Enzyme assisted extraction of black carrot juice with Pectinase @ 0.1 to 0.25 per cent was carried out: Enzyme concentration at 0.2% was optimized based upon various biochemical analysis (Table 9). Extraction of anthocyanins/ biocolor from black carrot pomace powder was carried out using ultrasonication at 40, 50, 60 °C for 15, 30, 45 min.

Table 9. Antioxidant content of black carrot juice as affected by enzyme-assisted processing *(Pectinase)*

Pectinase concentration (%)	Total phenols[1]	Anthocyanin content[2]	DPPH[3]
Control	300.63	485.25	82.20
0.10	330.84	620.56	90.01
0.15	355.54	686.55	95.21
0.20	380.22	1000.14	96.02
0.25	370.12	932.54	89.11

[1]mg GAE/100 ml juice, [2]mg/L juice, [3]% Inhibition

Table 10. Extraction of anthocyanins at different temperature

min	^{0}C	ACN	ACN
15	40	40.91	85.82
30	40	63.63	105.97
45	40	55.72	117.82
15	50	55.13	128.07
30	50	54.64	145.46
45	50	96.98	116.01
15	60	72.10	148.94
30	60	45.30	162.28
45	60	41.80	152.41

Fig. 28. Anthocyanin extraction process from black carrot

Black carrot (*Daucus carota L.*)

↓

Washing & Cutting (3.0*2.5cm^2)

↓

Blanching (90^0C for 2min)

↓

Pulping (blender)

↓

Enzymatic liquefaction

↓

Incubation (60^0C FOR 60min)

↓

Pressing (2000 lb/m^2)

↓

Pasteurization (90^0C for 5min)

↓

Acidification

↓

Storage (2-4^0C)

Fig. 29. Process flowchart for extraction of anthocyanin from black carrot

Novel freezing based process for development of soft aonla candy

Process protocol for making soft aonla candy was optimized. Blanching time was optimized on the basis of ascorbic acid content and was fixed at 100 °C for 15 min. Blanched segments of aonla were frozen for 10 h and samples were collected at an interval of 1 h followed by TPA. Optimized freezing time was 6 h at -6 °C. Thawing of frozen segments was carried out at five different temperatures (10, 20, 30, 40 and 50 ° C). Frozen segments took 250, 180, 120, 60 and 30 min for thawing.

Table 11. Peak force before & after freezing at different interval of time

Process time (h)	Peak Force after freezing (N)	Peak Force after thawing (N)
0 h	75.18	-
1 h	127.45	81.96
2 h	132.01	75.60
3 h	186.96	71.89
4 h	210.02	66.74
5 h	301.06	73.66
6 h	292.22	58.37
7 h	324.98	55.71
8 h	252.51	56.31
9 h	310.38	58.97
10 h	322.60	58.98

Fig. 30. a) Control candy

Fig. 30. b) Soft candy

Textural force for control candy without freezing was observed as 13.14 N and for soft candy it was recorded as 6.86 N.

Corn cob powder incorporated earthen cup

Utilization of corn cob powder was taken under the project title on "Bio transformation of Corn by-products for protein and other value added products". In this work, corn cob blended earthencups were prepared as a value addition of Corn cob residue powder. Agricultural residues such as sawdust, husks from rice and coffee with earthenclay mixtures can be used as base materials to manufacture ceramic devices. With this background, Corn cob powder has been utilized for the preparation of cups in partial replacement of earthen clay.For making corn cob blended earthen cup, Corn cobs were cleaned, milled using hammer mill and sieved by manual sieving for uniform size particles. The cup compositionswere prepared with addition of increasing amount of corn cob powder (0%, 5%, 10%, and 15% inwt) in the earthen clay slurry. The samples were fired within the range of 900-1200°C. Engineering properties like compressive strength, size, shape, volume, surface area, density, colour and thermal properties like thermal conductivity, specific heat and diffusivity of corn cob blended earthen cup were measured to determine the effect of corn cob powder on Engineering and thermal properties of cups. Volume, surface area, density of the cups ranged from 79 to 83.66 ml; from 84.61 to 92.59cm^2; and from 0.83 to 1.09 g/ml, respectively. L, a, and b of the cups ranged from 46.15 to 48.09; from 13.32 to 17.03; and from 23.77 to 25.22, respectively. Thermal conductivity, specific heat capacity and diffusivity of the cups varied from 0.132 to 0.192, w/mK; from 0.142 to 1.075, mJ/m^3/K; and 0.132 to 0.137, mm^2/s, respectively. Newton's cooling constant ranged from 0.49 to 0.54, 1/min.All percentages of addition of Corn cob powder

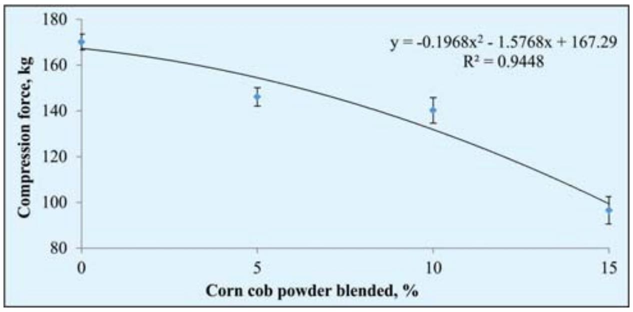


Fig. 31 a. Corn cob powder blended vs compression force

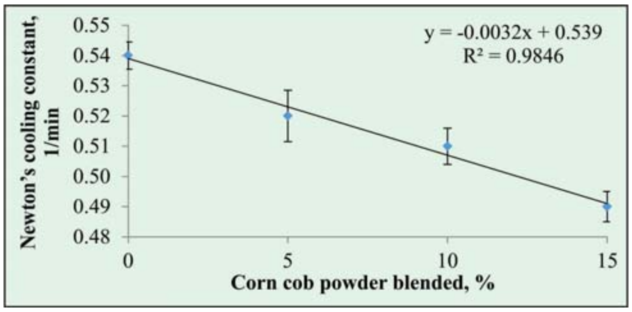


Fig. 31 b. Corn cob powder blended vs Newton's cooling constant improved the mixture for earthen cup manufacturing.The blending of corn cob residue for making earthen cup is not only a value addition but it also provides an alternated solution for disposal of corn cob residues.

Micronutrients enriched reconstituted rice for rice fortification

Technology for development of micronutrients enriched rice kernel, which is to be utilized for rice fortification, was developed following FSSAI standards for micronutrients fortification. The study was carried out by standardize various process parameters considering Box Behnken design of response surface methodology using Design Expert software and food extruder. The process parameters considered for experimental design and optimization were feed moisture, barrel temperature and screw speed. The experiments were carried out using desired amount of micronutrients premix (procured from Hexagon Nutrition Pvt. Ltd., Nasik) containing iron (as ferric pyrophosphate) 200 g, folic acid 13.0g and vitamin B_{12} (as cyanocobalamin) 0.10g per 1.5 kg premix for rice fortification (amount as per the company specification). Samples of developed fortified rice kernel (FRK) were evaluated for important quality parameters namely expansion in diameter, expansion in length, bulk density, colour quality parameters of grain and powder form, hardness, toughness, cooking time, solid loss in cooking water, water absorption, water solubility, pasting characteristics, iron content, total minerals and sensory characteristics. Numerical optimization technique of the Design–Expert software was used for optimization of the selected multiple responses namely expansion in diameter, expansion in length, bulk density, cooking time, solid loss in cooking water, iron content, water absorption, water solubility, whiteness index and yellowness index. All the quality parameters were found significantly affected due to variation in the process parameters. Bulk density, expansion in length, expansion in diameter of different developed FRK samples 626.663 to 719.019 kg/m^3, 0.773 to 0.923 and 1.414 to 1.835, respectively. Cooking time and solid loss in cooking water of developed FRK varied between 8.02 to 10.05min and 33.89 to 45.21% as compared to 12.11min and 15.66% in case of unprocessed rice. Iron content and total mineral content of FRK varied between 107.08 to 119.28mg/100g and 1.033 to 1.333%, respectively. Water absorption and water solubility index of FRK ranged from 4.184 to 5.498g/g and 1.809 to 3.432%, respectively while whiteness index of FRK in grain as well as in powder form ranged from 65.015 to 68.463 and 80.55 to 84.501, respectively. The optimum level of feed moisture, barrel temperature and screw speed were determined based upon maximizing bulk density,

Fig. 32 a. Fortified rice kernel with iron, folic acid and vitamin B_{12}

Fig. 32 b. Raw rice with fortified rice Kernel, 100:2

Fig. 32 c. Cooked fortified rice with iron, folic acid & vitamin B_{12}

cooking time, iron content, whiteness Index (whole/grain & powder form) while minimizing expansion in diameter & length, water solubility, colour difference and keeping the solid/ gruel loss in cooking water, water absorption and independent parameters in range. Based upon numerical optimization with maximum desirability level (0.965), it can be said that FRK could be successfully developed for its use for rice fortification. The optimized sample indicated the bulk density, cooking time, water absorption, water solubility index, whiteness index and iron content as 695.02 kg/m^3, 8.48min, 4.56g/g, 1.66%, 83.374, 113.68mg/100g. The mean overall acceptability score (by 18 semi-trained panelists) for cooked fortified rice (unfortified rice: FRK: 100:1.7) was 8.58±0.49 as compared to 8.24±0.58, thus indicating the good sensory acceptability of fortified rice with desired amount of FRK.

Micronutrients enriched wheat product for wheat *dalia* fortification

Technology for development of micronutrients enriched wheat product to be utilized for wheat *dalia* fortification, has been developed considering the FSSAI standards for fortification of whole wheat flour. The study was carried out to standardize various process parameters considering Box Behnken design of response surface methodology using Design Expert software and food extruder. The process parameters considered for experimental plan and optimization were feed moisture, barrel temperature and screw speed. Experimental plan was developed using desired amount of micronutrients premix (procured from Hexagon Nutrition Pvt. Ltd., Nasik) containing iron (as sodium iron EDTA) 20 g, folic acid 1.3g and vitamin B_{12} (as cyanocobalamin) 0.010g per 200g premix (amount as per the company specification). Samples of developed fortified wheat product samples were evaluated for important quality parameters namely expansion in diameter, bulk density, colour quality parameters (L, a, b, whiteness index, colour difference, grain and powder form), hardness, toughness, cooking time, solid/gruel loss in cooking water, water absorption, water solubility, pasting characteristics, iron content, total minerals and sensory characteristics. Numerical optimization technique of the Design–Expert software was used for optimization of the selected multiple responses namely expansion in diameter, bulk density, cooking time, solid loss in cooking water, iron

Fig. 33 a. Raw wheat *dalia* with fortified wheat product, 100:2

Fig. 33 b. Cooked fortified wheat *dalia* with iron, folic acid & vitamin B_{12}

content, water absorption, water solubility, whiteness index and yellowness index. All the quality parameters significantly affected due to variation in the process parameters. Bulk density and expansion in diameter of fortified wheat product (FWP) ranged between 701.10 to 796.55 kg/m^3 and 1.186 to 1.371, respectively. Cooking time and solid/ gruel loss in cooking water of FWP varied between 3.43 to 4.03min and 38.23 to 41.88% with lesser cooking time than unprocessed wheat *dalia*. Iron content and total mineral content of FWP varied between 111.998 to 118.1mg/100g (wb) and 2.007 to 2.187%, respectively. Water absorption and water solubility index of FWP ranged from 4.464 to 5.837g/g and 7.862 to 13.456%, respectively while whiteness index of FWP in grain as well as in powder ranged from 68.231 to 73.78 and 49.387 to 41.355, respectively. The colour difference of FWP grain and powder ranged varied between 14.213 to 19.98 and 4.637 to 11.493, respectively. The optimum level of feed moisture, barrel temperature and screw speed were determined based upon maximizing bulk density, cooking time, iron content, whiteness index (whole/grain & powder form) while minimizing expansion in diameter, water solubility, colour difference and keeping the solid/ gruel loss, water absorption and independent parameters in range. Based upon numerical optimization with maximum desirability level (0.942) and validation of the process, it can be said that micronutrients enriched wheat product could be successfully developed for its use for wheat *dalia* fortification. The optimized sample indicated the bulk density, water absorption, water solubility index, whiteness index and iron content as 752.65 kg/m^3, 4.85 g/g, 8.64%, 71.48, 116.39mg/100g. The mean overall acceptability score (by 29 semi-trained panelists) for cooked fortified wheat *dalia* (unfortified wheat *dalia*: FWD: 100:1.8) was 8.29±0.77 as compared to 8.07±0.73, thus indicating the good sensory acceptability of fortified wheat *dalia*.

Farmers' First Project

Processing and Value Addition of Agricultural Produce for Enhancing Farmers Income and Employment in Production Catchment

The project is implemented in Shahid Bhagat Singh Nagar district of Punjab. Based on Farmer Scientist interface meeting and subsequent visits of FFP team in the selected villages, some indicators were selected. The indicators were interest of the famers in processing activities, farmers/ entrepreneurs already have some knowledge and experience pertaining to selected enterprises, leadership quality, reputation in the village. Based on these selected indicators, famers were identified as the beneficiaries of the project. Besides, scope and potential of selected post-harvest interventions were accessed considering the production and market scenario in village catchments. Under the project, Akola Mini Dhal Mill and Honey Processing Plant which includes Honey heating cum filtration unit, storage tank cum heating tank, moisture reduction unit and bottling unit were purchased. MoU was signed and machinery was handed over to the farmers. The pulse processing unit was installed in Nurpur village, Punjab. Farmers are processing dhal and selling under the brand name "Kisaan Sauda". The honey processing unit is established in Nawanshahr and farmers are processing and selling the honey under brand name "Happy Honey". Two hands on training programme on pulse processing was organised for the farmers under the project in ICAR-CIPHET, Ludhiana. One hands on training programme on honey processing was also organised during this period. Demonstration was conducted in the established pulse processing and honey processing unit for the farmers in the village. The project team members also visited the implementation site to identifying potential beneficiaries for chemical free jaggery unit and on-farm fresh handling of horticultural crops. A farmer-scientist interface

Fig. 34 a). Established Honey processing unit at Nawanshahr

Fig. 34 b). Established Honey Brand "Happy Honey"

Fig. 34 c). Pulse Processing Unit

Fig. 34 d). Dhal processed and sold under brand name "Kisaan Sauda"

meeting was organized at ICAR-CIPHET, Ludhiana on 17th March, 2018. About 150 farmers from SBS Nagar participated in the meeting. Farmers were made aware about the potential of processing and value addition of the crops grown at SBS Nagar, Punjab during the meet.

Food Quality and Safety

Method development for quantification of metanil yellow from turmeric

Method for quantification of metanil yellow from turmeric sample based on visible spectroscopy was developed. Metanil yellow dye stock solution was prepared by dissolving 10 mg dye in 10 ml of distilled water. From this stock solution, 10 ml was further diluted to 1 ml. To it 50 ml of conc. HCl was added. Solution was mixed throughly and kept for 5 minutes. Sample thus prepared was scanned in the range of 340-800nm. Absorption maxima was obtained at 525 nm. Further, for the estimation of the metanil yellow in unknown sample, 100 mg of sample was taken and to it 2 ml of water was added. The contents were centrifuged and after centrifugation 1 ml extract was taken. To this extract 50 µl of concentrated hydrochloric acid was added. Pink to purple color developed was read at 525nm. Optical characteristics of proposed method revealed Beer's law limit of 20 µg/ml while, the limit of detection and quantification were 0.053 and 0.16 µg/ml respectively.

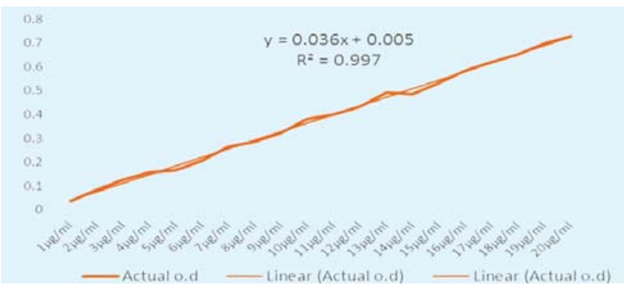


Fig. 35. Standard curve for detection of metanil yellow Y = mx+c, where x is concentration of metanil yellow in (µg/ml) and Y is absorbance at the given maxima

Method for qualitative estimation of lead chromate from turmeric

Lead chromate is yellow colored powder and is used as an adulterant by the unscrupulous traders to give bright color to turmeric samples. Lead chromate can induce chromosomal damage. Method has been developed for detection of lead chromate with detectable limit of 0.1-0.2%. It is an indirect method based on detection of chromate. 3 ml of dilute HCl was added to 0.1 g of sample. After mixing the contents 1 ml of potassium iodide solution (20%) was added. Immediate development (within 5 minutes) of purple/blue color shows test is positive for lead chromate.

Shelf life study of the wadi prepared by the automatic wadi making machine

Different packaging material viz., Aluminium foil, LDPE, LLDPE has been selected to store the wadi prepared by the automatic wadi making machine. The duration planned for shelf life study was six months and the different parameters like moisture content, protein content, fat content, ash content, water activity, temperature and humidity were studied at monthly intervals. The average temperature and relative humidity for the six months of study ranged between 16^{0}C to 35^{0}C and 32 to 75%. The moisture content of the wadi sample varied between 9.43-17.13% for LDPE, 9.43-15.58% for LLDPE and 9.43-13.88% for Aluminium foil. The free fatty acid content ranged between 0.32-0.72% for LDPE, 0.32-0.61% for LLDPE and 0.32-0.52% for aluminium foil samples. As reported in literature that if FFA content in food is less than 2% it is considered safe for consumption. Insignificant difference was observed in ash content, protein content and

Fig. 36. Wadi packaged in different packaging materials

carbohydrate content of the wadi samples during the period of study. However, the water activity of the wadi sample varied between 0.38-0.75 for LDPE, 0.38-0.62 for LLDPE and 0.38-0.53 for aluminium foil which implies that water activity was least in aluminium foil followed by LLDPE and LDPE. Wadi could be safely stored for six months in the above packaging materials with preference for aluminium foil followed by LLDPE and LDPE.

Utilization of fruit waste and plant extracts in developing antimicrobial coatings for extending shelf-life of fruits

Formulation of antimicrobial coating using natural pant extract

Formulated edible coating using different antimicrobial compound (0.1-0.2% essential oil and 2-3% bark extract of plant) and tested their performance under ambient (30-36^{o}C) and low temperature storage (7-10^{o}C) of mango and guava. The result showed that essential oil (0.2%) from clove and grape significantly reduced decay loss as compared to fruit treated with 3% amaltas or arjun bark extract. Among essential oil, clove was more effective in reducing the decay loss but it resulted in low sensory quality. Among bark extract, cassia bark presented better control of post harvest disease over its arjun bark.

Evaluation of aloevera gel coating for mango

Aloevera gel was prepared with different concentration of its leaf gel (100, 75 and 50%) and the study revealed that Aloevera gel (25 %) maintained the gloss but failed to prevent the weight loss and microbial load. However, higher concentration at 50 or 100 % prevented the weight loss and thresh hold limit of 10% PLW was reached after 32 days of cold storage (12^{o}C). There was no spoilage upto 20 days of cold storage and thereafter it progressively increased and reached 40 % at the end of storage period. On the other hand, control fruit under ambient condition (30-36^{o}C) lost 8.96 % of their weight within 6 days of storage whereas coated fruit reached the same stage (9.74 %) after 8 days of storage.

Testing the efficacy of antimicrobial compound in vitro

In vitro trial with clove and grapefruit oil at 2000 ppm resulted in maximum inhibition of Botrytis (92-98%) which is responsible for causing stem end rot but had only (48-65%) inhibition for Colletotrichum which is responsible for causing anthracnose.

Effect of edible coating material on storage of mango

Prepared and evaluated different coating formulation using 20 and 30% shellac, 20% carnauba wax, 3% cassava starch and 75 % aloevera gel for storage study of dusheri mango. The result revealed that carnauba wax was found most effective for reducing the weight loss (5.93 % after 32 days of cold storage) among all other coating material but it drastically reduced the fruit appearance by leaving white stains of coating on fruit surface which limits its commercial application. Shellac coating at 20 or 30 % resulted in least fruit spoilage (11.43-11.98%) compared to all other coating after 32 days of storage.

Carnauba wax coating to extend shelf life of guava

Carnauba wax was applied at the rate of 0, 10, 20 and 30 % emulsion and the fruits were evaluated after every two days during their storage. Wax application (10 or 20%) kept the weight loss of guava within acceptable limit for longer period as compared to cassava or shellac coatings. Wax coating slowed down the fruit softening by 13-21 % but coated fruits were more prone to white staining during storage.

Effect of anti-microbial coating on storage of guava

Assessed effect of antimicrobial coating on storage of summer guava and the result showed that fruits treated with 20% shellac incorporated with 5 % cassia or arjun bark extract were free from anthracnose and stem end rot upto 8 days of ambient storage. Clove and grapefruit extract (0.2%) were found effective against anthracnose but not against stem end rot. Fruit firmness decreased during storage of all sample but it was better maintained in coated fruit. Bioyield of control sample decreased from 2.50 kg to 1.03 kg while flesh firmness decreased from 1.61 kg to 0.38 kg under ambient storage. The values for shellac coated fruits were found to be 1.42-2.11 kg for bioyield and 0.49-1.06 kg for flesh firmness, irrespective of antimicrobial compound. Antimicrobial coating containing 20% shellac and 0.2 % grape fruit oil extended the shelf of guava to 14 days under low temperature condition and to 5 days under ambient condition.

