वार्षिक प्रतिवेदन

ANNUAL REPORT

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भाकृअनुप-केन्द्रीय कटाई-उपरांत अभियांत्रिकी एवं प्रौद्योगिकी संस्थान,
लुधियाना (पंजाब)

ICAR-Central Institute of Post-Harvest Engineering & Technology,
Ludhiana (Punjab)
(An ISO 9001:2008 Certified Institute)

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PREFACE

I feel myself fortunate for being closely associated with ICAR-CIPHET for more than fifteen years. Close personal ties have been established during these years which have led to the co-operation in many important tasks and to the development of ideas and techniques for further research. It would be an understatement, if I say that I am happy to witness the growth of the institute during these years. ICAR-CIPHET observed a year full of celebration and events for completing 25 glorious years of post harvest research and extension activities.

It's my privilege and honour to place before you the Annual Report (2014-15) for Silver Jubilee Year of ICAR-CIPHET. The institute continues its efforts to bring evergreen revolution in food processing and value addition for sustainable food security and reduction in post harvest losses in the country. During the reported year, the institute has developed various machines, process technologies, value added products to enhance the productivity and profitability, resource use efficiency and environmental sustainability.

ICAR-CIPHET is a pioneer organization mandated to undertake lead researches in the area of post-harvest engineering and technology appropriate to agricultural production catchment and agro-industries. Being a nodal institute in the field of post-harvest processing, ICAR-CIPHET has developed a national database on post-harvest machinery/ equipment which is available on the institute website and can be continually updated. The institute has widened the horizons of research varying from development of processing machines such as potato peeling machine, taro peeler etc. to electronic gadgets for quality evaluation and maintenance *viz*. RFID system, impedance analyzer for detection of fish freshness and live fish carrier system. Apart from developing mechanical tools, we are also striving hard in the direction of providing biological tools for processing and value addition to agro-produce. During the year, five putative probiotic cultures have been isolated, characterized, submitted and registered with national depositories namely ICAR-NBAIM, Mau and CSIR-IMTECH, Chandigarh. We are constantly working towards development of health foods including pasta fortified with groundnut meal and beetroot juice, buckwheat based extrudates, pearled amaranth flour based muffins, peanut protein isolate from commercial groundnut cake, hydrolyzed peanut protein, extraction of bioactive compounds etc. A number of process protocols for value addition and quality evaluation have also been developed during this period.

The research outcomes were actively disseminated in the form of technology licensing and its commercialization to various end users. During the reported year, a total of 16 licenses based on technologies *viz*. groundnut flavoured beverage, curd and paneer, pearl millet based composite extrudates and pasta, *makhana kheer* mix, evaporatively cooled storage structure, minimal processing of vegetables and low fat meat emulsion were licensed to different entrepreneurs which includes progressive farmers from all over the country. During 2014-15, 6 trainings for Agricultural Officers, 3 for farmers and 7 for students were conducted. ICAR-CIPHET participated in various exhibitions across the country and demonstrated its

technologies to the various stakeholders like farmers, entrepreneurs and researchers. Besides, institute technologies were also showcased through news clippings, extension bulletins, radio programmes etc. Various national and international prestigious awards were also bagged by the scientists of ICAR-CIPHET.

The AICRP on Post-Harvest Technology (PHT) developed various machines, products and process protocols such as power operated turmeric slicer, power operated Mahua stamen remover, ozone based storage structure for managing insects in grains, fly ash based organic pesticides for effective and safe management of pulse beetle, poultry, rabbit and fish feed based on mango peel, mushroom fortified chapatti. AICRP on PHT also conducted repeat study of post-harvest losses of agricultural commodities sponsored by MOFPI, New Delhi