Composite coating for extending shelf life of mango

Composite coatings were formulated using shellac, cassava and aloevera jel in different combination and their effects were compared with simple coating. Shellac 20 % alone or in combination with cassava starch (2%) and aloevera gel (50%) was found quite effective in maintaining the overall quality parameters of treated mangoes under both storage conditions. Further composite coating reduced the decay loss over its simple coating but it resulted in anaerobic respiration leading to faster senescence of fruit. Antimicrobial coating comprising of 20% shellac and 0.5g/ml of antimicrobial compound (grape fruit oil) enhanced the shelf life of mango from 5 to 8 days under ambient condition. Low temperature storage extended the shelf life of coated mango to 24 days.

Effect of package perforation on storage of guava

Determined the changes in colour and textural properties of guava using different package perforation (2, 4, 6 holes). The findings revealed that fruit coated with foam pad retained greater firmness (2.047 kg) with 2 perforation level as compared to 4 or 6 perforation level (1.735 kg and 1.986 kg, respectively) after 12 days of ambient storage. Further, uncoated fruits become overripe and reached gloss value (L*) of 66.59-77.50 compared to foam coated fruits (56.20-69.58). Maximum bioyield of 1.45 kg was noticed in foam coated fruit having 4 package perforation after 40 days of cold storage with off smell in all treatments.

Antimicrobial activity of aqueous and acetonic extracts from plant extracts and fruit waste

Aqueous and acetonic extracts were prepared from various fruit wastes and plant extracts using 0.5 g extract per ml. These extracts along with some essential oils were screened for their antimicrobial potential against two important post-harvest fungal pathogens *i.e. Colletotrichum gloeospori-oides* and *Botryodiplodia theobromae* which are responsible for development of anthracnose and stem end rot diseases, respectively. Acetonic extracts of *Cassia fistula* (including bark, petal, seed and fruits), kinnow peel, pomegranate peel and oil (Grapefruit essential oil and clove oil) exhibited significant antimicrobial activity against both pathogens (Table 12). Antimicrobial activity in aqueous prepared plant extracts was found comparatively low or negligible as compared to acetonic plant extracts. Maximum growth inhibition of *B. theobromae* was observed against clove oil (38.93%), followed by grapefruit essential oil (33.95%), *Cassia fistula* petal, fruit and bark (Table 12). On the other hand, maximum growth inhibition of *C. gloeosporioides* was reported in presence of *Cassia fistula* bark

Table 12. % Growth inhibition of various extracts against *Botryodiplodia theobromae* ITCC 7740 (stem end rot) and *Colletotrichum gloeosporioides* ITCC 7753 (anthracnose)

Types of extracts	Plant extracts screened for antimicrobial activities	% growth inhibition against stem end rot	% growth inhibition against anthracnose
Aqueous extracts	*Cassia fistula* bark	ND	ND
	Cassia fistula petal	ND	ND
	Cassia fistula fruit	ND	ND
	Cassia fistula seed	ND	ND
	Kinnow peel	ND	ND
	Cactus extracts-25%	ND	ND
	Cactus extracts-50%	ND	ND
	Papaya leaf extract	ND	ND
	Pomegranate peel	ND	ND
	Arjun bark	ND	ND
Acetonic extracts	*Cassia fistula* bark	20.81	41.35
	Cassia fistula petal	22.82	26.92
	Cassia fistula fruit	21.48	27.88
	Cassia fistula seed	14.77	23.56
	Kinnow peel	6.04	19.71
	Papaya leaf extract	16.11	20.19
	Pomegranate peel	11.41	16.35
	Cactus extract	14.09	15.38
	Arjun bark	22.07	30.21
Other extracts	*Aloe vera* extract	9.40	ND
	Grapefruit essential oil	33.95	31.73
	Clove essential oil	38.93	36.54

ND= Not detected

(41.35%), followed by clove oil (36.54%), grapefruit essential oil (31.73%) (Table 12).

Effect of edible coating combinations without antimicrobial compounds on storage life of mango fruits

Polymer based coatings were prepared using food grade ingredients as base materials *viz*. starch (3%; T1), aloe vera [100 (T2), 75 (T3) and 50% (T4)], carnauba wax (20%; T5) and shellac [20 (T6) and 30% (T7)]. A simultaneous control (T8) was also run. All the coatings were applied on dusheri mango fruits and stored at ambient as well as cold storage (11±1°C). Aloe vera gel was prepared with different concentrations of its leaf gel (100, 75 and 50%) and the study revealed that higher concentrations at 50 or 100 % prevented the weight loss and threshold limit of 10% PLW was reached after 32 days of cold storage (11±1°C). There was no spoilage upto 20 days of cold storage and thereafter it progressively increased and reached 40% at the end of storage period. On the other hand, control fruit under ambient condition (30-36°C) lost 8.96% of their weight within 6 days of storage whereas coated fruit reached the same stage (9.74%) after 8 days of storage (Fig. 37). The result revealed that carnauba wax was found most effective for reducing the weight loss (5.93 % after 32 days of cold storage) among all other coating material but it drastically reduced the fruit appearance by leaving white stains of coating on fruit surface which limits its commercial application. Shellac coating at 20 or 30% resulted in least fruit spoilage (11.43-11.98%) compared all other coating after

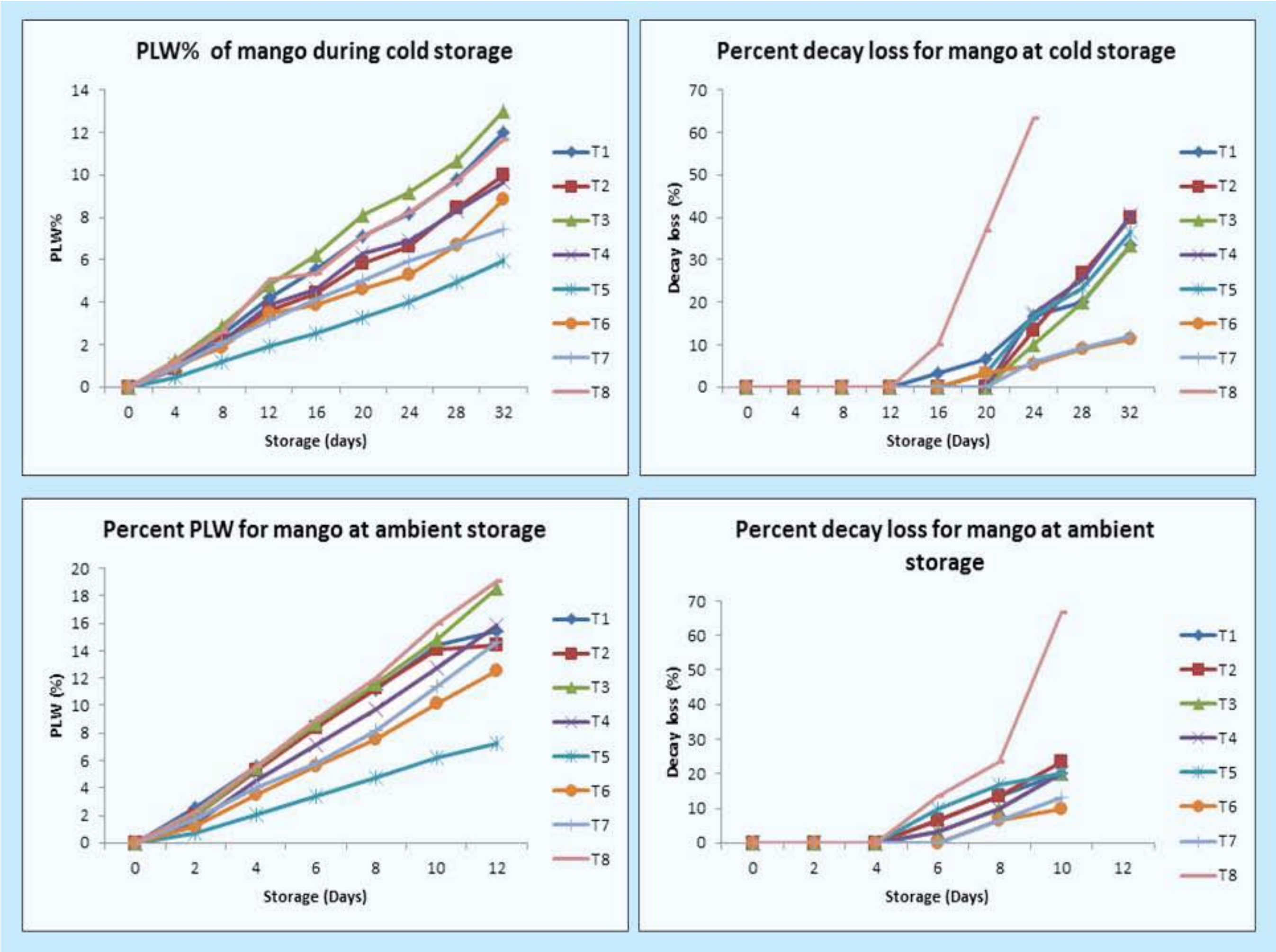


Fig. 37. PLW and decay loss % of coated and uncoated mango fruits under different storage conditions

32 days of storage (Fig. 37). Based on the physiological loss in weight and decay loss % during both storage conditions, 20% shellac (T7) was found best compared to others as base material for simple coating (Fig. 37).

Effect of edible coating enriched with antimicrobial compound on storage life of mango

Various formulations comprising of 20% shellac (A), 50% aloe vera + shellac (5%) (B) and Starch (2%) + shellac (5%) (C) were selected for preparation of simple (A) and composite (B and C type) coating combinations. The coatings were further added with essential oils of grapefruit and clove, and acetonic extracts of Cassia and Arjun bark as shown in Table 13. The mango fruits were coated using foam padding and stored at low temperature (11±1°C) in corrugated fiber boxes (CFB). Various physico-chemical parameters were recorded up to 32 days after storage; however, for shelf-life estimation, 10% physiological weight loss combined with decay loss was selected as key indicator of shelf-life. Percent decay loss during ambient and refrigerated storage with 20% shellac coating has been elaborated in Fig. 38. Shellac coated mangoes crossed 10% decay loss at 24th day of cold storage while control smaples had 36.67% decay loss under similar time duration.

Table 13. Formulation of edible coating combinations with antimicrobial compounds for mango experiment

Notation	Description (edible coating base material)	Antimicrobial compound added
A1	20% shellac	Grapefruit essential oil
A2	20% shellac	Clove essential oil
A3	20% shellac	Cassia bark acetonic extract
A4	20% shellac	Arjun bark acetonic extract
B1	50% aloe vera + shellac (5%)	Grapefruit essential oil
B2	50% aloe vera + shellac (5%)	Clove essential oil
B3	50% aloe vera + shellac (5%)	Cassia bark acetonic extract
B4	50% aloe vera + shellac (5%)	Arjun bark acetonic extract
C1	Starch (2%) + shellac (5%)	Grapefruit essential oil
C2	Starch (2%) + shellac (5%)	Clove essential oil
C3	Starch (2%) + shellac (5%)	Cassia bark acetonic extract
C4	Starch (2%) + shellac (5%)	Arjun bark acetonic extract
D	Control	-

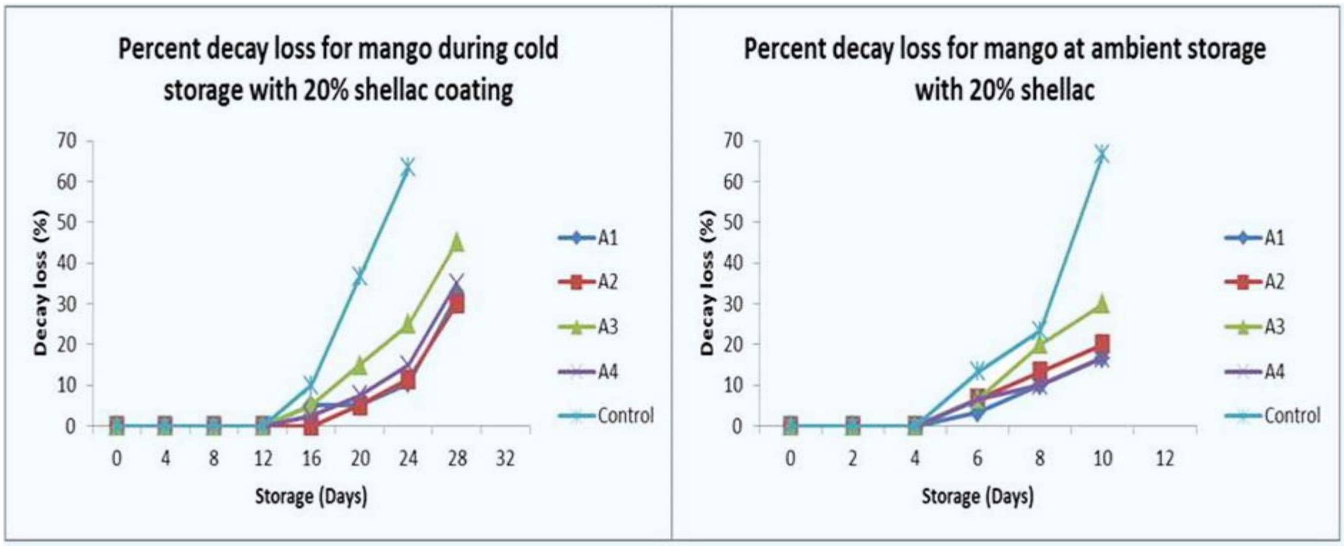


Fig. 38. Effect of shellac coating decay loss (%) of mango fruits stored at low and ambient storage

Physiological loss in weight (PLW) and decay loss increased with the increase in storage duration. These losses were much higher in control sample compared to treated ones. PLW and decay loss crossed 10% weight loss in treated samples after 24th days of storage while the loss value crossed after 16th day in case of control samples (Table 14). % titratable acidity decreased while TSS increased during storage (Table 14). Also, both the parameters decreased slowly at low temperature storage. Textural profiling of each coating type samples was done using texture

Table 14. Physico-chemcial composition of mango fruit under cold storage (11±1°C) at 24th day of storage

Treatment	Physiological weight loss (%)	Decay loss	% TA	TSS (°Brix)
A1	3.47	10.50	0.35	17.80
A2	4.54	11.50	0.36	15.60
A3	4.35	25.00	0.66	19.33
A4	4.05	15.00	0.70	19.17
B1	5.57	40.00	0.66	17.80
B2	5.37	25.00	0.72	17.10
B3	5.67	22.50	0.73	17.23
B4	5.44	32.50	0.70	17.33
C1	7.09	45.00	0.68	17.40
C2	5.31	20.00	0.71	17.30
C3	5.13	20.00	0.73	17.40
C4	5.95	35.00	0.70	18.13
Control	8.21	63.33	0.70	18.40

analyser. Both bio-yield point and flesh firmness decreased with advent of storage period irrespective of treatments, though there was less decrease with coating materials compared to control fruits (Fig. 38). All the treated mangoes were of marketable quality compared to control samples upto the end of storage period. However, on the basis of sensory score, shellac based mango coating was rated the best compared to other coatings (Fig. 39). The shelf-life of shellac based antimicrobial coated mangoes was 24 d as against 16 d for uncoated mango under low temperature condition.

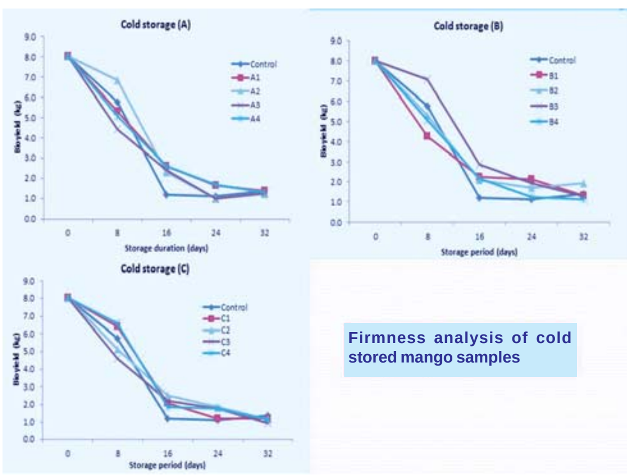


Fig. 39. Textural profile of cold stored mango samples

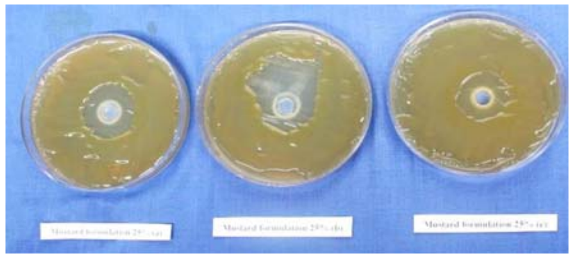
Fig. 40. Visual apperance of cold stored mango samples after 20th days of cold storage

Recommendation for extending shelf-life of mango:

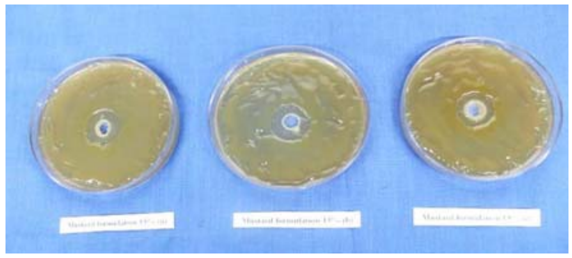
1. Acetonic extracts of *Cassia* bark and essential oils of clove and grapefruit were highly effective against *Botryodiplodia theobromae* (stem end rot) and *Colletotrichum gleosporoids* (anthracnose).
2. Shellac based coating was found the best under cold storage conditions comapred to other coating types as well as control.
3. The shelf-life of shellac based antimicrobial coated cold stored mangoes was 24 d as against control under cold storage having shelf-life of 16 d.

Development and Evaluation of Eco-Friendly mustard based antimicrobial formulation using other botanicals for eradication of bacterial blight in pomegranate

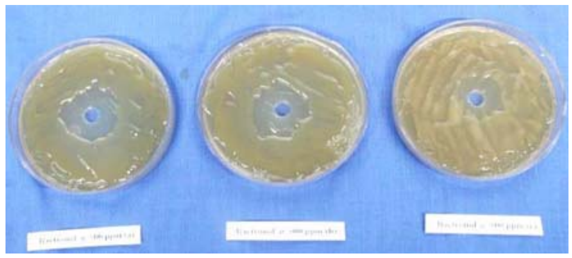
The mustard based formulations was optimized at ICAR-CIPHET and its antibacterial properties was checked against bacterial blight pathogen i.e. *Xanthomonas* sps. Invitro antibacterial activity was performed as reported by Valgas,2007 using agar well diffusion method. The optimized formulation was supplied to NRCP, Solapur for further greenhouse and field trials. The results of preliminary trials carried out at ICAR-NRCP are given below.Mustard formulation was tested *in vitro* for inhibition of Xap at 25%, 20%, 15% and 5% concentrations. It was found that mustard formulation inhibited Xap with maximum inhibition zone of 29.67mm at 25% concentrations and 15.33 mm at 10% concentration. The zone at 25% concentration was equivalent to that of Streptomycin sulphate 90%+ Tetracycline hydrochloride and 2-bromo-2-nitro-propane 1,3-diol at 0.05% (500ppm).



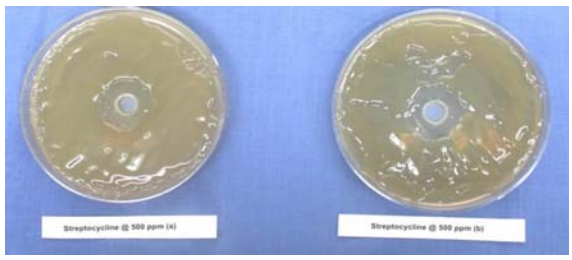
Mustard Formulation 25%



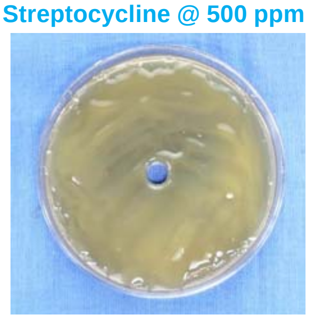
Mustard Formulation 15%



Bactronol-100 @ 500 ppm



Streptocycline @ 500 ppm

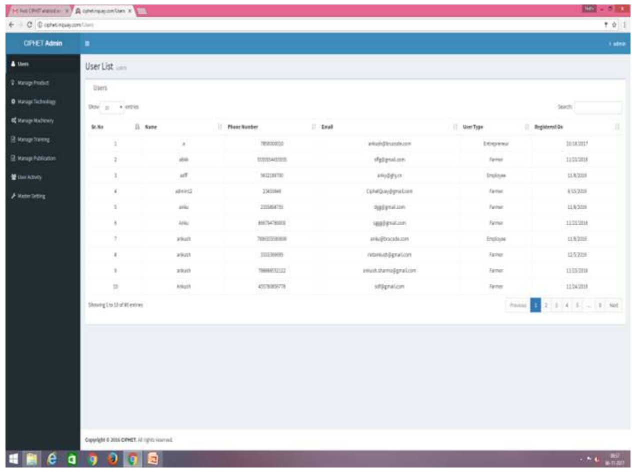


Negetive Control (Sterile water)

Fig. 41. Effect of mustard formulation on inhibition of *X. axonopodis pvpunicae*

Android based mobile application (*Mobile app*) for technology dissemination and outreach program on post-harvest processing and value addition

The present intervention by developing mobile app will help farmers to interact with the activities related to post harvest technology and value addition. All types of post-harvest related information on agricultural produce such as harvesting, on-farm storage, processing, packaging, transportation etc. and related machinery at any point in time, and any number of times is available on finger tips of farmers. A separate admin panel was also developed for dynamic operation of app in android environment. The app was launched by DG ICAR HQ.



Dynamic Admin Panel

Fig. 42. Launch of ICAR-CIPHET Mobile App by Dr. Trilochan Mohapatra Hon'ble Director General, ICAR and Secretary, DARE, New Delhi

All India Coordinated Research Project on Post Harvest Engineering and Technology

Tamarind dehuller and pongamia decorticator (Bengaluru Centre)

AICRP on PHET centre of UAS Bangalore has developed a high capacity tamarind dehuller and pongamia decorticator. First, *High Capacity Tamarind Dehuller* is an electric motor operated (5 hp, 3 phase), double stage equipment. It can dehull about 600-1000 kg/h tamarind fruits and the dehulling efficiency is over 90%. The prototype consists of two dehulling chambers, placed one above the other for effectively dehulling in two stages. Each dehulling unit has two banks of oppositely rotating (inward) serrated rings mounted on a shaft and spacing between the two banks is carefully maintained so that the long fruit will not break into smaller pieces while passing through them. When a raw tamarind fruits pass by gravity between two banks of rings, the brittle tamarind hull breaks into pieces. The dehulled fruit and broken hull fall on perforated screen where most of the hulls are separated. The fruits again pass through the second dehulling chamber for residual hull removal. When the dehulled fruit falls by gravity, a blower pushes air across the falling fruits to carry away the hulls. The specific energy consumption is 0.3 Units/100 kg. Total operational cost of tamarind dehuller is Rs. 110.27/h or Rs 0.11/kg pods. Whereas the dehulling cost of tamarind pods by manual labour (@Rs. 300/day) is worked out to be Rs. 37.50/h or 1.25 Rs/kg pods. Hence, mechanical decortication using the developed prototype is 11.36 times cheaper than manual method. The cost of *high capacity tamarind dehuller* is Rs. 1,00,000/- (with motor).

Second, Pongamia decorticator is an electric motor (3 hp) operated equipment that can be used

Fig. 43. High Capacity Tamarind Dehuller

Fig. 44. Pongamia decorticaton

to remove the hard outer shells from pongamia nuts and extract the kernels. It mainly consists of: decorticating unit (having a rotating fluted drum and a fixed ribbed concave); feeding unit (hopper with rotary feeder); separation unit (screens & blower) and driving unit (motor & pulley assembly). The capacity of the machine is 250 kg/h (for semi-automatic feeding) and has a good dehulling efficiency of over 90%. The specific energy consumption of pongamia decortication is 0.75 Units/100 kg nuts.The cost of pongamia decorticator prototype unit is about Rs. 70,000/- (with motor). Total operational cost of pongamia decorticator is Rs. 95.33/h or Rs 0.38/kg nuts. The decortication cost of pongamia nuts by manual labour (@Rs. 300/day) is worked out to be Rs. 37.50/h or 5.36 Rs/kg nuts and hence mechanical decortication of pongamia nuts using developed prototype is 14.11 times cheaper than manual method.

Turmeric dryer and dust free turmeric polisher (Coimbatore centre)

AICRP on PHET centre TNAU Coimbatore has developed the turmeric dryer and dust free turmeric polisher. In turmeric drying, the drying chamber consists of rotating cylindrical drum enclosed in square casing with plenum chamber and air vent. The dimensions of the rotational drum are 1.15 m length and 0.96 m diameter. It was made with a sheet of 30 x 2 mm rectangular opening. One portion of the cylindrical drum was used as a door for loading and unloading. A shaft of 50 mm diameter was used to rotate the drum in horizontal axis inside the drying chamber. Two thrust bearings were used to support shaft through the drying chamber. The overall dimension of the drying chamber is 1.22 x 1.22 m and it made up of 20 gauge galvanized iron sheet. A plenum chamber and exhaust air vent are provided at the bottom and top of the drying chamber respectively. A set of baffles are provided inside the chamber to effectively divert the hot air through the cylindrical drum. The sides of the drying chamber are insulated with asbestos sheet of 5 mm thick to maintain adiabatic conditions. A recirculation system was added to recover the energy escaping with the hot air. The heater for the dryer is made of 3 kW electric coil type. A drying trial takes about 30-35 h for removing moisture from 90% to 10% w.b.

Fig. 45. Turmeric dryer

A batch type turmeric dust free polisher capable of handling 1 tonne of rhizome has been released to farmers for about a decade. However it is not environmentally friendly and it generates a lot of dust around the rotating polishing drum and it has serious consequences on the health of farm workers and the environment. Therefore a dust free type polishing machine was developed. A shroud made of nylon sheet was provided on a collapsible frame structure made around the polishing drum. The machine was evaluated and found to arrest dust emission completely.

Fig. 46. Turmeric dust free polisher

Bamboo stalk cooked rice (chunga chawal)

AICRP on PHET centre of AAU-Jorhat developed a bamboo stalk cooked rice (chunga chawal) making machine conceptualized, designed and fabricated. Capacity: 4 kg/batch of 8 bamboo stalks. Fuel (LPG) consumption: 0.5 kg/batch. Cost of prototype: Rs.24,700.00. For same overall acceptability level traditional method needs 25 min whereas machine cooking needs 18 min. Texture of cooked rice was at par with traditionally done product. Issue of hygiene, drudgery, safety and environmental pollution well addressed. Waste heat utilization facility provided for water boiling.

Fig. 47. Chunga chawal making machine

Chutney powder from small sized dried prawns (Mangalore centre)

AICRP on PHET centre in KVA& FSU, Mangalore has developed the chutney powder from small sized dried prawns. After cleaning the prawns, they were fried for 10 to 15 minutes without adding oil and fry dried red chilly (long and short) for 5 minutes and grinding in mixer grinder to form powder. Fried coconut gratings to remove moisture content and powdered it in a mixer grinder. Tamarind, ginger, garlic and salt were ground in a mixer grinder and fried for a while. Mixed all the ingredients on frying pan for 8 to 10 minutes. Cooled it to room temperature and packed in plastic/glass container. The Technology was commercialized through an startup entrepreneur M/s “Bayman’s Delight” Home Industries, Shakthinagar, Mangalore.

Fig. 48. Prawn chutney powder

Honeycomb packaging material production machine (Raichur Centre)

AICRP on PHET, UAS Raichur Centre has developed honeycomb structured packaging material production machine which consists of cylindrical gumming rollers, teflon/rubber strips, paper feeding tray and auto paper feeding

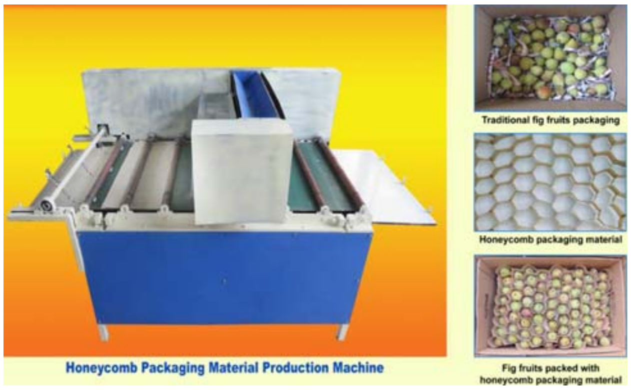


Fig. 49. Honeycomb packaging material production machine

mechanism. The production capacity of the machine was found to be 1600-1800 sheets per hour and theses sheets could be used for packaging of 80-100 CFB boxes (20 kg capacity) of fig fruits. The cost of the machine was estimated to be Rs. 85,000/- and the production cost of honeycomb structured packaging material was about Rs. 32.50 per box. The packaging material was found to be best suited for reducing the transportation damages and increased the shelf life of fig fruits 2-3 days more than traditional packaging.

Chironji decorticator machine (Raipur centre)

AICRP on PHET, IGKV – Raipur has developed the *Chironji* decorticator machine. The speed of the c*hironji* decorticator is 197 rpm with a disc clearance of 7 mm. The total kernel, whole and broken recovery is 18.88, 16.00 and 2.88 % of seeds, respectively. The efficiency of the machine is 87.20%. The power consumption is 0.17 kWh. The average cost of processing of chironji nuts into kernels is Rs/kg 5.06.

Fig. 50. *Chironji* decorticator machine

All India Coordinated Research Project on Plasticulture Engineering and Technology

Surface cover cultivation/ pond lining & irrigation/ farm machinery tools & post-harvest management/ Mulching, aquaculture & animal husbandry

Agro-techniques for cultivation of Okra in off-season under protected environment

Yield performance of off-season okra under different type structures and mulch conditions was studied at Junagadh representing Saurashtra region in Gujrat. Performance of Hybrid variety (GJO-H4) developed by the University was evaluated inside structure. Internode length (18.75 cm), number of fruits/plant (38), weight of fruits/ plant (416.50 gm) and fruit yield (22.4 tonne/ha) were found significantly higher inside the net-cum-polyhouse without ridge vent with silver black plastic mulch. Weed intensity at 30 DAS (8.50 number/sqm), 60 DAS (8.25 number/sqm) and 90 DAS (6.50 number/sqm) was found significantly lower inside the net-cum-polyhouse without ridge vent with silver black plastic mulch as compared to no mulch in open field. Water saving was the highest (28.75%) for mulch conditions inside the structures while under mulch condition in open water saving was 13.78%. Maximum water use efficiency (71.58 kg/ha-mm) was found under silver black plastic mulch inside the Net-cum-polyhouse without ridge vent while it was minimum (0.54 kg/ha-mm) in no mulch condition in open field environment. Maximum net profit of Rs. 8 lakh per ha could be obtained for off-season okra cultivation inside the net-cum-polyhouse without ridge vent under silver black plastic mulch. The B: C ratio obtained was 2.61.

Fig. 51. Cultivation of okra under protocol environment

Solar cabinet dryer for hills

The capacity of dryer is 25-30 kg with lower operational cost because it is operated with solar powered exhaust fan to remove moistened air. Temperature inside solar cabinet drier rose by 11.4°C, 24.6°C, 33.2°C, and 40.9 °C in basement, lower tray, middle tray and upper tray, respectively over the outside temperature (26.0°C).The dryer is still under refinement and testing. Two dryers were given to farmers for field evaluation.

Fig. 52. Solar cabinet dryer

Organic tomato cultivation in polyhouse for Srinagar region

The yield of crop 50t/ha was obtained in chemical treatment whereas in different organic treatments it was 35 t/ha and 31 t/ha for wheat straw amended plots.The soil water content for inorganic treated soil ranged from 23.2 to 37.9%. Moisture movement was faster under fertilizer applied soil and moisture retention found more in organic treated soil.

Fig. 53. Organic tomato cultivation

Bunch type groundnut cultivation in summer season

Maximum crop parameters viz., plant height (41.63 cm), numbers of pod, weight of pod per plant (25.38 number and 54.5 g), pod yield, haulm yield (3469.63 kg/ha and 6876.09 kg/ha) were found under silver black plastic mulch over in control. Minimum weed intensity (12.25 no./sq. m) was observed in silver black plastic mulch. Water saving of 41.24% in mulch was found over control. Maximum water use efficiency (6.77 kg/ ha-mm) was found under silver black plastic mulch while it was minimum (1.74 kg/ha-mm) in control. The farmers of South Saurashtra Agro climatic Zone are advised to use silver black plastic mulch (20 µm) with drip irrigation and raised bed for water saving and to achieve higher crop production of bunch type groundnut in summer season.

Fig. 54. Bunch type groundnut cultivation

Pigeon pea cultivation under colour plastic mulch with drip irrigation in Raichur region

Maximum plant height at 90 days (145.47 cm) was recorded with 75% of RDF, irrigation at 100% of ET underwhite on black mulch. Maximum number of primary branches (16.9) and number of secondary branches at 90 DAT (34.5) were recorded at 75% of RDF, irrigation at 80% of ET under black colour plastic mulch, whereas minimum number of primary branches (10.1) and

Fig. 55. Pigeon pea cultivation under coloured mulch

number of secondary branches at 90 DAT (16.5) were recorded at 100% of RDF, irrigation at 100% of ET without mulch. Maximum soil temperature and minimum soil moisture was recorded with black colour plastic mulch in all the irrigation levels. Maximum seed yield (32.12 q/ha) was recorded with 100% of RDF, irrigation at 80% of ET and white on black plastic mulch. The yield of the pigeon pea was observed maximum with 100 per cent of recommended dose of fertilizers along with 100% irrigation and white coloured plastic mulch (33.35 q/ha). The fertilizer use efficiency of pigeon pea was observed maximum with 75 per cent of recommended dose of fertilizers along with 60% irrigation and white coloured plastic mulch (71.14 kg/kg/ha).

Soil less cultivation of cucumber and tomato under naturally ventilated polyhouse

The results showed that among three levels of fertigation (70, 85 and 100 percent), fruit yield of 85 and 100 percent treatments were statistically at par and were significantly higher than 70 percent fertilizer dose. Among the cucumber hybrids/varieties Multistar variety (180 tonne per ha) gave the highest yield which was statistically at par with Kafka variety but significantly superior than all other varieties PBRK4 (PAU), PBRK 3 (PAU) and Falconstar. The yield of 160 tonne per ha for tomato was obtained. The results showed that among the different tomato cultivars viz. Punjab Sartaj, Himshikhar (Syngenta) and NS 4266 (Namdhari Seeds), NS-4266 an indeterminate Tomato hybrid

Fig. 56. Soil less cultivation of cucumber and tomato

is performing best, with yield of 5.4 Kg/Plant. Fertigation dose up to 85% of the dose recommended for climate controlled polyhouse is optimum for tomato production in soilless media as further increase in fertigation dose did not result significant increase in the yield.

Plastic lining of water harvesting tanks were standardized and demonstrated in Udaipur, Ranchi, Raichur and Barapani

The cost of harvested water in plastic lined pond ranged between Rs. 86 to 105 per m^3. On an average the net income from Rainwater Harvesting in plastic lined ponds (Capacity 37 m^3) based farming models with 500 m^2 demonstration area were Rs. 14,910 /- (crop + piggery) and Rs. 11,410/- (crop + poultry) and Rs. 8800/- (crop + Fish) which were 261, 176 and 124% higher than farmers' practice, respectively. Similarly, employment and water use efficiency enhanced by 221 and 586% and 168 and 218 % respectively, under crop + piggery and crop + poultry farming model over farmers' practice, due to adoption of RWH technology.

Fig. 57. Plastic lining of water harvesting tanks

Manual mulch laying cum retival machine for hills

The machine (50 kg weight) performs multiple operations in a single run (mulch laying, drip line laying and marking for sowing/planting). Plastic mulch of less than the standard width of 1.2 m width can also be layed with it's the adjustable nature of frame as per the need of farmer. Facility of laying inline drip pipe/tape beneath the plastic mulch has also been provided in the machine. It also marks/punches small holes on the layed plastic mulch and the marking can be done as per spacing (row to row and plant to plant) of required for a crop.

Fig. 58. Mulch laying cum retival machine

Nutrient recycling system in soilless cultivation of vegetables under protected cultivation

On an average 7- 8 picking of fruit were observed per month from April onwards. No visual ill effects of leachate reuse were observed, on the crop. The treatments include three varieties of parthenocarpic cucumber Kafka (Syngenta), Multistar (RijkZwaan) and PBRK 3 (PAU) and three levels of fertigation involving leachate reuse (100% fresh solution,85% fresh solution +15 % leachate and 70% fresh solution + 30 % leachate) were used in experiment. Photochemical (total phenolic content, total carotenoid content) and antioxidant activities (FRAP and DPPH) were found increased in fruits produced in soilless media Numerous studies with plant phytochemicals show that phytochemicals with antioxidant activity may reduce risk of cancer and improve heart health. Yield in greenhouse soil less cultivation is 2-2.5 kg/plant (i.e 75 t/ha) compare to open cultivation i.e 17.5 t/ha (cropping period March –June). Obtained yield is 4- 5 times more than open field condition.

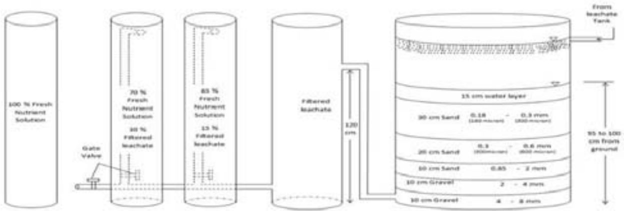


Fig. 59. Nutrient recycling system in soil-less cultivation

Low cost Aquaponics System in aquaculture

The system comprises of fish culture tank, submersible water pump, trickling filter, four NFT grow pipes each having length of 3 m and 9 perforations (3-inch diameter each for holding net pots) for growing plants. The system is designed to use excess nutrients from aquaculture for growing agriculture crops for having synergistic

Fig. 60. Low cost Aquaponics System in aquaculture

effect on both crop and fish. The combination of tilapia (Oreochromisniloticus) fish and marigold plants were shown yielding 450 marigold flowers from 36 plants in the system in 3 months.

Animal shelter for initial growth trial fabricated

Animal shelter with overall dimensions of the structure is 9.75 m x 4.75 m x 2.59 m have been

Fig. 61. Animal shelter for initial growth trial

fabricated at SKUAST, Srinagar. The floor area of shelter to house animals is 46.31 m^2. Shelter can accommodate 25-30 animal because floor space required to house one animal under covered area is 1.5 m^2.

Effect of mulching on root nodulation

Root nodulation can be directly related to nitrogen fixation bacteria. The effects of organic and plastic mulching on root development and nodulation related biometric properties of cowpea determined at different stages of crop growth after 60 days and 90 days after sowing (DAS) evaluated by Abohar centre. Majority of the root development parameters such as root length, number of secondary roots/lateral roots, root weight with nodules, root weight without nodules were recorded highest in plants grown under organic mulch treatments with different level of drip irrigation.. Highest number of nodules per main root of plant i.e., 12.67 and 17.00 after 60 DAS and 90 DAS (at harvest stage) was observed in NM-80% and OM-60% treatments respectively, At 60 DAS and 90 DAS (at harvest stage), highest number of root nodules per secondary/lateral root (184.67 and 195.50) and total root nodules per plant (195.00 and 211.00) was recorded in organic mulch treatment plants. Fresh weight of total nodule per plant after 60 DAS and 90 DAS was recorded highest in NM-100% (2.72 g) and OM-100 % (5.77g). In conclusion, overall development of plant roots and root nodulation was positively affected by organic mulches while black mulch has negatively influence on these plant parameters.

Solar energy based adsorption cooling system

Solar energy based adsorption cooling system was developed under the approved project of AICRP on PET "Design and development of composite solar-air-conditioning system coupled farm level cold store for hot and region". Developed system lowered the evaporator temperature by 15-18°C. Storage capacity of the system: 1 quintal; Cooling capacity of the system under no load condition was 0.13 Tons of Refrigeration (0.44 kW). COP of the system was 0.14.

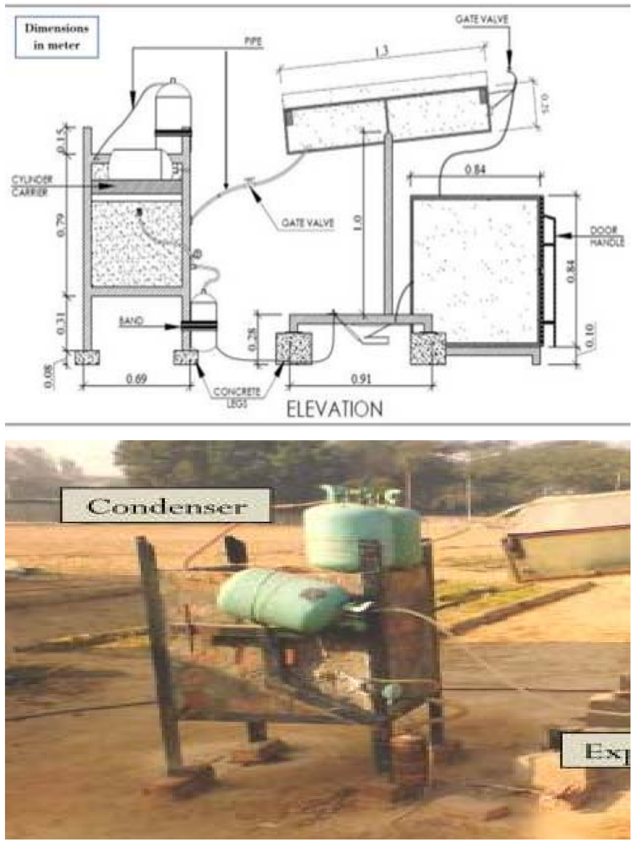


Fig. 62. Solar energy based adsorption cooling system for on-farm storage of fruits and vegetables

POST-HARVEST MACHINERY & EQUIPMENT TESTING CENTRE (PHMETC)

ICAR-CIPHET, Ludhiana has received testing fees of Rs. 10,47,017 through PHME Testing Centre during 2017-18. The machines tested during the reported period are given below:

Sr. No.	Machine Name	Test Report No & date of release	Address of Manufacturer	Testing Fee Received (Rs.)
1.	Mini Dall Mill (Bengal Gram and Pigeon pea)	PHMETC/CIPHET-1/11/ 2017, October, 2017	Maa Durga Plastic Products, Akola (M.S)	1,57,297
2.	Ragi Cleaning & Destoning (2.5 HP)	PHMETC/CIPHET-1/12/ 2018, February, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,12,355
3.	Ragi Cleaning & Destoning (3 HP)	PHMETC/CIPHET-1/13/ 2018, February, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,12,355
4.	SS Pulverisor for Grain (Ragi)	PHMETC/CIPHET-3/14/ 2017, February, 2018	Sri Bala Ji Industries, Combatore (T.N.)	73,600
5.	16" Flour Mill, (7.5 HP)	PHMETC/CIPHET-5/15/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,12,355
6.	Rawa/Cattle Feed Mix (10 HP)	PHMETC/CIPHET-6/16/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,12,355
7.	12" Pulverizer, (7.5 HP)	PHMETC/CIPHET-7/17/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	73,600
8.	14" Flour Mill (3 HP)	PHMETC/CIPHET-8/18/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	57,155
9.	18" Flour Mill	PHMETC/CIPHET-9/19/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,12,355
10.	Double Head Pulveriser for Spices and Grains	PHMETC/CIPHET-10/20/ 2018, March, 2018	Sri Bala Ji Industries, Combatore (T.N.)	1,23,590

TRAINING AND CAPACITY BUILDING

HRD Budget Utilization in 2017-18

Allocated Buget (Rs. in lakhs)	Buget Utilized (Rs. in lakhs)
1.0	0.96

Following Staff of ICAR-CIPHET Ludhiana/Abohar undergone training during 2017-18

Scientific Staff

Sr. No.	Name & Designation	Title of Training	Duration	Place
1.	Dr. R. K. Singh, Director (Actg.) & PC (PET)	Regional Training on Protected Agriculture Technology in Asian Countries	Jan 22-29, 2018	Shanghai, China
2.	Dr Renu Balakrishnan, Scientist Dr Sandeep Mann Principal Scientist	Methodological framework for implementation of Farmers First Programme	Nov 06-09, 2017	ICAR-IISWC, Dehradun
3.	Dr Renu Balakrishnan, Scientist Dr Sandeep Mann Principal Scientist	Promotion of Farmers Producer Organisation	Nov 27-29, 2017	PAMETI, PAU, Ludhiana
4.	Dr Swati Sethi, Scientist	CAFT training program on Challenges and opportunities in food processing in context to value addition and post-harvest management of agricultural products	Sept 01-21, 2017	Institute of Agricultural Sciences, Banaras Hindu University, Varanasi
5.	Mr Vikas Kumar, Scientist	CAFT training on Advances in microbiological and biochemical techniques in the assessment of seafood quality and safety	Jan 09-29, 2018	ICAR-CIFE, Mumbai
6.	Dr Prerna Nath, Scientist	Summer School on Farmers Empowerment and Entrepreneurial Development in Food Technologies for Sustainable Agriculture	June 27 - July 17, 2017	PAU, Ludhiana, Punjab
7.	Dr Armaan U Muzaddadi, Principal Scientist	CAFT training programme on Design and Manufacturing of Agro Processing Machines	Aug 01-21, 2017	ICAR-CIAE, Bhopal
8.	Dr Sakharam Kale, Scientist	CAFT training programme on Design and Manufacturing of Agro Processing Machines	Aug 01-21, 2017	ICAR-CIAE, Bhopal
9.	Dr Kirti Jalgaonkar, Scientist	CAFT training programme on Design and Manufacturing of Agro Processing Machines	Aug 01-21, 2017	ICAR-CIAE, Bhopal
10.	Dr Poonam Choudhary, Scientist	Measurement Uncertainty in Tests and Calibrations	Jan 31- Feb 2, 2018	FICCI Quality Forum, New Delhi
11.	Er. Indore Navnath, Scientist	ANSYS software for simulation and modelling of structures	Jan 31- Feb 8, 2018	Indo German Tool Room, Aurangabad

Technical Staff

Sr. No.	Name & Designation	Title of Training	Duration	Place
1	Sh Jagtar Singh, Technical Assistant	Selection, Adjustment, Operation and Maintenance of Agricultural Implements for Field and Horticultural crops	Aug 01-10, 2017	ICAR-CIAE, Bhopal
2	Sh Jaswinder Singh, Technical Assistant	Selection, Adjustment, Operation and Maintenance of Agricultural Implements for Field and Horticultural crops	Aug 01-10, 2017	ICAR-CIAE, Bhopal
3	Sh Vishal Kumar, Sr. Technical Assistant	Implementation of NIC's e-procurement solution at IASRI, New Delhi	Sept 02-04, 2017	ICAR-IASRI, New Delhi
4	Sh Beant Singh, Technical Assistant	Selection, Adjustment, Operation and Maintenance of Agricultural Implements for Field and Horticultural crops	Aug 01-10, 2017	ICAR-CIAE, Bhopal

Administrative Staff

Sr. No.	Name & Designation	Title of Training	Duration	Place
1	Sh Iqbal Singh,UDC	MIS/FMS (ICAR-ERP system)	July 04-06, 2017	ICAR-IASRI, New Delhi
2	Sh Kunwar Singh, Assistant	MIS/FMS (ICAR-ERP system)	Oct 04-06, 2017	ICAR-IASRI, New Delhi
3	Sh Mohan Lal, Assistant	MIS/FMS (ICAR-ERP system)	Nov 04-06, 2017	ICAR-IASRI, New Delhi

Professional Attachment Training

Dr. Bhupendra M Ghodki, Scientist successfully completed three months Professional Attachment Training (18 May - 17 Aug 2017) at Institute of Chemical Technology (ICT) Mumbai. At ICT, he worked on a short project entitled "Development of Functional Whole Wheat Bread with Fermented Green Gram Flour" under the guidance of Dr. Snehasis Chakraborty.

Dr. Thingujam Bidyalakshmi Devi, Scientist had undergone Professional Attachment Training for the period of three months from 24th November, 2017 to 23rd February, 2018 at National Institute of Solar Energy (NISE)-MNRE, Gurugram, Haryana. At NISE-MNRE, she had worked under the guidance of Er. S.K. Singh and worked on "Development of solar dryer for ginger drying". The developed dryer was completely operated by solar energy using both thermal and electrical solar power. She also acquired knowledge of utilizing solar energy in agricultural processing sectors. It includes drying with storage medium, solar refrigeration cycle for cold storage, solar bucket, extraction of bio-oil from agro-waste etc.

Er. Sandeep P. Dawange, Scientist completed his 3 month Professional Attachment Training under the supervision of V. D. Shivling, Head, Agrionics Division, CSIR-Central Scientific Instruments Organisation, Chandigarh from 17thNovember 2017 to 16thFebruary 2018. During this training, he worked on 'Application of *Aurdino* tools for designing electronics gadgets for application in food processing and/or development of machines'. He also worked on 'Feasibility study for development of freeze dryer for 100 kg apple slices' covering the aspects related to biological material and submitted the report to CSIR-CSIO, Chandigarh.

Trainings organized for various categories

Farmers' trainings (2017-18)

1. A farmers training on 'Post-harvest Management of Agricultural Produce' for 15 farmers from Pune, Maharashtra was organised during 11-13 September, 2017 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Yogesh Kalnar, Scientist coordinated this training.

2. A training to 14 farmers of Bihar, Chhattisgarh and Uttar Pradesh was imparted under CRP-SA on Makhana project on 'Operation of Makhana processing plants' during 24-27 September, 2017 at ICAR CIPHET, Ludhiana.

3. A Progressive Farmers exposure visit programme was organized for 28 farmers from Solapur, Maharashtra through Centre for Agriculture and Rural Development (CARD) during 06-07 November, 2017 at ICAR-CIPHET, Ludhiana. A. U. Muzaddadi, Principal Scientist and Vikas Kumar, Scientist conducted the training.

4. A farmers training on 'Post-Harvest Management of Agricultural Produce' for 25 farmers from Alwar, Rajasthan was held during 13-17 November 2017 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Yogesh Kalnar, Scientist coordinated the training.

5. A training programme was organised on 'Post-harvest Management' for 28 farmers from Umrer, Nagpur Dist, Maharashtra during 11-13 December, 2017 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Renu Balakrishnan, Scientist conducted the training.

6. A farmer training on 'Post-Harvest Management of Agricultural Produce' for 30 farmers from Wardha, Maharashtra was organized during 08-10 January, 2018 at ICAR-CIPHET, Ludhiana. A. U. Muzaddadi, Principal Scientist and Yogesh Kalnar, Scientist coordinated the training.

7. Training programme on 'Fruits and Vegetable Preservation' for 20 women farmers from Udampur, Jammu & Kashmir was organized during 17-19 January, 2018 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Renu Balakrishnan, Scientist coordinated the training.

8. A farmer training on ‘Post-Harvest Management of Agricultural Produce’ for 30 farmers from Nashik, Maharashtra was organized during 07-09 February, 2018 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Yogesh Kalnar, Scientist conducted the training.

9. Under Farmers First Project, training was imparted to identified beneficiaries of honey and pulse processing module and the machineries were handed over to them for implementation in the identified field for production of chemical free jaggery and good quality dhal. On site monitoring and demonstrations of the established pulse processing and honey processing unit was done. Sandeep Mann, Rahul Kumar Anurag, Yogesh Kalnar and Renu Balakrishnan supervised and coordinated this training.

10. Under Farmers First Project, a farmer-scientist interface meeting was organized at ICAR-CIPHET, Ludhiana on 17.03.2018. About 150 farmers from SBS Nagar, participated in the meeting. Farmers were made aware about the potential of processing and value addition of the crops grown at SBS Nagar, Punjab. Sandeep Mann, Anil Dixit, and Renu Balakrishnan conducted this training programme.

Technical Officer Training (2017-2018)

1. A Training programme for officers of Madhya Pradesh was organised on ‘Food Processing and Post-Harvest Technology for Horticultural Crops’ during 12-16 March, 2018, sponsored by Directorate of Horticulture and Farm Forestry, M.P. Sandeep Mann, Principal Scientist and Vikas Kumar, Scientist coordinated this training.

2. A 12 days training programme for Technical Staff of SLFMTTC, Odisha on 'Training of Post-harvest Equipment and Machinery was organized, during 25th July to 5th August, 2017 sponsored by OFMRDC, Orissa. Ranjeet Singh, Senior Scientist, V. Eyarkai Nambi, Scientist and Pankaj Kumar, Scientist coordinated this training programme.

3. Training on 'Operation of Makhana Processing Machines' was imparted during 24-27 September, 2017 and 22-24 October, 2017. Ranjeet Singh, Senior Scientist conducted these trainings.

Training to Entrepreneurs (2017-18)

1. Skill development and capacity building for income generation and employment security through agro-processing

Groundnut/soy based products are loaded with various other essential goodness that makes it critically important for individuals on diets, people who have to enhance their overall health, as well as vegetarians and vegans around the world. In recent times, non-dairy foods are becoming popular and ICAR-CIPHET is committed and working consistently to meet the food requirement of the nation by developing and promoting health food products. Two budding entrepreneurs namely Mr. Manjit Singh from Sangrur and Mr. Nirbhai Singh from Bathinda approached ICAR-CIPHET for groundnut/soy processing. Ranjeet Singh, Sr. Scientist has imparted hands on training to entrepreneurs during 26-27 July, 2017.

International Training

1. International Training program on 'Modern Storage Technologies in Agriculture'

ICAR-CIPHET, Ludhiana organized an International Training Program on "Modern Storage Technologies in Agriculture" during 01-15 September, 2017. Dr R K Gupta was the Course Director, Dr R K Vishwakarma and Dr. V. E Nambi were the Course Co-Director of this training programme. The inauguration was graced by the presence of Dr. Chindi Vasudevappa, Vice Chancellor, National Institute of Food Technology Entrepreneurship and Management (NIFTEM) and Dr. Chandrashekhara P., Program Director, National Institute of Agricultural Extension Management (MANAGE), Hyderabad. Dr. R.K. Gupta, Director ICAR-CIPHET and Course Director highlighted the need to understand technology requirements for storage. He emphasized that it is high time when we should work on production of quality crops, their primary processing and storage. Dr. P. Chandra Shekara, Director, MANAGE who is instrumental in collaborating with delegates informed that the theme of training was selected on the basis of need and demand raised by the participating countries. Under this training program 20 executives from 11 countries, i.e. Afghanistan, Botswana, Cambodia, Ghana, Kenya, Liberia, Malawi, Mongolia, Myanmar, Sudan and Uganda were participated.

Summer school/Winter School

1. ICAR sponsored 21 days summer school on 'Advanced Strategic Processing Techniques for Oilseeds to Combat Protein-Energy Malnutrition and Augment Framers' Income

ICAR-CIPHET, Ludhiana organized a 21 days ICAR sponsored summer school on "Advanced Strategic Processing Techniques for Oilseeds to Combat Protein-Energy Malnutrition and Augment Framers' Income" from August 01-21, 2017. Dr. D. N. Yadav was the Course Director and Dr. S. K. Nanda and Er. Chandan Solanki were the Course Co-Directors of the summer school. The course had been designed to give the participants a complete exposure to the use of advanced processing techniques for efficient oil recovery coupled with extraction of protein to combat the protein-energy malnutrition for augmenting farmers' income. Fifteen participants from different disciplines attended the summer school. This course provided an opportunity to the participants to interact with subject-experts and fellow workers from different parts of the country and to update themselves with the latest information in the field of oilseeds processing.

2. ICAR Sponsored Summer School on 'Competency Skill development in Post-Harvest Processing and Value Addition for start I ups/Agri-Enterprise

ICAR-CIPHET, Ludhiana has organized a 21 days ICAR sponsored summer school on 'Competency Skill development in Post-Harvest Processing and Value Addition for start-ups/Agri-Enterprise' from September 05-25, 2017. Dr. Ranjeet Singh (Course Director) and V. Eyarkai Nambi & Er. Indore Navnath S (Course Co-Director) organized the training. Altogether 17 participants of from 7 States of India participated and successfully completed the Summer school training. Training comprises of 31 lectures delivered by well distinguished faculties of CIPHET, experts from outside institution such as PAU, CIAE, MSME, ICAR-Hdq etc, 7 practical's and 4 industrial visits.

3. ICAR sponsored 21 days winter school on 'Technological Innovations in Processing and By-Products Utilization of Agricultural Produce'

ICAR-CIPHET, Ludhiana has organized a 21 days ICAR sponsored winter school on 'Technological Innovations in Processing and By-Products Utilization of Agricultural Produce' during 4-24 December, 2017. Dr. S. K. Tyagi was the Course Director and Dr Manju Bala and Ms. Surya Tushir were the Course Co-Directors of the winter school. The main objective for organizing this winter school was to bring together multidisciplinary researchers/scientists working in the area of processing and by-product utilization and to apprise them of the recent developments in this field. A total of 19 participants from different States of India, participated and successfully completed the winter school training.

Model training courses

1. ICAR-CIPHET, Ludhiana has organized Model training course (MTC) on 'Relevance of Cold Chain Management of Agri Based Products pertaining to Horticultural Produce' during November 27 to 04 December, 2017. Dr R K Gupta was the Course Director, Dr. Ranjeet Singh and Dr. Eyarkai Nambi were the Course Co-Director for this training programme.

Entrepreneurship Development Programme

1. An Entrepreneurship Development Programme (EDP) was conducted on 'Processing and Value Addition of Aloe Vera' during 21-23 June, 2017.

2. An Entrepreneurship Development Programmes (EDPs) under CRP-Secondary Agriculture was conducted on 'Guava Processing' under CRP-Secondary Agriculture during 05-07 September, 2017 and 12-14 October, 2017.

3. An Entrepreneurship Development Programme (EDP) under CRP-Secondary Agriculture was conducted on 'Dehydration of Onion' for one farmer during 23-25 March, 2018.

4. An Entrepreneurship Development Programme (EDP) under CRP-Secondary Agriculture was conducted on 'Strawberry Fruit Bar/Fruit Barfi' during 18-20 May, 2017 for one entrepreneur.

5. Entrepreneurship Development Programmes (EDPs) under CRP-Secondary Agriculture was conducted on 'Aonla Processing' during 28-30 December, 2017, 03-05 January, 2018, 08-10 February, 2018, 12-14 February, 2018, 27 Feb-1 March 2018 and 23-25 March, 2018.

6. A training programme was organised on 'Groundnut/Soybean processing' for Mr. Lakshman Singh Rawat from village Khirsu, Pauri Garwal District, Uttaranchal during 5-6 February, 2018 at ICAR-CIPHET, Ludhiana. Sandeep Mann, Principal Scientist and Renu Balakrishnan, Scientist coordinated this training.

7. An EDP was conducted on 'Groundnut/Soya Processing' for 6 farmers (2 from Rajasthan and 4 from Himachal Pradesh) at ICAR-CIPHET during 11-12 July, 2017. Dr. Sandeep Mann and Dr. Rahul Anurag coordinated the training.

TECHNOLOGY TRANSFERED/LICENSED/ PATENT FILED/GRANTED

Technology Transfered/Licensed

Sl. No	Technology	Contracting party	License Fee (excluding service tax)	Date of signing agreement/ duration	Type	Innovator
1.	Nutritious functional chapatti flour	The Swati Women Food Processing & Preservation Co-operative Workshop Industrial Society Ltd., Opp. Working Women Hostel, Amritsar Road, Landeke, Moga -142 001 (Pb.)	11,000/-	25.05.17	Licensing and training of non-IP protected technology	Dr. Mridula D.
2.	Strawberry Fruit leather technology (Strawberry Fruit Barfi)	Zoot India Company, Behrampur Road, Gurdaspur – 143 521 through its Proprietor Mr. Rakesh Verma	10,000	17.10.2017	Licensing and training of non-IP protected technology	Dr. R.K. Vishwakarma Ms. Kirti Jalgaonkar

Patents Granted

S. No.	Title	Patent Application No.	Patent No.	Inventors	Date of grant
1	Process technology for preparation of blended guava leather/bar	515/DEL/2008	286775	Dr. Ramesh Kumar Dr. Gautam Mandal Dr. Satya Vir Singh	29/08/2017
2	Ready to constitute makhana kheer mix	746/DEL/2008	287541	Dr. S.N. Jha	20/09/2017
3	Pomegranate aril extractor	2584/DEL/2008	293135	Dr. Abhay Kumar Thakur Dr. R.T. Patil Dr. Desh Beer Singh Dr. Ram Kishor Gupta	21/02/2018

EXTENSION ACTIVITIES

Participation in Exhibitions/Melas

1	Sankalp Se Siddhi Campaign	Sept 10, 2017	KVK, ICAR-CIPHET, Abohar
2	Kisan Mela	Sept 22 - 23, 2017	P.A.U., Ludhiana
3	Food Industry and Craft Mela 2017	Oct 12, 2017	P.A.U., Ludhiana
4	Exhibition of 1st International Extension Congress 2018	Feb 01 – 03, 2018	ICAR-CIWA, Bhubaneswar
5	Krishi Unnati Mela 2018	Mar 16 – 18, 2018	IARI, New Delhi
6	Kisan Divas/ Melas	Mar 23 – 24, 2018	P.A.U., Ludhiana

Farmers/Officers/Faculty/Students visited ICAR-CIPHET during 2017-18

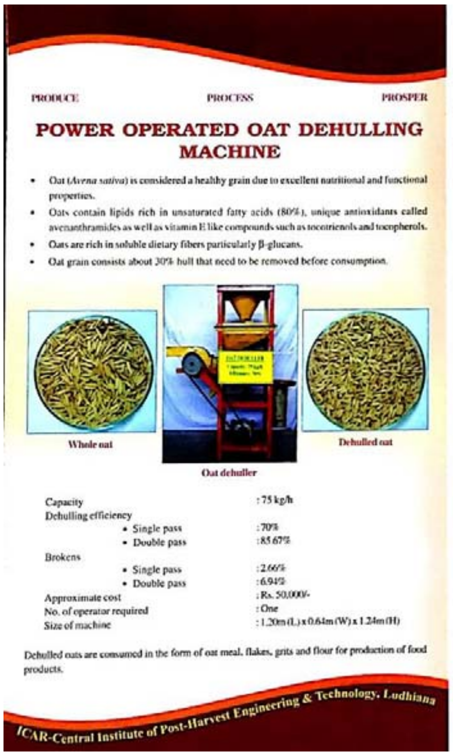
Sr. No.	Visitor name & address (with description)	Visitors	Date of visit	Facilitated by
1.	College of Agriculture Business Management, Narayangarh, Rahuri Tal- Junnar, Dist. Pune (Maharashtra)	54 (S)	03.04.2017	Mr Vikas Kumar
2.	B.Sc (Agri)- IV students from College of Agriculture, Lalsot (Dausa)	28 (S) + 2 (O)	10.04.2017	Mr Vikas Kumar Dr Bembem
3.	Agricultural College & Research Institute, Tamil Nadu Agricultural University, Coimbatore	113 (S) + 3 (O)	19.09.2017	Mr Vikas Kumar Dr Renu Balakrishnan Dr Rahul Anurag
4.	Agricultural College & Research Institute, Tamil Nadu Agricultural University, Kudumiyanmalai, Pudukkottai	52 (S)	20.09.2017	Mr Vikas Kumar
5.	Department of Food & Nutrition, PAU, Ludhiana	15 (S) + 3 (F)	13.11.2017	Mr Vikas Kumar Dr Rahul Anurag
6.	Agricultural Engineering and Research Institute, TNAU, Kumulur	69 (S) + 3 (O)	11.12.2017	Mr Vikas Kumar Er Yogesh Kalnar
7.	Agriculture College and Research Institute, TNAU, Killikulam, Vallandu, Thhothukudi	107 (S) + 4 (O)	28.12.2017	Mr Vikas Kumar Er Yogesh Kalnar
8.	B.Tech. (Food Process Engineering) students of AEC&RI, Tamil Nadu Agricultural University, Coimbatore	55 (S)	22.03.2018	Mr Vikas Kumar
9.	Students of BSc. (Biotechnology), Dept. of Biotechnology, Kanya Maha Vidyalaya, Jalandhar	55 (S)	28.03.2018	Mr Vikas Kumar
10.	Students from Tamil Nadu Veterinary and Animal Science University, College of Food and Dairy Technology, Koduvalli, Alamathi, Chennai	18 (S)	28.03.2018	Mr Vikas Kumar
11.	College of Technology and Engineering, MPUAT, Udaipur, Rajasthan	42 (S) + 2 (O)	07.04.2018	Er Yogesh Kalnar
12.	Lovely professional University, School of Bio-engineering and bio sciences, Phagwara, Punjab	30 (S) + 2 (O)	14.03.2018	Er Yogesh Kalnar
13.	Students (B.Tech., Food Tech.) from University of Agricultural Sciences, College of Community Science, Dharwad	21 (S) + 3 (O)	12.12.2017	Er Yogesh Kalnar

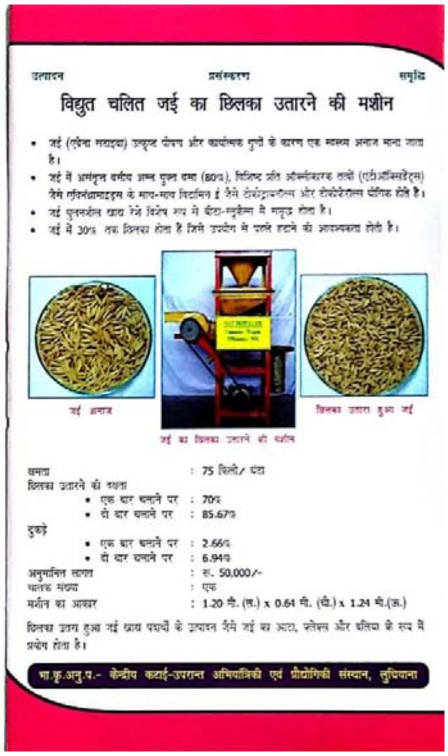
Sr. No.	Visitor name & address (with description)	Visitors	Date of visit	Facilitated by
14.	Project Director, Agriculture Technology Management Agency (ATMA), Distt. Dhule, Maharashtra	49 (F) + 1 (O)	15.12.2017	Er Yogesh Kalnar
15.	College of agriculture, GKVK, UAS Bengaluru	52 (S) + 3 (O)	19.11.2017	Er Yogesh Kalnar
16.	College of Horticulture, Halladakeri farm, University of Horticultural Sciences, Bagalkot, Karnataka	61 (S) + 3 (O)	23.12.2017	Er Yogesh Kalnar
17.	College of Agriculture, Padannakkad, Kasaragod, Kerala Agricultural University, Kerala	55 (S) + 4 (O)	30.10.2017	Er Yogesh Kalnar
18.	KK Wagh College of Agriculture, Nashik, Maharashtra	17 (S) + 1 (O)	27.02.2018	Er Yogesh Kalnar
19.	B. Tech Agril. Engg. Students from Kerala Agricultural University	20 (S)	08.03.2018	Er Yogesh Kalnar
20.	Participants of summer school on "Competency skill development in post-harvest processing and value addition for start-ups/ Agri-enterprise" held during 05-25 Aug 2017	25 (Fa)	05.09.2017	Er Yogesh Kalnar
21.	Kelappaji College of Agricultural Engineering and Technology, KAU, Tavanur, Kerala	40 (S) + 2 (O)	03.04.2017	Dr Renu Balakrishnan
22.	K.K. Wagh College of Horticulture, M.P.K.V, Rahuri University, Nashik, Maharashtra	12 (S) + 2 (O)	06.04.2017	Dr Renu Balakrishnan
23.	College of Horticulture, KAU, Thrissur, Kerala	58 (S) + 4 (O)	13.04.2017	Dr Renu Balakrishnan
24.	Agripreneurs from Moga, Punjab	4 (F)	06.10.2017	Dr Renu Balakrishnan
25.	College of Agricultural Engineering, UAS Campus, Raichur, Karnataka	57 (S) + 3 (O)	23.11.2017	Dr Renu Balakrishnan
26.	B.Sc. Agril. 3rd Year students from College of Horticulture, KAU, Thrissur, Kerala	57 (S) + 3 (O)	23.11.2017	Dr Renu Balakrishnan
27.	Department of Agriculture, IHGI, Jalandhar	25 (S)+ 3(Fa)	25.04.2017	Dr Sandeep Mann
28.	Department of Vegetable Science, P.A.U., Ludhiana	12 (S) + 1(Fa)	02.05.2017	Dr Bembem
29.	Agriculture Technology Management Agency (ATMA), Nagpur, from Taluka- Umred, Distt – Nagpur (MS)	30 (F)	15.05.2017	Dr Sandeep Mann
30.	Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal, Haryana	34 (S) + 2 (Fa)	24.06.2017	Dr Rahul K Anurag
31.	ARIAS Society, Khanapara, Assam	6 (F) + 1(Fa)	29.07.2017	Dr Rahul K Anurag
32.	PAMETI, P.A.U. Campus- Ludhiana	13(O) + 1 (Fa)	02.08.2017	Dr Rahul K Anurag
33.	Agripreneurs from VPO. Dhanaula (Barnala)	3 (F)	03.08.2017	Dr Sandeep Mann
34.	BTM, ATMA, P.D. ATMA,Vidisha (M.P.)	26 (F) + 2 (O)	24.08.2017	Dr Sandeep Mann
35.	Agripreneur from Aurangabad, Maharashtra	3 (F)	01.09.2017	Dr Sandeep Mann
36.	Framers, VillTimberwal, P.O. Malaudh, Teh. Payal, Ludhiana.	4 (F)	11.10.2017	Dr Sandeep Mann
37.	Technical officers from Asst. Horticulture Office, Balangir, Odisha.	5 (O)	17.10.2017	Dr Rahul K Anurag
38.	Farmers from P.A.U. Campus, Ludhiana.	17 (F)	27.10.2017	Dr Sandeep Mann
39.	Farmers from PDAMA office, Distt. Reoa, M.P.	12 (F)	16.11.2017	Dr Sandeep Mann
40.	Consultants, NFDB Hyderabad	2 (O)	07.12.2017	Dr Armaan
41.	Farmers from V.P.O. Salia, Kalapipal, district Shajapur, M.P.	9 (F)	30.12.2017	Dr Sandeep Mann
42.	ATI, Ludhiana	7 (O) + 1 (Fa)	15.02.2018	Dr Sandeep Mann

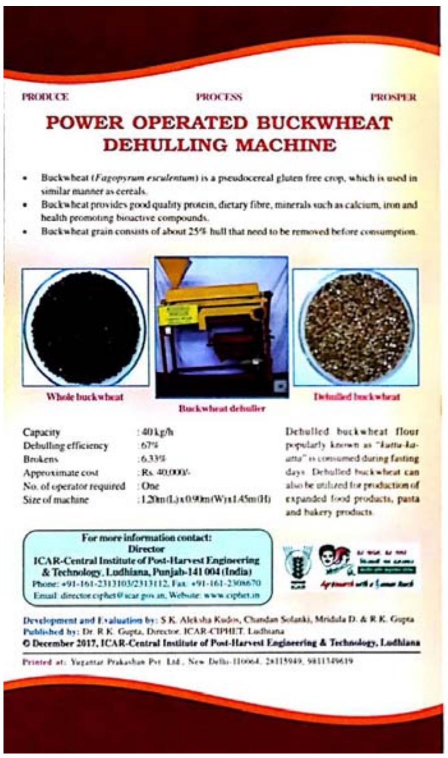
*O: Officers; F: Farmers; S: Students; Fa: Faculty

Pamphlets/Poster

Pamphlets of different technologies were prepared and printed in English and Hindi for end users







ICAR-CIPHET in News

रूबरू | पीएम मोदी ने किसानों को प्रोसेसिंग व मार्केटिंग की तरफ बढ़ने के लिए कहा, उन्नति मेले में किया संबोधित

200 किसानों ने पीएम मोदी के संबोधन का प्रसारण देखा

जासं, लुधियाना: आइसीएआर सेंट्रल इंस्टीट्यूट ऑफ पोस्ट हार्वेस्ट इंजीनियरिंग एंड टेक्नोलॉजी (सीफेट) में शनिवार को वैज्ञानिकों व 200 से अधिक किसानों ने दिल्ली में कृषि उन्नति मेले में पीएम मोदी के उद्बोधन का सीधा प्रसारण देखा। इस मौके पर आइसीएआर के पूर्व डीडीजी डॉ अनवर आलम, डॉ नवाब अली व डायरेक्टर सिफेट आरके गुप्ता बतौर मुख्यातिथि पहुंचे।

प्रसारण सुबह साढ़े ग्यारह बजे से शुरू हुआ। जिसमें प्रधानमंत्री ने किसानों को संबोधित करते हुए कहा कि जब लक्ष्य निर्धारित हो तो कोई भी काम मुश्किल नहीं है। किसान भाइयों ने रिकॉर्ड अनाज उत्पादन कर इसे साबित कर दिया है। लेकिन मेरी किसानों से अपील है कि वे खेतों में पराली न जलाएं। इससे धरती मां का नुकसान होता है। पराली जलाने से भूमि, जल व वायु को नुकसान होता है। उन्होंने कहा कि फसल के जिस अवशेष को किसान सबसे बड़ी आफत मानते हैं, वह उससे पैसा भी कमा सकते हैं। उन्होंने किसानों से अपील की कि वे अब केवल फसल उगाने तक सीमित न रहें, बल्कि फसलों की प्रोसेसिंग की तरफ भी ध्यान दें। प्रोसेसिंग करके उसका मंडीकरण भी खुद करें। ऐसा करके किसान मुनाफा कमा सकते हैं।

सीफेट में एकत्रित किसान व वैज्ञानिक प्रधानमंत्री मोदी के उद्बोधन के सीधे प्रसारण को देखते हुए • जागरण

ई मार्केटिंग से बेचें उत्पाद

पीएम ने कहा कि ई मार्केटिंग के जरिए वे अपने प्रोसेसिंग किए गए उत्पादों को बेचें। जब किसान फसल की प्रोसेसिंग व मार्केटिंग करना सीख जाएंगे, तो उनकी आय दोगुनी, तिगुनी हो जाएगी। टीवी पर पीएम मोदी को लाइव देखकर किसान काफी खुश दिखे। इसके बाद सीफेट में फार्मर फर्स्ट प्रोजेक्ट के तहत सीफेट के प्रिंसिपल साइंटिस्ट डॉ. संदीप मान ने किसानों को वैल्यू एडिशन व प्रोसेसिंग के बारे में जानकारी दी।

सीफेट के मोबाइल एप से किसान होंगे प्रशिक्षित

जासं, लुधियाना : सेंट्रल इंस्टीट्यूट ऑफ पोस्ट हार्वेस्ट इंजीनियरिंग एंड टेक्नोलॉजी (सीफेट) की ओर से एक ऐसा मोबाइल एप तैयार किया गया है, जो न सिर्फ पंजाब बल्कि विश्व के किसानों व एंटरप्रेन्योर के लिए बहुत फायदेमंद होगा।

सोमवार को इस एप को आइसीएआर नई दिल्ली के डायरेक्टर जनरल डॉ. त्रिलोचन महापात्रा ने इंस्टीट्यूट लेवल पर लांच किया, जबकि दो सप्ताह बाद इसे हर किसी के लिए लांच कर दिया जाएगा। इस एप को सीफेट के इंस्टीट्यूट टेक्नोलॉजी मैनेजमेंट यूनिट के इंचार्ज व वरिष्ठ वैज्ञानिक डॉ. रणजीत सिंह व डॉ. वीई नांबी ने संयुक्त रूप से तैयार किया है।

आइसीएआर डायरेक्टर जनरल डॉ. महापात्रा ने एप को इंस्टीट्यूट लेवल पर किया लांच, एप बनाने में लगा छह माह का समय

डॉ. रणजीत सिंह के अनुसार इस एप को आईसीएआर सीफेट मोबाइल एप का नाम दिया गया है। इसे उन्होंने छह महीने में तैयार किया है।

यह एप कृषि, बागवानी, फार्म हार्वेस्ट, फूड व पैकेजिंग इंडस्ट्री से जुड़े हुए लोगों व एंटरप्रेन्योर के लिए काफी फायदेमंद होगा। क्योंकि, इस एप में सीफेट के इंफ्रास्ट्रक्चर, सुविधाएं, एक्टिविटी, ट्रेनिंग, टेक्नोलॉजी, प्रोडक्ट, मशीनरी, हैंड टूल्स सहित करंट मंडी रेट, वेदर कंडीशन, फूड प्रोसेसिंग से संबंधित समस्याओं के समाधान, कटाई के उपरांत अनाज की प्रोसेसिंग, हैंडलिंग, स्टोरेज व मार्केटिंग से संबंधित हर तरह की छोटी बड़ी जानकारियां है। जिससे किसानों सहित हर वर्ग के लोगों को काफी फायदा होगा। यह एक डायनेमिक एप है। इस एप को प्ले स्टोर से आसानी से डाउनलोड किया जा सकेगा।

इए एप से किसानों को काफी फायदा होगा। उन्हें खेती संबंधी सारी जानकारियां इसी एप के माध्यम से मिल जाया करेगी। इसके साथ ही कई जानकारियां उपलब्ध होंगी।

EVENTS ORGANIZED

Institute Research Council (IRC) Meeting

The 26th Institute Research Council Meeting was held during June 05-06, 2017 at ICAR-CIPHET, Ludhiana under the Chairmanship of Dr RK Gupta, Director, ICAR-CIPHET, Ludhiana. Dr Ashok Kumar, ADR, PAU, Ludhiana, Dr PC Sharma, Dean, College of Horticulture & Forestry, Neri, Hamirpur and Dr AK Singh, Head, Department of Processing & Food Engineering, PAU, Ludhiana were the invited experts. Member Secretary, IRC presented the Action Taken Report (ATR) on suggestion/recommendation of the last IRC held during May 17-19, 2016. Salient achievements of each divisions were thereafter presented by the respective Head of Divisions, followed by presentations of new project proposals (RPP-I), ongoing projects (RPP-II) and completed projects (RPP-III). Besides, 27th IRC meeting was held during Nov 06-07, 2017 to review the progress of projects after the 26th IRC meeting.

National conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector"

National Conference on 'Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector' was organized during March 16-17, 2018. The Conference aimed to facilitate interactions and knowledge sharing amongst professionals of various research and development organizations, food processing industries, industry associations, policy makers, farmers, entrepreneurs etc. to address the future expectations of stakeholders and agri-preneurship in food processing sector through innovative approaches to enhance farmers' income and livelihood of farm families. The inaugural session was Chaired by Honourable Dr. Anwar Alam, Former DDG (Engg.) and Former VC, SKAUST-S as Chief Guest, Dr. Ramesh Kanwar, VC, LPU, Phagwara, Dr. S. M. Ilyas, Former Director, ICAR-NAARM, Hyderabad & Former Director, ICAR-CIPHET, Dr. Nawab Ali, Former DDG (Engg.) graced the occasion as Guest of Honour. Dr. R. K. Gupta, Director ICAR-CIPHET, Ludhiana & Chairman-cum-Organizing Secretary welcomed all the dignitaries, researchers, farmers, entrepreneurs and SHG members during this conference, which was sponsored by MOFPI, New Delhi. A galaxy of learned and experienced engineers, scientists, academicians, entrepreneurs, farmers, students, media personnel also showed their presence. Dignitaries on the dais released the Souvenir of National Conference, Prasaskaran Pragati-CIPHET Hindi publication and other Institute publications on this occasion.

During this Conference, the idea of schools for food value chain was evolved, which may be supported by agricultural engineers, food technologists & allied subject & management to promote entrepreneurship in larger way in food processing sector particularly in rural areas and

various academic institutes should come forward to implement this idea. On this occasion, farmers, entrepreneurs, and Self Help Groups and people from industries also participated and displayed their value added products based on institute technologies. Participants, researcher, entrepreneur etc. from different parts of the country attended this two days National Conference and visited various facilities of the Institute. Dr Mridula D, Dr Ranjit Singh and Er Dhritiman Saha were the convenors of this conference.

XIII Annual Workshop of AICRP on PET

XIII Annual Workshop of All India Coordinated Research Project on Plasticulture Engineering & Technology was organized at BAU, Ranchi during December 6-7, 2017. Prof. P. Kaushal, Hon'ble Vice Chancellor, BAU Ranchi was the Chief Guest and Dr. S.N. Jha, ADG (PE), was Chairman for the Inaugural Session. Altogether 80 participants including 14 centre PI's, farmers, person from host institution and delegates from ICAR were present in session of workshop. Dr. R.K. Singh, Project Coordinator AICRP on PET presented the progress and achievements of AICRP on PET during 2016-17. Detailed progress was presented by the respective PI's of AICRP on PET centres.

Workshop on ICAR-AICRP on PHET

All India Coordinated Research Project on Post-Harvest Engineering and Technology (AICRP on PHET) organized its 33nd Annual Workshop in ICAR-Central Institute of Post-Harvest Engineering and Technology during 23-25 January 2018 at JAU, Junagadh, Gujarat. There were two technical sessions namely Technical Session-I on New Research Proposals (RPP-I) and Technical Session-II on Presentation of Progress Reports. Addition to these, progress of FCI sponsored project titled 'Study on determining storage losses in food grains in FCI and CWC warehouse and to recommend norms for storage losses in efficient warehouse management' and business session were held. The workshop was chaired by Dr. S. N. Jha, ADG (PE) as Chairman and Dr. R. K. Gupta, Director, ICAR-CIPHET & I/c, PC-PHET Ludhiana as Coordinator. Dr. B. Ranganna and Dr. V. K. Sehgal were expert invitees to review the progress of the centers. As approved in the EFC during 2017-2018, ICAR-Central Island Agricultural Research Institute (CIARI), Port Blair Centre (A & N Islands) a new approved centre joined in the team of coordinating centers. About 140 participants include delegates from council and FCI officers, scientists from ICAR-CIPHET and from all 31 centers of AICRP on PHET have participated in this workshop. Around 202 research projects (i.e., 132 on- going projects and 70 new proposals) were discussed in the Workshop. Out of 70 new research proposals, 29 were approved.

National Swachhta Pakhwara

The intensive National Swachhta Pakhwara ware celebrated from May 16-31, 2017 and Sept. 15 – Oct. 02, 2017 by taking 'Swachhta Pledge' by all staff members of ICAR-CIPHET, Ludhiana and Abohar followed by intensive cleanliness activity in and around the campus. Apart from the cleaning activities, ICAR-CIPHET, Ludhiana Celebrated Sewa Diwas on 17th Sept., 2017, Samagra Swachhta Diwas on 24th Sept., 2017, Sarwatra Swachhta Diwas on 25th Sep., 2017 with cleaning and sweeping of the entire campus of the institute, public places and nearby tourist place i.e. Rose Garden, Ludhiana. General masses were made aware of the Swachh Bharat mass movement by circulating notices and leaflets. To mark the event grand success numerous swachhta related activities were planned and successfully accomplished. All staff members of ICAR-CIPHET Ludhiana and Abohar campus actively took part in the cleanliness drive.

National Nutrition Week

National Nutrition Week (1-7 September, 2017) was celebrated at ICAR-CIPHET, Ludhiana and Abohar. During the week, awareness programmes were conducted in village and schools for rural women and school children on the suggested topics. During the awareness programmes major emphasis was given on topics such as importance of nutrition and balanced diet, importance of green leafy vegetables in daily diet, importance of weaning foods among children, intake of fruits and dry fruits in daily diet, importance of traditional millets in diet, how to reduce anemia through diet, importance of vegetables and pulses in our diet, how to tackle under nutrition in children, junk foods excessive consumption of fats and oils, effect of excessive heating on quality of fats and oils, importance of adequate water consumption, personal hygiene and cleanliness in the village. Rural women and students took keen interest in the programme. The Team of Scientists and Technical Officers namely Dr. Mridula D. (Principal Scientist, Food and Nutrition), Er. Chandan Solanki (Scientist, Agricultural Process Engineering), Er. Indore Navnath Sakharam (Scientist, Agricultural Structure & Environment Management) and Sh. Satwinder Singh (Sr. Technical Assistant) from ICAR-CIPHET, Ludhiana carried out different activities during the National Nutritional week in Rajjowal village, which is adopted by this team under the prestigious Pradhan Mantri Mera Gaon Mera Gaurav scheme. More than 150 farm women with some farmers and children from Rajjowal village participated and benefited by this programme. The awareness program at KVK, Abohar in ICAR-CIPHET, Abohar were carried out by Dr Prerna Nath (Scientist, Food Technology) and Sh. Devender Kumar (Technical Assistant) in Abohar. About 192 students from three different schools namely Government Girls Senior secondary school, Near Civil Hospital and Alpine Senior secondary school (Pvt), Abohar, Distt Fazilka and, Maya Devi Memorial Adarsh School (Pvt), VPO-Kera Khera, Tehsil-Abohar, Punjab were covered for the Nutrition and Health Education activities during this National Nutrition Week through lecture, discussion and questionnaires. All the beneficiaries of this programme took keen interest in the different activities and had curiosity to know more and more about various aspects of nutrition and health. Additionally, a slogan writing competition was also organized at ICAR-CIPHET, Ludhiana for all the staff including contractual staff of the institute on the topic 'Importance of Nutrition and Balanced diet' wherein 9 staff members participated in the competition. In general, very good response was received from all the participants of National Nutrition Week and the organizing teams succeeded in enhancing the awareness about Nutrition and Health to the best possible extent for happy and healthy society of the country.

Vigilance awareness week

ICAR-CIPHET, Ludhiana organized Vigilance Awareness Week during Oct 30- Nov 4, 2017 in which various activities such as e-pledge and pledge taking ceremony by the officers and officials of the institute were taken as per the guidelines. On 1st Nov. 2017, a debate competition on "Corruption free India: A utopian dream or a possible vision" was organized by the Institute and prizes (1st, 2nd & 3rd) for the participants were also given. In addition, a number of vigilance related posters were displayed at various places of ICAR-CIPHET, Ludhiana and ICAR-CIPHET, Abohar. A workshop was organized on 3rd Nov, 2017 to sensitize the staffs of the Institute about the different aspects of vigilance. The week concluded on 3rd Nov, 2017 with presentation of awards for the debate competition and an appeal to be honest and vigilant for a corrupt free atmosphere.

International Yoga Day

ICAR-CIPHET, Ludhiana celebrated "International Yoga Day" on 21st June 2017, as per the directives of ICAR and Ministry of AYUSH, Government of India. On 21st June 2017, morning yoga session was conducted in the presence of an expert yoga teacher, Mr. Shatrughan Bansal, Bhatiya Yog Sansthaan, Ludhiana. He also explained the various asanas and highlighted the importance of yoga in human life for holistic development. Two more yoga trainers namely Mr Reena Chadha and Mr Raju, members from Bhatiya Yog Sansthaan, Ludhiana were also there to share the various aspects of physical yoga with the participants of this programme. Ms Reena Chadha motivated the people and elucidated the urgent need to adopt good food habits and yoga in our day to day life for healthy mind and body in general and making ourselves free from lifestyle related diseases. All the staff members, student trainees and family members of CIPHET staff actively participated and performed various yoga asanas and enjoyed the whole programme.

Agriculture Education Day

An interactive meeting with 30 students of Xth class from Partap Public School, Ludhiana was organized at ICAR-CIPHET, Ludhiana. Dr. Manju Bala, Senior Scientist, FG & OP Division and Chairperson, Organizing committee of Agriculture Education Day, briefed about the importance of day. Dr. R. K. Gupta, Director ICAR-CIPHET, Ludhiana and Chief Guest of the function addressed the students of Partap Public School, Ludhiana, encouraged them to choose their field

in area of agriculture or agricultural engineering and related areas which could be useful in growth of agriculture sector of country.

World Soil Health Day

World Soil Health Day was celebrated at 5th December, 2017 at ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana. The video film of mobile app launched by the Hon'ble Minister of Agriculture, Govt. of India, Sri Radha Maohan Singh Ji was shown to the gathering. The event was graced by G.S Prasad, Chief Scientist and Head, MTCC, CSIR-IMTECH, Chandigarh. A deliberate discussion was made in the conference hall of this institute on *Soil Health Card Scheme* of government. Banner was placed at front gate of the institute to ensure wider publicity and broad awareness. More than fifty people participated in the event and keenly discussed the various issue of soil health.

Mera Gaon Mera Gaurav (MGMG)

Mera Gaon Mera Gaurav (MGMG) scheme was launched by the Hon'ble Prime Minister on 25 July, 2015 at Patna. It has been initiated to provide the methodology of scientific farming and a new technology to every village. In this regard, the Institute has adopted 43 villages across Punjab and the scientists of ICAR-CIPHET, Ludhiana and Abohar provides various information related to post-harvest processing of agricultural commodities to the farmers. The scientists are also involved in creating general awareness, providing literature support, conducting meetings and explaining various post-harvest technologies among the rural masses. Dr. Sandeep Mann Principal Scientist, is the Nodal Officer and Mr. Vikas Kumar, Scientist, is the Co-Nodal Officer of MGMG at ICAR-CIPHET, Ludhiana.

Summary of activities organized under MGMG by the Institute

S. No.	Name of activity	No. of activities conducted	No. of farmers participated/ benefitted
1.	Visit to village by teams	19	330
2.	Interface meeting/ *Goshthies*	16	246
3.	Mobile based advisories	02	50
4.	Literature support provided	06	79
5.	Awareness created	12	314
6.	Linkages developed with other agencies	04	81
7.	Exposure of farmers to ICAR-CIPHET's technologies; Also on Jaggery Processing technologies and Honey Processing Technologies	19	22

fgnh dk;'kkykvk dk vk;ktu

इस वर्ष (2017–18) में, सीफेट लुधियाना के तत्वधान में निम्नलिखित हिंदी कार्यशालाओ का आयोजन किया गया है:–

- 'भाषा, व्यक्तित्व, व्यवहार एवं त्वरित ध्यान", विषय पर डॉ. शिव कुमार शर्मा, एम. डी. (ए.एम.), ऋषि नगर, लुधियाना, ने 27 मार्च 2018 को मुख्य वक्ता के रूप में भाग लिया एवं अपने विचारो से सभी को अवगत कराया।
- 'नोटिंग, ड्राफ्टिंग एवं टिप्पणियां' और 'हिंदी में पत्राचार', विषय पर श्री कँवलजीत सिंह, वरिष्ठ अनुवादक (सेवानिवृत), कर्मचारी भविष्य निधि संगठन, क्षेत्रीय कार्यालय, लुधियाना, ने 26 दिसंबर 2017 में अपने विचार व्यत किये।
- 'मानक हिंदी वर्तनी' और 'भाषा, आचरण एवं व्यवहार' विषय पर डॉ. कुलदीप सिंह, विभागाध्यक्ष (हिंदी), मास्टर तारा सिंह मेमोरिअल कॉलेज फॉर वुमेन, लुधियाना ने दिनांक 23 सितंबर 2017 को अपनी प्रस्तुति देकर सभी को लाभान्वित किया।

- 'नोटिंग, ड्राफ्टिंग एवं टिप्पणियां और 'व्यक्तित्व विकास में भाषा का योगदान' विषय पर डॉ. राजिंदर सिंह साहिल, सह–प्राध्यापक (हिंदी) एवं प्रभागाध्यक्ष, गुरु हरगोबिन्द खालसा कॉलेज, गुरुसर, सधार, लुधियाना ने 29 जून 2017 को अपने विचार रखे।

इन सभी कार्यशालाओ में सीफेट परिवार के सभी सदस्यगणों ने भाग लिया तथा अपना हिंदी ज्ञानवर्धन किया।

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- राजभाषा हिंदी प्रोत्साहन पखवाड़ा को 14 से 27 सितम्बर के बीच आयोजित किया गया। इस पखवाड़े के दौरान, नौ विभिन्न प्रतियोगिताओ

जैसे कि कंप्यूटर टंकण, नोटिंग ड्राफ्टिंग, प्रार्थना पत्र, हिंदी अनुवाद, हस्त लिखित पोस्टर, निबंध, कविता, शोध पत्र लेखन प्रतियोगिताओ, का सीफेट लुधियाना एवं अबोहर परिसर के सभी कर्मचारियों के बीच संयुक्त रूप आयोजन किया गया तथा संयुक्त रूप से पुरस्कार वितरित किए गए।

AWARDS AND RECOGNITIONS

Sr. No.	Name of Awardee	Name of Award
1.	Er. Chandan Solanki Dr. Mridula D Dr. S K A Kudos Dr. R K Gupta	♦ **Best Poster Award (2018)** for research paper on 'Oat Dehuller and Optimization of Dehulling Parameters' in National Conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector" during March 16-17-2018, held at ICAR-CIPHET, Ludhiana. ♦ **Best Poster Award (2018)** for research paper on 'Buckwheat dehuller and optimization of dehulling parameters' in National Conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector" during March 16-17-2018, held at ICAR-CIPHET, Ludhiana.
2.	Dr. Renu Balakrishnan Dr. Sandeep Mann Dr. R K Gupta	♦ **Best Poster Award (2018)** for research paper on 'Role of extension in increasing farmers income' at "Ist International Extension Congress" organized by Orissa Society of Extension Education at ICAR- CIWA, Bhubaneswar during 1-3rd February 2018.
3.	Dr. V. Eyarkai Nambi	♦ **Jawaharlal Nehru Award (2017)** for Outstanding Ph. D Thesis. ♦ **Young Engineer Award (2017)** from Institution of Engineers (IEI), New Delhi.
4.	Dr. Ranjeet Singh	♦ **Best Scientist Award (2017)** during 5th Faculty Branding Award-2017 EET CRS Research wing for excellence in professional education and Industry at Kolkata on 23rd July 2017. ♦ **Best Poster Award (2018)** for research paper on 'A Comparative Study on Roasting of Foxnut: Traditional vs Mechanized' in National Conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector" during March 16-17-2018, held at ICAR-CIPHET, Ludhiana.
5.	Dr. Vandana Churendra Dr. RK Gupta Dr. S.Patel Dr. Mridula D	♦ **Best Poster Award (2018)** for research paper entitled 'Processing of Kodo Millet (Pasplum Scrobiculatum) for Value Added Products using Extrusion Technology' in National Conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector" during March 16-17-2018, held at ICAR-CIPHET, Ludhiana.
6.	Dr. Mridula D Dr. RK Gupta Ms. Sheetal Bhadwal Er. Dritiman Saha	♦ **Best Poster Award (2018)** for research paper on "Screw pressing of de-hulled sunflower: Optimization of oil expelling parameters in National Conference on "Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector" during March 16-17-2018, held at ICAR-CIPHET, Ludhiana.
7.	Dr. Ramesh Kumar	♦ **First and Second Prize (2018)** respectively for kinnow pomace bar under citrus and other processed product category in Seminar cum exhibition organized by PAU, Regional Station, Abohar campus during 2-3 February, 2018.
8.	Dr. Sakharam Kale	♦ **Young Scientist Award (2017)** in the subject Agricultural Structures by Venus International Foundation, Chennai.
9.	Dr. Prerna Nath	♦ **Young Scientist Award (2017)** in the subject Post-Harvest Technology by Venus International Foundation, Chennai.

PUBLICATIONS

Research Papers

1. Ahmad T, Kumar Y and Singh JN (2018). Effect of frozen storage of goat meat on quality parameters stored in the form of chunk and mince in two packaging materials. Indian Journal of Animal Research, 52(5) 2018: 780-785.

2. Ahmad T, Ismail A, Ahmad SA, Khalil KA, Leo TK, Awad EA and Sazili AQ (2018). Characterization of gelatin from bovine skin extracted using ultrasound subsequent to bromelain pretreatment. Food Hydrocolloids, 80, 264-273.

3. Ahmad T, Ismail A, Ahmad SA, Khalil KA, Leo TK, Awad EA and Sazili AQ (2018). Effects of ultrasound assisted extraction in conjugation with aid of actinidin enzyme on the molecular and physicochemical properties of bovine hide gelatin. Molecules, 23(4), 730; doi:10.3390/molecules23040730.

4. Bala M, Kumar Arun, Nanda SK, and Gupta RK (2018). Effect of casein and hydrocolloid on maize dough and chapati properties, International Journal of Current Microbiology and Applied Sciences, doi.org/10.20546/ijcmas.2018.704.236.

5. Balakrishnan R, Singh P, Padaria RN, Satyapriya and Murai AS (2017). Teachers' values for the profession in agricultural higher education system. Indian Journal of Extension Education, 53(2): 93-96.

6. Bansode V, Mridula D, Bhadwal S and Mukherjee A (2017). Optimization of potato flour, wheat semolina and guar gum for development of healthy and nutritious pasta. The Indian Journal of Nutrition and Dietetics, 54 (3): 278-293.

7. Barua S, Singh P, Mridula D, Gupta RK, Satyapriya and Tomar BS (2017). Attitude assessment of farmers towards post-harvest technologies and value addition of horticultural crops in Punjab. Journal of Human Ecology, 59(2-3):164-168.

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10. Dukare A, Kale S, Kannaujia P, Indore N, Mahawar MK, Singh RK, Gupta RK (2017). Root development and nodulation in Cowpea as affected by application of organic and different types of inorganic/plastic mulches. International Journal of Current Microbiology and Applied Sciences, 6: 1728-1738.

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13. Ghodki BM, Kumar KC, Goswami TK (2018). Modeling breakage and motion of black pepper seeds in cryogenic mill. Advanced Powder Technology, doi.org/10.1016/j.apt.2018.01.023.

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15. Jalgaonkar K, Mahawar MK, Bibwe B, Dukare A, Kannaujia P (2017) Moisture Dependent Physical Properties of Litchi Seeds (*Litchi chinensis*). Food Nutrition Journal, doi: 10.29011/2575-7091.100048.

16. Jalgaonkar K, Mahawar MK, Kale S, Nath P, Bibwe B, Dukare A, Kannaujia P, Meena VS (2018). Response surface optimization for development of Dragon fruit based ready to serve drink. Journal of Applied and Natural Science, 10 (1):272-278.

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40. Sharma M, Yadav DN, Singh AK, Vishwakarma RK, and Sabikhi L (2017). Impact of octenyl succinylated pearl millet *(Pennisetum typhoides)* starch addition as fat replacer on the rheological, textural and sensory characteristics of reduced-fat yoghurt. International Journal of Dairy Technology, doi: 10.1111/1471-0307.12461.

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53. Yadav A, Mangaraj S, Singh R, Kumar NM and Arora S (2018). Biopolymers as packaging material in food and allied industry. International Journal of Chemical Studies, 6(2): 2411-2418.

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2. Bansal S, Mangal M, Tushir S, Oberoi HS and Gupta R K (2017). Aflatoxin detection in foodgrains & oilseeds. ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana (Punjab), Technical Bulletin No: ICAR-CIPHET/Pub/2017/04.

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Books Authored/ Edited/ Book Chapters/Journal Edited

Books Edited

1. Nambi VE, Gupta RK, Viswakarma RK and Chandrasekar V (2017). Course material for International Training on Modern Storage Technologies in Agriculture. Published by ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana, Punjab (India), ISBN: 978-81-931450-5-0.

Book Chapter

1. Nambi VE (2017). Sensors and Machine Vision Applications for Quality Monitoring of Stored Eco-System, p: 153-167. Course material for International training on Modern Storage Technologies in Agriculture (Eds.Nambi V. Eyarkai.,Gupta R.K.,Viswakarma R.K.and Chandrasekar V.). ICAR-CIPHET, Punjab (India), ISBN: 978-81-931450-5-0.

2. Nambi VE and Gupta RK (2017). Non-thermal processing of Horticultural Crops, In Horticultural Sciences Perspectives and Applications (Eds.Peter K.V.). Brillion Publishing, New Delhi, ISBN:978-81-932226-52, p 147-167.

3. Nambi VE, Chandrasekar V (2017). Design of Silos for Food Grain Storage. Course material for International Training on Modern Storage Technologies in Agriculture (Eds. Nambi V. Eyarkai, Gupta R.K., Viswakarma R.K. and Chandrasekar V.). ICAR-CIPHET, Punjab (India), ISBN: 978-81-931450-5-0, p 81-89.

4. Nambi VE, Manickavasagan A and Shahir S (2017). Rice Milling Technology to Produce Brown Rice, In Brown Rice (Eds. Annamalai Manickavasagan, Chandini Santha Kumar and Venkatachalapathy N). Springer Publications, Switzerland, ISBN: 978-3-319-59010-3.

5. Narsaiah K, Rawat R and Bhadwal S (2018). Encapsulation of bio-active compounds from vegetables for better nutraceutical delivery. (Eds.Singh Barjinder, Singh Sudhir and Koley Tanmay) Advances in Post-harvest Technologies of Vegetable Crops (ISBN 978-81-77188-619-2). Apple Academy Press, Waretown, USA, p 339-354.

6. Paul S, Dukare AS, Bandeppa, Manjunatha BS and Annapurna K (2017). Plant growth promoting rhizobacteria for abiotic stress alleviation in crops. In: Advances in Soil Microbiology: Recent trends and future prospects, Volume 2: Soil-Microbe-Plant-Interaction (Eds. Adhya T.K., Mishra B.B., Annapurna K. and Kumar U.), Springer Nature, Singapore, p 57-79.

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Technical/popular articles in Summer School/Winter school/Training manual etc.

1. Bala M (2017). Extraction of oil using SCFE from given oilseed sample. ICAR-Summer school compendium on 'Advanced strategic processing techniques for oilseeds to combat protein-energy malnutrition and augment farmers' income (Eds. Yadav DN, Nanda SK and Solanki C), ICAR-CIPHET, Ludhiana during August 01-21, 2017, p 204.

2. Bala M, Tushir S, and Nanda SK (2017). Analytical Techniques Utilized for Food Testing in Summer school compendium on 'Competency Skill development in Post-Harvest Processing and Value Addition for start-ups/ Agri-Enterprise'. (Eds. Singh R, Nambi VE and Indore N) ICAR-CIPHET, Ludhiana during September 05 -25, 2017, p 147.

3. Bala M, Tushir S, and Sethi S (2017). Adulteration in Spices in winter school compendium on 'Technological Innovations in Processing and By-Products Utilization of Agricultural Produce' (Eds. Tyagi SK, Bala M and Tushir S), ICAR-CIPHET, Ludhiana. December 4-24, 2017, p 263-266.

4. Bala M, Tushir S, Kumar P and Nanda SK (2017). Application of Supercritical fluid extraction technologies for oils and oilseeds processing. Summer School compendium on 'Advanced strategic processing techniques for oilseeds to combat protein-energy malnutrition and augment farmers' income (Eds. Yadav DN, Nanda SK, and Solanki C), ICAR-CIPHET, Ludhiana during August 01-21, 2017, p 192-199.

5. Bala M, Tushir S, Kumar P and Nanda SK (2017). Emerging trends in development of gluten free products. In ICAR sponsored Winter School Compendium on 'Technological Innovations in Processing and by-products utilization of Agricultural Produce'(Eds: Tygai SK, Bala M, and Tushir S), ICAR-CIPHET, Ludhiana during December 04-24, 2017.

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9. Jaiswal AK, Kumari A, Bansal S, and Yadav DN (2017). Anaj prasanskaran ke sahutpado ki karyatmak khsmata. Prasanskaran Pragati-Ank 1: 1-31.

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13. Mridula D (2017). Role of oils and fats in human health & nutrition. Compendium of ICAR sponsored summer school on 'Advanced strategic processing techniques for oilseeds to combat protein-energy malnutrition and augment farmers' income' (Eds D.N. Yadav, Nanda SK and Solanki C), ICAR-CIPHET, Ludhiana during August 01-21, 2017, p 26-37.

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3. Chandrasekar V, Tushir S, Tyagi SK and Mann S (2018). Physical and Thermal Properties of Corn Cob Blended Mud Cup. Souvenir: National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector during at ICAR-CIPHET, Ludhiana (Punjab), March 16-17, 2018.

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5. Churendra V, Gupta RK, Patel S and Mridula D (2018). Processing of Kodo Millet *(Pasplum scrobiculatum)* for Value Added Products using Extrusion Technology. Souvenir: National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sectorduring March 16-17, 2018 at ICAR-CIPHET, Ludhiana (Abstract No. EDF 26, Pp 223).

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7. Goswami D, Sharma S, Tyagi SK and Singh B (2017). A comprehensive processing technique for reduction of anti-nutritional factors in mustard (*B. juncea*) meal. Souvenir: 26th Convention of Food Scientists and Technologists on Food and Nutrition Challenges: Role of Food Science and Technology during December 7-9, 2017 at CSIR-Indian Institute of Chemical Technology, Hyderabad.

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9. Gupta RK, Chandrasekar V and Nambi VE (2017). Value addition of onion, garlic and potato. Souvenir of State Level Seminar on Improved Technology and Methods for Increasing Production Usage and Processing of Potato, Onion and Garlic in Punjab at ICAR-CIPHET, Abohar, Punjab during September 25-26, 2017.

10. Mridula D (2018). Multi-food based novel extruded nutri-products. Souvenir: National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sectorduring March 16-17, 2018 at ICAR-CIPHET, Ludhiana (Abstract No. EDF 08, p 212).

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20. Kumar P, Bala M, Saha D and Nanda SK (2018). Characterization of cryogenically ground curry leaf powder. Souvenir : National Conference on Promoting Entrepreneurial Growth through

Innovative Approaches in Food Processing Sector held during March 16-17, 2018 at ICAR-CIPHET, Ludhiana, India (Abstract No: BTA-18, p 169).

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23. Singh R and Sharma A (2018). Agri-start-ups: Need of hours to meet the future challenges in India. Souvenir: National conference on promoting entrepreneurial growth through innovative approcehes in Food processing sector during March 16-17, 2018 at ICAR-CIPHET, Ludhiana.

24. Singh R and Nambi VE (2018). Mobile app for effective transfer of post-harvest and value addition technologies.Souvenir: 52nd ISAE convention on Doubling farmers income through technological invention during 08-10 January, 2018 at AAU Gujrat.

25. Singh R, Viswakarma RK and Nagda N (2018). A comparative study on roasting of foxnut: Traditional Vs Mechanised. Souvenir: National conference on promoting entrepreneurial growth through innovative approaches in Food processing sector during March 16-17, 2018 at ICAR-CIPHET, Ludhiana.

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34. Mann S, Dixit AK, Balakrishnan R and Singh P (2018). Role of agro processing in increasing farmers income: Punjab prospective. Souvenir: 52nd Annual Convention of ISAE and Symposium on Doubling Farmers Income through Technological Interventions during January 08-10, 2018, at AAU, Anand, Gujarat.

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36. Mann S, Kalnar Y and Balakrishnan R (2018). Increasing Farmers Income through on Farm Processing of Agricultural Produce. Souvenir: National Conference on 'Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector' during March 16-17, 2018 at ICAR-CIPHET, Ludhiana, p 233.

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44. Singh R and Nambi VE (2018). Mobile app for effective transfer of post-harvest and value addition technologies. Souvenir: 52nd ISAE convention on Doubling farmers income through technological invention during 08-10 January, 2018 at AAU Gujrat.

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56. Nambi VE (2018).Image Processing approaches for detection of broken wheat kernels towards the development of smart device for stored grains. Souvenir: 52nd ISAE convention and National seminar held at AAU, Anand during 8-10 Jan 2018.

57. Nambi VE, Singh R and Bhusan B (2018). Image Processing approaches for detection of broken wheat kernels towards the development of smart device for stored grains. Souvenir: 52nd ISAE convention on doubling farmer's income through technological invention during 08-10 January, 2018 at AAU Gujrat.

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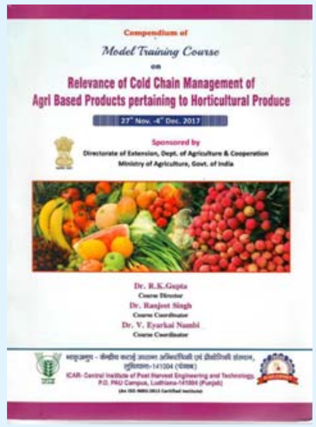
Other Publications (Souvenir/Compendium)



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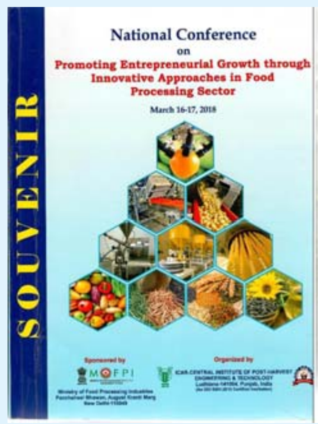

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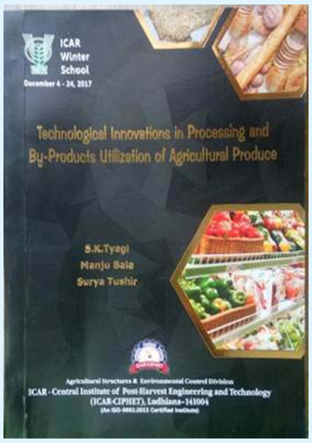

E- Publication

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2. Bibwe B, Mahawar M K, Jalgaonkar K, Dukare A and Kannaujia P (2017). Pressurized Hot Water Extraction: Promising Green Extraction Technology, Biotech articles, (http://www.biotecharticles.com/Applications-Article/Hermetic-Storage-Safe-and-cheap-technique-for-grain-storage-3857.html)

3. Santosh MA, Balakrishnan R, Preeti M and Pragya B (2017). Agrotourism for doubling farmers' income. Biotech Article.https://www.biotecharticles.com/Agriculture-Article/Agro-Tourism-for-Doubling-Farmers-Income-4267.html.

Participation in Conferences/Seminars/Meetings/ Symposia/Seminars/other forum

1. Bala M, Ranjit Singh, Sethi S and Kumar P (2018). 21st Punjab Science Congress on 'Scientific advances for inclusive development and environmental protection' held at PAU, Ludhiana during February 7-9, 2018.

2. Balakrishnan R (2018). 1st International Extension Congress' organized by Orissa Society of Extension Education at ICAR-CIWA, Bhubaneswar during 1-3 February 2018.

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4. Chandrasekar V (2017). National workshop on Developing a Roadmap for Agricultural Management in during September 27-28, 2017 at NASC complex, New Delhi.

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6. Chandrasekar V (2018). 33rd annual workshop of AICRP-PHET at JAU, Junagadh during January 23-25, 2018.

7. Dukare A (2018). International Conference on "Microbial Technology for Better Tomorrow" Department of Microbiology, Dr. D.Y. Patil Vidyapeeth in association with Microbiologists Society (India) at Pune (MH)-411018 during February 17-19, 2018.

8. Ghodki BM (2018). 52nd Annual Convention of Indian Society of Agricultural Engineers (ISAE) and National Symposium on Doubling Farmer's Income through Technological Interventions, Anand Agriculture University, Anand, India during January 08 – 10, 2018.

9. Ghodki BM (2018). Meeting on "Operation Greens" at Ministry of Food Processing Industries, New Delhi on 5th Feb, 2018.

10. Goswami D and Nagda N (2017). 26th Convention of Food Scientists and Technologists on Food and Nutrition Challenges: Role of Food Science and Technology held at CSIR-Indian Institute of Chemical Technology, Hyderabad during December 7-9, 2017.

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12. Kalnar Y (2017). PAU Kisan Committee and PAU Fruit and Vegetable Growers Meeting' on 06.12.2017 at Punjab Agricultural University, Ludhiana.

13. Kalnar Y (2018). 1st International Extension Congress organized by Orissa Society of Extension Education at ICAR-CIWA, Bhubaneswar during February 1-3, 2018.

14. Kannaujia P (2018). Participated in National Workshop on 'Revisiting FOCARS: Reflections and Feedback of Trained Scientists' – March 15-16, 2018 at ICAR-NAARM, Hyderabad.

15. Mann S (2017). Food Industry and Crafts Mela on 12-10-2017 organized by PAU, Ludhiana.

16. Mann S (2017). Golden Jubilee International Conference on Gender Issues and Socio-Economic Perspectives for Sustainable Rural Development at CCS HAU Hisar during October 23-25, 2017.

17. Mann S (2017). International Summit for Packaging Industries (ISPI- 2017) organized by Indian Institute of Packaging during 27-28 October 2017 at New Delhi.

18. Mann S (2017). Methodological framework for implementation of FFP at ICAR-IISWC, Dehradun from 6-9th Nov, 2017.

19. Mann S (2017). Methodological framework for implementation of FFP during 06.11.2017 to 09.11.2017 at ICAR-IISWCR organized by NAARM Hyderabad.

20. Mann S (2017). PAU Kisan Committee and PAU Fruit and Vegetable growers Meeting during 06-12-2017.

21. Mann S (2017). Preventive vigilance workshop at ICAR-CIPHET Ludhiana during 08-09-2017.

22. Mann S (2017). Punjab state Coordination Committee Meeting for Doubling Farmers Income by 2022 held at ICAR-CIPHET, Ludhiana on 21 April, 2017 during 24-25 January 2017.

23. Mann S (2017). Skill development in agriculture at hotel Mount-View, Chandigarh on 15.09.2017.
24. Mann S (2017). Training programme on Promotion of Farmers Producer Organisation during 27-29 Nov, 2017 at PAMETI, PAU, Ludhiana.
25. Mann S (2018). 52nd Annual Convention of Indian Society of Agricultural Engineers (ISAE) & National Symposium on Doubling Farmers Income through Technological Interventions organized at AAU Anand, Gujrat during Jan. 08 to 10, 2018.
26. Mann S (2018). Annual Review Workshop of FFP and presented progress at IARI, New Delhi during 21-22 February, 2018.
27. Mann S (2017). 4th meeting of Indian grain storage working group and one day workshop on bulk handling, storage and transportation of grains and oilseeds New Delhi on 12th June 2017.
28. Mridula D, Yadav DN, Goswami D, Saha D, Solanki C, Sethi S and Kumar P (2018). National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector held at ICAR-CIPHET, Ludhiana during March 16-17, 2018.
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30. Muzaddadi AU (2017). 11th Indian Fisheries and Aquaculture Forum Conference on 'Fostering innovation in Fisheries and Aquaculture held at Le Meridian Hotel, Kochi during 21-24 November 2017.
31. Muzaddadi AU (2018). World Fisheries Day celebration on November 21, 2017 at NASC Complex, New Delhi organized by the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers' Welfare, Govt. of India.
32. S.K. Nanda, Sandeep Mann, Nambi VE, Chandan Solanki and Dhritiman Saha, (2018). 52nd ISAE convention and National seminar held at AAU, An and during 8-10 Jan' 2018.
33. Nambi VE (2018). 31stNational Convention of Agricultural Engineers organized and National Seminar on Engineering Interventions in Doubling the Income of Small and Marginal Farmers by 2022 by IEI, Delhi state during 2-3 Feb' 2018.
34. Nambi VE (2018). Workshop of approved testing centers organized by Mechanization and Technology Division, Dept. of Agricultural Cooperation and Farmers Welfare, at New Delhi during 1st Feb' 2018.
35. Narsaiah K (2018). 11th IFAF International Symposium during 21-24 November, 2017 at Kochi, Kerala.
36. R.K. Gupta, Tyagi S.K., Chandrashekhar V and Narsaiah K (2018). Annual workshop of AICRP on PHT from 23th to 25th January 2018 at Junagadh.
37. Narsaiah K (2018). Training program of GPC on 19th December 2017 Aimil Ltd. New Delhi.
38. Nath P, Kale SJ, Vishwakarma RK and Gupta RK (2018). International Conference on Bio and Nano Technologies for Sustainable Agriculture, Food, Health, Energy and Industry, during February 21-23, 2018 at GJU, Hisar, Haryana.

39. Singh R (2017). Role of Entrepreneurship & Employment Generation organized by All India Progressive Forum and Small Scale Industrialists and Traders Association (MSME) Ludhiana on 14.10. 2017 at ICAR-CIPHET, Ludhiana.

40. Tushir S (2018). International Conference on Innovations and Translational Dimensions: Food, Health, and Environmental Biotechnology-BioSangam 2018", during 9-11 March 2018 at MNNIT, Allahabad.

41. Vishwakarma RK (2018). 'Feed the Futures' programme organized by MANAGE at Hyderabad along with the south, rest Asia and Africa delegation 2nd Aug 2017.

42. Mann S, Muzaddadi AU, Balakrishnan R (2018). National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector held at ICAR-CIPHET, Ludhiana during March 16-17, 2018.

43. Tyagi SK, Narsaiah K., Chandrasekar V, Choudhary P (2018). National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector held at ICAR-CIPHET, Ludhiana during March 16-17, 2018.

44. Kumar Ramesh, Kumar Sunil, Jalgaonkar K, Nath P, Mahawar MK, Bibwe B and Kale S, (2018). National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector held at ICAR-CIPHET, Ludhiana during March 16-17, 2018.

45. Sharma Alka, Verma Ayushi and Nagda N, (2018). National Conference on Promoting Entrepreneurial Growth through Innovative Approaches in Food Processing Sector held at ICAR-CIPHET, Ludhiana during March 16-17, 2018.

RESEARCH PROJECTS

Institute Funded Projects

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
1.	Development of continuous primary processing and shrink packaging line for cauliflower and cabbage	Dr. R.K. Vishwakarma (PI) Dr. Ramesh Kumar (Co-PI) Ms. Leena Kumari (Co-PI) Dr. Manoj Kumar (Co-PI)	01.10.2013 01.10.2013 01.10.2013 01.06.2016	31.12.2017 31.03.2017 30.06.2016 31.12.2017
2.	Development of vegetable mixed-wadi making system	Dr. Sandeep Mann (PI) Ms. Deepika Goswami (Co-PI) Er. Dhritiman Saha (Co-PI)	01.10.2013 01.10.2013 01.02.2015	30.09.2017 22.01.2015 30.09.2017
3.	Design and development of Wonder Bag for wheat storage	Dr. Sandeep Mann (PI) Dr. H.S. Oberoi (Co-PI) Ms. Surya (Co-PI) Er. Akhoon Asrar Bashir (Co-PI)	01.07.2014 01.07.2014 01.06.2015 01.06.2016	Till date 15.11.2014 Till date Till date
4.	Development of nutritious and convenience foods using extrusion processing technique for 'at risk' children	Dr. Mridula D. (PI) Ms. Deepika Goswami (Co-PI) Ms. Surya (Co-PI) Dr. Khwairakpam Bembem, Co-PI	01.07.2014 01.07.2014 01.07.2014 01.11.2016	31.12.2017 22.01.2015 31.12.2017 31.12.2017
5.	Development of a process for extraction and utilization of low methoxyl pectin from citrus fruit residue	Dr. Sunil Kumar (PI) Dr. Ramesh Kumar (Co-PI) Dr. V.E.Nambi (Co-PI)	01.04.2014 01.04.2014 01.06.2016	31.12.2017 31.12.2017 31.12.2017
6.	Impact Assessment of Technologies from CIPHET and AICRP on PHET and PET	Dr. Anil Dixit (PI) Dr. S.K. Nanda (Co-PI) Dr. Indu Karki (Co-PI) Dr. Ranjeet Singh (Co-PI) Dr.V.K.Saharan (Co-PI) Sh. Rajesh Kumar (Co-PI) Er. Navnath Indore (Co-PI) Er. Arun Kumar T.V. (Co-PI)	01.06.2014 01.06.2014 01.06.2014 01.06.2014 01.07.2015 01.07.2015 01.06.2016 01.06.2016	31.05.2017 30.06.2015 30.04.2015 30.06.2015 31.05.2017 31.05.2017 31.05.2017 30.06.2017
7.	Design development and evaluation of equipments/machine and storage structures for primary processing and low temperature storage of onions in bulk	Dr. D. M. Kadam (PI) Er. Arun Kumar TV (Co-PI) Ms. Leena Kumari (Co-PI) Ms. Surya (Co-PI) Dr. Kalyani Gorrepati (Co-PI) Dr. Bhupendra M. Ghodki (PI) Dr. Dukare Ajinath Shridhar (Co-PI) Dr. Pankaj Kumar Kannaujia (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.11.2017 01.11.2017 01.11.2017	19.06.2017 30.06.2017 11.09.2017 31.10.2017 31.10.2017 Till date Till date Till date
8.	Development and evaluation of active ethylene absorbing packaging film material for selected climatric fruits.	Dr. Rahul K. Anurag (PI) Dr. Tanweer Alam (Co-PI)	01.07.2015 01.07.2015	Till date Till date

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
9.	Development of quality sensing system for mushroom and minimally processed pomegranate arils	Dr. Pranita Jaiswal (PI) Mrs. Leena Kumari (Co-PI) Dr. Rahul Kumar Anurag (Co-PI) & (PI) Dr. Shammi Kapoor (Co-PI)	01.07.2015 01.07.2015 01.07.2015 20.06.2017 01.08.2015	19.06.2017 11.09.2017 19.06.2017 Till date Till date
10.	Development and mechanization of low fat high fibre functional meat products	Dr. Yogesh Kumar (PI) Dr. Nitin Mehta (Co-PI) Dr. Sandeep Mann (Co-PI)	01.07.2015 01.07.2015 01.06.2016	Till date Till date Till date
11.	Development of improved Process and Machinery for enhanced Dhal Recovery from Pigeon Pea	Dr. R.K Vishwakarma (PI) Dr. Sangita Bansal (Co-PI) Dr. Arvind Jaiswal (Co-PI) Dr. D. N. Yadav (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.06.2017	Till date 19.06.2017 22.03.2017 Till date
12.	Development of process protocol for extraction of anthocyanins from pigmented indigenous rice varieties and its utilization in functional foods	Dr. S.K. Nanda (PI) Dr. Swati Sethi (Co-PI) Dr S.S. Roy (Co-PI) Dr. Manju Bala (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.06.2016	31.12.2017 31.12.2017 19.05.2016 31.12.2017
13.	Development of process protocol for gluten analogue and its application in maize and millets flour	Dr. Manju Bala (PI) Er. Arun Kumar TV (Co-PI)	01.07.2015 01.07.2015	31.12.2017 30.06.2017
14.	Newer methods for energy efficient oil extraction and novel product development from mustard seed	Dr. S. K. Tyagi (PI) Dr. Manju Bala (Co-PI) Er. Chandan Solanki (Co-PI) Dr. A U Muzaddadi (Co-PI) Dr. Yogesh Kumar (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.07.2015	Till date Till date Till date Till date Till date
15.	Development of technology for destalking and packaging of dried chillies	Er. Kirti R. Jalgaonkar (PI) Dr. Manoj K. Mahawar (Co-PI) Ms. Prerna Nath Kale (Co-PI)	01.07.2015 01.07.2015 01.07.2015	Till date Till date Till date
16.	Process Protocol for production of quality Green Raisins	Ms. Prerna Nath Kale (PI) Dr. Bharat Bhushan (Co-PI) Er. Sakharam Jagan Kale (Co-PI) Dr. Ajay Sharma (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.07.2015	Till date 19.06.2017 Till date 19.05.2016
17.	Development of composite peeler cum juice extract for sweet orange and kinnow	Dr. Manoj Kumar Mahawar (PI) Er. Kirti R. Jalgaonkar (Co-PI)	01.07.2015 01.07.2015	31.12.2017 31.12.2017
18.	Development of National Database on NARES Technologies in Post-Harvest Sector	Dr. S.K. Nanda (PI) Dr. Ranjit Singh (Co-PI) Dr. A.U. Muzaddadi (Co-PI) Dr. Indra Mani Mishra (Co-PI) Dr. J.T. Sheriff (Co-PI) Dr. G. Senthil Kumaran (Co-PI) PC (PHET) (PI) Dr. Anil Kumar Dixit (Co-PI) Dr. Sandeep Mann (Co-PI) Er. Arun Kumar (Co-PI) Dr. Renu Balakrishnan (Co-PI) Dr. V. Chandrasekar (Co-PI)	01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.07.2015 01.04.2016 01.04.2016 01.04.2016 01.04.2016 01.04.2016 01.11.2017	31.03.2016 31.03.2016 31.03.2016 31.03.2016 31.03.2016 31.03.2016 Till date 19.06.2017 31.10.2017 30.06.2017 Till date Till date

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
19.	Development and Evaluation of Eco-Friendly mustard based antimicrobial formulation using other botanicals for eradication of bacterial blight in pomegranate	Dr. S.K. Tyagi (PI) Dr. J. Sharma (Co-PI) Dr. Manju Bala (Co-PI) Mrs. Surya (Co-PI) Dr. K. Dhinesh Babu (Co-PI) Mr. Mallikarjun Harsur (Co-PI)	01.04.2016 01.04.2016 01.04.2016 01.04.2016 16.08.2017 16.08.2017	31.03.2018 31.03.2018 31.03.2018 31.03.2018 31.03.2018 31.03.2018
20.	Development of spectroscopic techniques for instant detection of honey adulteration	Dr. Pranita Jaiswal (PI) Dr. Rahul Anurag (Co-PI) & (PI) Dr. A.K. Jaiswal (Co-PI) Dr. Gagan Jyot Kaur (PAU) (Co-PI) Dr. Poonam (Co-PI)	01.04.2016 01.04.2016 20.06.2017 01.04.2016 01.04.2016 01.11.2017	19.06.2017 19.06.2017 Till date 22.03.2017 Till date Till date
21.	Development of rapid spectroscopic and molecular techniques for detection of animal species in meat products	Dr. Yogesh Kumar (PI) Dr. Pranita Jasiwal (Co-PI) Dr. Sangita Bansal (Co-PI)	01.04.2016 01.04.2016 01.04.2016	31.03.2018 19.06.2017 19.06.2017
22.	Bio transformation of Corn by-products for protein and other value added products	Mrs. Surya (PI) Dr. S.K. Tyagi (Co-PI) Dr. A.K. Jaiswal (Co-PI) Dr. V. Chandersekar	01.04.2016 01.04.2016 01.04.2016 01.06.2017	31.03.2018 31.03.2018 22.03.2017 31.03.2018
23.	Development of real time monitoring system for transportation of perishables	Dr. R.K. Vishwakarma (PI) Ms. Leena Kumari (Co-PI) Dr. Rahul Anurag (Co-PI) Er. A.A. Bashir (Co-PI) Dr. Bhupendra M. Ghodki (PI) Dr. Manoj Kumar (Co-PI) Dr. Pankaj Kumar Kannaujia (Co-PI)	01.04.2016 01.04.2016 01.04.2016 01.04.2016 01.11.2017 01.11.2017 01.11.2017	31.10.2017 11.09.2017 31.10.2017 31.10.2017 Till date Till date Till date
24.	Development of testing kits for detecting adulterants in selected spices	Dr. Manju Bala (PI) Dr. Swati Sethi (Co-PI) Dr. Sangita Bansal (Co-PI)	01.04.2016 01.04.2016 01.04.2016	31.03.2018 31.03.2018 19.06.2017
25.	Development of groundnut based milk powder analogue	Dr. S.K. Nanda (PI) Er. Dhritiman Saha (Co-PI) Dr. D.N. Yadav (Co-PI)	01.04.2016 01.04.2016 01.04.2016	30.09.2017 30.09.2017 30.09.2017
26.	Design and development of dehumidified hot air dryer for maize	Dr. Arun Kumar T.V. (PI) Dr. Pankaj Kumar (PI) Er. Dhritiman Saha (Co-PI)	01.04.2016 01.11.2017 01.04.2016	30.06.2017 Till date Till date
27.	Design and development of microwave assisted continuous popping system for selected food grains	Er. Chandan Solanki (PI) Er. Navnath Indore (Co-PI)	01.04.2016 01.04.2016	31.03.2018 31.03.2018
28.	Development of improved flaking system for small scale production of rice flakes	Er. Dhritiman Saha (PI) Dr. Arun Kumar T.V. (Co-PI) Dr. Swati Sethi (Co-PI)	01.04.2016 01.04.2016 01.04.2016	Till date 30.06.2017 Till date
29.	Development of convenient breakfast products using sprouting and extrusion technology	Dr. Swati Sethi (PI) Dr. Mridula D. (Co-PI)	01.04.2016 01.04.2016	31.03.2018 31.03.2018
30.	Utilization of fruit waste and plant extracts in developing antimicrobial coatings for extending shelf-life of fruits and vegetables	Dr. Sunil Kumar (PI) Dr. Dukre Ajinath Shridhar (Co-PI) Dr. Ramesh Kumar (Co-PI) Dr. Bharat Bhushan (Co-PI)	01.04.2016 01.04.2016 01.04.2016 01.04.2016	31.03.2018 31.03.2018 31.03.2018 19.06.2017

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
31.	Design and Development of Mechanized System for Fruit Bar Manufacturing	Er. Kirti Jalgaonkar (PI) Dr. Ramesh Kumar (Co-PI) Mrs. Prerna Nath (Co-PI) Dr. Manoj Mahawar (Co-PI)	01.04.2016 01.04.2016 01.04.2016 01.04.2016	31.03.2018 31.05.2017 31.03.2018 31.03.2018
32.	Development of technology for de-poding and preservation of cowpea & green pea	Er. B.B.Ratnakar (PI) Er. Kirti Jalgaonkar (Co-PI)	01.04.2016 01.04.2016	31.03.2018 31.03.2018
33.	Development of woman-friendly semi-automatic fish cleaning-cum-dressing system	Dr. A.U. Muzaddadi (PI) Mr. Vikas Kumar (Co-PI)	01.04.2016 01.04.2016	31.03.2018 31.03.2018
34.	Development of user friendly android based mobile application (Mobile app) for technology dissemination and out-reach program on postharvest processing and value addition.	Dr. Ranjeet Singh (PI) Dr. V.E. Nambi (Co-PI)	01.04.2016 01.04.2016	31.03.2018 31.03.2018
35.	Development of smart device for automatic detection and identification of insects in stored grains using machine vision technology	Dr. V.E. Nambi (PI) Dr. Ranjeet Singh (Co-PI) Er. B.B. Ratnakar (Co-PI)	01.04.2016 01.04.2016 01.04.2016	Till date Till date Till date
36.	Skill development and capacity building for income generation and employment security through agro-processing	Dr. Ranjeet Singh (PI) Dr. V.K. Saharan (Co-PI)	01.04.2016 01.04.2016	Till date Till date
37.	Development of cold plasma system for decontamination/dis-infestation of agricultural produces	Dr. V. Chandrasekhar (PI) Er. D. Saha (Co-PI) Dr. V E Nambi (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date
38.	Development of hermetically sealed storage structure of 1Tonne capacity for pulses	Er. Akhoon Asrar Bashir (PI) Dr V. Chandrasekar (Co-PI)	01.04.2017 01.04.2017	Till date Till date
39.	Development of process for color extra-ction from black carrot and its by-products and its utilization in value added product	Dr. Prerna Nath Kale (PI) Dr. Sunil Kumar (Co-PI) Mr. Ajinath Dukare (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date
40.	Development of mechanized litchi de-stoner	Dr. Bibwe Bhusan (PI) Dr. Kirti Jalgaonkar (Co-PI) Dr. Pankaj Kumar Kannaujia (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date
41.	Carbon footprint analysis in wheat processing for better sustainability of post-harvest management of wheat	Dr. V. Eyarkai Nambi (PI) Dr. V. Chandrasekar (Co-PI) Dr. Ranjeet Singh (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date
42.	Designing Extension Strategies for Wider Adoption of Post-Harvest Technologies based on Adoption Behaviour of End Users	Dr. Renu Balakrishnan (PI) Dr. Anil Kumar Dixit (Co-PI) Dr. Sandeep Mann (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date 19.06.2017 Till date
43.	Development of pigmented cereals based expanded/ extruded products and their nutritional evaluation	Dr. K. Bembem (PI) Dr. Pankaj Kumar (Co-PI)	01.04.2017 01.04.2017	Till date Till date
44.	Development of Automatic Sorter/Grader for Pomegranate and Tomato	Er. Yogesh Kalnar (PI) Dr. V E Nambi (Co-PI)	01.04.2017 01.04.2017	Till date Till date
45.	Design and analysis of greenhouse structures for selected regions of India	Er. Indore Navnath Sakharam (PI) Dr. Sakharam Kale (Co-PI) Er. Akhoon Asrar Bashir, (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date

Externally Funded Projects

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
1.	Up-gradation of Quality Control Food Testing Laboratory	Dr. S.N. Jha (PI)	01.09.2011	17.03.2015
		Dr. S. Kumar Devatkal (Co-PI)	01.09.2011 & 06.11.2012	21.03.2012 & 17.03.2015
		Dr. H.S. Oberoi (Co-PI)	01.09.2011	15.11.2014
		Dr. Rahul Kumar (Co-PI) /Team Member	01.09.2011	Till date
		Dr. Manju Bala. (Incharge Lab)	17.03.2015	29.09.2015
		Ms. Surya (Team Member)	17.03.2015	23.10.2017
		Dr. Mridula D. (Incharge Lab)/Team Leader	29.09.2015	Till date
		Dr. Arvind K. Jaiswal (Team Member)	06. 10.2015	22.03.2017
		Dr. Poonam (Team Member)	24.10.2017	Till date
2.	Development of molecular tools for detection of adulteration of medicinal oilseeds and spices for value addition and processing	Dr. R.K. Gupta (PI)	19-06-17	30.09.2017
		Dr. Sangita Bansal (PI)	08.10.2013	19.06.2017
		Dr. Anupan Mangal (Co-PI)	08.10.2013	30.09.2017
		Dr. Sanjeev Kumar (Co-PI)	08.10.2013	30.09.2017
3.	Study on determining storage losses in food grains in FCI and CWC ware houses and to recommend norms for storage losses in efficient warehouse management.	Dr. S.N. Jha (PI)	24.05. 2014	29.12.2015
		Dr. R.K. Gupta (PI)	14.11.2013	24.05.2014
		Director & PC PHET	30.12.2015	Till date
		Dr. S.K. Nanda, PC, PHT (PI)	01.07.2013	13.11.2013
		Dr. S.K. Aleksha Kudos (Co-PI)	14.11.2013	10.12.2015
		Dr. A.K. Dixit (Co-PI)	14.11.2013	19.06.2017
		Dr. R.K. Vishwakarma (Co-PI)	16.02.2016	Till date
		Dr. Arun Kumar T.V. (Co-PI)	16.02.2016	30.06.2017
4.	Development of nano-biocomposite based construction material for storage of food grains	Dr. D.M. Kadam (PI)	01.11.2013	19.06.2017
		Dr. Manju Bala (Co-PI)	01.11.2013	31-10-17
5.	Studies and refinement of live-fish carrier system for mass transportation of table fish, brooders, fingerlings and aquarium fishes	Dr. A.U. Muzadaddadi (PI)	08.08.2014	Till date
		Dr. S.K. Nanda (Co-PI)	08.08.2014	31.10.2017
		Ms. Monika (Co-PI)	08.08.2014	13.11.2015
6.	Development of food Bio-polymer based micro & nano scale delivery systems for bioactive ingredients in functional foods	Dr. K. Narsaiah (PI)	02.01.2015	Till date
7.	Development of micronutrients enriched flour formulation and food products	Dr. Mridula D. (PI)	01.04.2015	31.03.2018
		Dr. Swati Sethi (Co-PI)	01.04.2015	31.03.2018
8.	Development of protein isolates and concentrates from de-oiled cakes and their application in health foods	Dr. D.N. Yadav (PI)	01.04.2015	31.03.2018
		Dr. Sangita Bansal (Co-PI)	01.04.2015	19.06.2017
		Ms. Monika Sharma (Co-PI)	01.04.2015	30.11.2015
9.	Development of automated fumigation chamber for treatment of grapes with CO_2 and SO_2 and standardization of treatment protocol for Export market access to New Zealand	Dr. R.K. Gupta, Nodal Officer	02.01.2017	31.01.2018
		Dr. R.K. Vishwakarma (PI)	01.04.2016	31.01.2018
		Er. V.E. Nambi (Co-PI)	01.04.2016	31.01.2018
		Ms. Leena Kumari (Co-PI)	01.04.2016	01.01.2017
		Er. Dhritiman Saha (Co-PI)	01.04.2016	31.01.2018

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
10.	Establishment of modern fruits and vegetables Agro Processing Centre (APC)	Dr. P C Sharma (PI) Dr. D.M. Kadam (PI) Dr. R.K. Vishwakarma (PI) Dr. Manoj Kumar Mahawar (Co-PI) Er. Bibwe Bhushan Ratnakar (Co-PI)	01.04.2015 20-02-16 19..11.2016 01.04.2015 19.11.2016	31.12.2015 19.11.2016 Till date Till date Till date
11.	Value addition of Makhana and its by-products	Dr. R.K. Vishwakarma (PI) Er. Arun Kumar TV (Co-PI) Dr. Ranjit Singh (Co-PI) Dr. Khwairakpam Bembem (Co-PI)	01.04.2016 01.04.2016 01.04.2016 16.08.2016	Till date 30.06.2017 Till date Till date
12.	Establishment of Agri-Business Incubation (ABI) Centre under XII Plan Scheme for National Agriculture Innovation Fund (NAIF) at ICAR-CIPHET, Ludhiana	Dr. V.E. Nambi (PI) Dr. Ranjit Singh (Co-PI) Dr. Ranjit Singh (PI) Mr. Vikas Kumar (Co-PI) Dr. Renu Balakrishnan (Co-PI)	01.01.2016 21.09.2016 31.10.2016 21.09.2016 21.09.2016	30.10.2016 30.10.2016 Till date Till date Till date
13.	Processing and Value Addition of Agricultural Produce for Enhancing Farmers income and Employment in Production Catchment under Farmer FIRST Programme (FPP)	Dr. Sandeep Mann (PI) Dr. A.K. Dixit (Co-PI) Dr. Rahul Kumar Anurag (Co-PI) Dr. Renu Balakrishnan (Co-PI) Er. Yogesh Kalnar (Co-PI) Dr. B.V.C Mahajan (Co-PI)	30.01.2017 30.01.2017 30.01.2017 30.01.2017 30.01.2017 30.01.2017	Till date 19.06.2017 Till date Till date Till date Till date
14.	Refinement of process protocol for preparation of traditional fermented fish products of Northeast India by using biotechnological tools and its process mechanization	Dr. A.U. Muzaddadi (PI) Er. Dhritiman Shaha (Co-PI)	23.03.2018 23.03.2018	Till date Till date

AICRP on PET, HCP Division, ICAR-CIPHET, Abohar

S. No.	Project Title	Project Leader & Associates	Period of Association From	To
1.	Design and development of composite Solar Air-conditioning System coupled farm level cold store for hot and arid region of Punjab	Dr. K. Sakharam Jagan (PI) Dr. Manoj Mahawar (Co-PI)	01.01.2015 01.01.2015	30.06.2017 30.06.2017
2.	Development of mobile weight evaporative cooling chamber for storage and transportation of fruits and vegetables	Dr. K. Sakharam Jagan (PI) Dr. Pankaj Kumar Kannaujia (Co-PI) Dr. Indore Navnath (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date
3.	Studies of mulching on growth, yield and quality of cow pea under drip irrigation system.	Dr. Pankaj Kumar Kannaujia (PI) Dr. Sakharam Kale (Co-PI) Dr. Ajinath Dukare (Co-PI)	01.04.2017 01.04.2017 01.04.2017	Till date Till date Till date

RAC, IMC & QRT MEMBERS

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9.	Dr. K. Narsaiah, ICAR National Fellow and Pr. Scientist, AS&EC Division, ICAR-CIPHET, Ludhiana	Member Secretary	Mob: 09417143925, Ph no. 0161-2313124 Email: knarsan@gmail.com

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S. No	Name	Contact Details
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Quinquennial Review Team (QRT)

S. No	Name	Designation	Contact Details
1	Dr. Nawab Ali Former DDG (Engg.) SDX-40, Minal Residency, J.K. Road, Bhopal-462 023 (M.P.)	Chairman	E-mail: alinawab11@gmail.com
2	Dr. D.C. Joshi, Dean, Faculty of Food Processing and Bio-Energy, AAU, Anand	Member	E-mail: dcjoshi@aau.in
3	Dr. P.K. Srivastava Former Dean, College of Agricultural Engineering and Post Harvest Technology, Centeral Agricultural University (CAE), Ranipool, Gangtok, Sikkim	Member	E-mail: prabhat410@rediffmail.com
4	Dr. S.K. Dash Professor & Head Department of Agricultural Processing and Food Engineering, College of Agricultural Engineering, OUAT, Bhubneshwar-751003	Member	Email: sk_dash1006@hotmail.com
5	Dr. P. Kumar Ex-Head, Division of Agricultural Economics, IARI, New Delhi.	Member	E-mail: promodkumar@iari.res.in
6	Dr. Bramh Singh, Former Director Life Sciences, Defence Research and Development Organisation , New Delhi Address : Pocket-E, Flat No. 713, Mayur Vihar Phase-II, New Delhi-110 001	Member	E-mail: brahma88@hotmail.com
7	Dr. D. N. Yadav Principal Scientist (Food & Technology), ICAR-CIPHET, Ludhiana-141004	Member Secretary	E-mail: dnyadav1977@yahoo.co.in

PERSONALIA

Promotion

1. Dr. Armaan U Muzaddadi, Sr. Scientist promoted to Pr. Scientist through CAS.
2. Dr. Sunil Kumar, Sr. Scientist promoted to Pr. Scientist through CAS.
3. Dr. Manju Bala, Sr. Scientist promoted to Pr. Scientist through CAS.
4. Dr. R.K. Vishwakarma, Sr. Scientist promoted to Pr. Scientist through CAS.
5. Dr. Ranjit Singh, Sr. Scientist (AS&PE) promoted to the next higher grade under CAS.
6. Smt. Deepika Goswami, Scientist (FST) promoted to the next higher grade under CAS.
7. Sh. Rajender Kumar Raheja, LDC promoted to UDC.

New Joining

1. Sh. Dawange Sandeep Popatrao, Scientist, Agricultural Structures & Process Engineering joined the Institute on 16.10.2017.
2. Ms. Thingujam Bidyalakshmi Devi, Scientist, Agricultural Structures & Process Engineering joined the Institute on 16.10.2017.

Transfer

1. Smt. P. Hemasankari, Scientist transferred from ICAR-CMFRI, Kochi to ICAR-CIPHET, Ludhiana on 5.5.2018.

Retirement

1. Dr. S.K Nanda, Former Head FG&OP, ICAR-CIPHET, Ludhiana retired from the services w.e.f. 31.10.2017.
2. Sh. Sohan Lal, LDC, ICAR-CIPHET, Ludhiana retired from the services w.e.f. 31.01.2018.

Ph.D.

1. Smt. Leena Kumari, Scientist, Electronics & Instrumentation went for pursuing Ph.D. w.e.f. 12.9.2017.

INSTITUTIONAL STAFF

ICAR-CIPHET, Ludhiana
Scientific

Name	Designation	Discipline
Dr. R.K. Gupta	Director	Agricultural Structures & Process Engineering
Dr. R.K. Singh	Project Coordinator	Soil Water Conservation Engineering
Dr. S.K. Tyagi	Pr. Scientist	Chemical Engineering
Dr. K. Narsaiah	Pr. Scientist	Agricultural Structures & Process Engineering
Dr. (Smt.) Mridula Devi	Pr. Scientist	Food & Nutrition
Dr. Sandeep Maan	Pr. Scientist	Agricultural Structures & Environmental Management
Dr. Deep Narayan Yadav	Pr. Scientist	Food Science & Technology
Dr. Manju Bala	Pr. Scientist	Plant Bio-Chemistry
Dr. Armaan Ullah Muzaddadi	Pr. Scientist	Fish Processing Technology
Dr. Ranjit Singh	Sr. Scientist	Agricultural Structures & Process Engineering
Dr. Yogesh Kumar	Scientist (SS)	Livestock Product Technology
Dr. Tanbir Ahmad	Scientist (SS)	Livestock Product Technology
Dr. Eyarkai Nambi, V.	Scientist	Agricultural Structures & Process Engineering
Dr. (Smt.) Deepika Goswami	Scientist (SS)	Food Science & Technology
Dr. Rahul Kumar Anurag	Scientist (SS)	Food Science & Technology
Smt. Leena Kumari	Scientist	Electronics & Instrumentation
Smt. Surya	Scientist	Agricultural Microbiology
Dr. (Smt.) Swati Sethi	Scientist	Food Technology
Er. Chandan Solanki	Scientist	Agricultural Structures & Process Engineering
Er. Dhritiman Saha	Scientist	Agricultural Structures & Process Engineering
Er. Akhoon Asrar Bashir	Scientist	Agricultural Structures & Environmental Management
Er. Indore Navnath Sakharam	Scientist	Agricultural Structures & Environmental Management
Er. Yogesh Kalnar	Scientist	Agricultural Structures & Process Engineering

Name	Designation	Discipline
Dr. (Smt.) Khwairakpam Bembem	Scientist	Home Science
Dr. (Smt.) Renu Balakrishnan	Scientist	Agricultural Extension
Sh. Vikas Kumar	Scientist	Fish Processing Technology
Dr. Pankaj Kumar	Scientist	Agricultural Structures & Process Engineering
Dr. V. Chandrasekar	Scientist	Agricultural Structures & Process Engineering
Dr. (Smt.) Lovejot Kaur	Scientist	Agricultural Biotechnology
Dr. (Smt.) Poonam	Scientist	Plant Bio-Chemistry
Er. Dawange Sandeep Popatrao	Scientist	Agricultural Structures & Process Engineering
Dr. Thingujam Bidyalakshmi	Scientist	Agricultural Structures & Process Engineering

Administrative

Name	Designation
Sh. Raj Kumar	SAO
Sh. Tej Singh Bhati	F & AO
Sh. Manni Lal	AF & AO
Sh. B.C. Katoch	AAO
Sh. Kunwar Singh	Assistant
Sh. Avtar Singh	Assistant
Sh. Tarsem Singh Purba	Assistant
Smt. Jasvir Kaur	Assistant
Sh. Gurdial Singh	UDC
Sh. Ashwani Kumar	UDC
Sh. Rajinder Kumar Raheja	UDC
Sh. Iqbal Singh	UDC
Smt. Sunita Rana	LDC
Sh. Ram Khelawan Yadav	LDC
Sh. Sughar Singh Verma	PS to Director

Technical

Name	Designation
Sh. V.K. Saharan	Chief Technical Officer
Dr. Mukund Narayan	Technical Officer
Sh. Gurdeep Singh	Technical Officer (Lab. Tech.)
Sh. Hardev Singh Sekhon	Technical Officer (Driver)
Sh. Beant Singh	Sr. Technical Assistant (Driver)
Sh. Vishal Kumar	Sr. Technical Assistant (DEO)
Sh. Lakhwinder Singh	Sr. Technical Assistant (Fitter)
Sh. Bhajan Singh	Sr. Technical Assistant (Fitter)
Sh. Jaswant Singh	Sr. Technical Assistant (Welder)
Smt. Sonia Rani	Technical Assistant (DEO)
Sh. Jaswinder Singh	Technical Assistant (Machinist)
Sh. Jagtar Singh	Technical Assistant (Electrician)
Sh. Pradip Kumar	Technical Assistant (Field Asstt.)
Sh. Yashpal Singh	Technical Assistant (Field Asstt.)
Sh. Satwinder Singh	Sr. Technician (Lab. Technician)
Sh. Sarup Singh	Sr. Technician (Lab. Technician)

Supporting

Name	Designation
Sh. Sukhbir	Skilled Support Staff
Sh. Manoj Kumar	Skilled Support Staff

ICAR-CIPHET, Abohar
Scientific

Name	Designation	Discipline
Dr. Rajesh Kumar Vishwakarma	Pr. Scientist	Agricultural Structures & Process Engineering
Dr. Ramesh Kumar	Pr. Scientist	Horticulture
Dr. Sunil Kumar	Sr. Scientist	Biochemistry (Plant Science)
Dr. (Smt.) Prerna Nath	Scientist	Food Technology
Dr. Manoj Kumar Mahawar	Scientist	Agricultural Structures & Process Engineering
Dr. Kale Sakharam Jagan	Scientist	Agricultural Structures & Environmental Management
Dr. (Smt.) Jalgaonkar Kirti Ramesh	Scientist	Agricultural Structures & Process Engineering
Sh. Bibwe Bhushan Ratnakar	Scientist	Agricultural Structures & Process Engineering
D. Dukare Ajinath Shridhar	Scientist	Agricultural Microbiology
Dr. Pankaj Kumar Kannaujia	Scientist	Vegetable Science
Dr. Bhupendra M Ghodki,	Scientist	Agricultural Structures & Process Engineering

Administrative

Name	Designation
Sh. Pawan Kumar	AAO
Sh. Mohan Lal	Assistant
Sh. Sanjay Kumar Gaur	LDC

Technical

Name	Designation
Sh. Prithvi Raj	Sr. Technical Officer (Field Farm.)
Sh. Rajesh Kumar	Sr. Technical Officer (Field Farm.)
Sh. Ganpat Ram	Sr. Technical Assistant (Driver)
Sh. Devinder Kumar	Sr. Technical Assistant (Fitter)
Sh. Dalu Ram	Technical Assistant (Fitter)
Sh. Pawan Kumar	Sr. Technical Assistant (Electrician)
Sh. Hardeep Singh	Technical Assistant (Turner)
Sh. Rajiv Sharma	Sr. Technical Assistant (Lab. Technician)

Supporting

Name	Designation
Sh. Surinder Kumar	Skilled Support Staff

NOTES

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

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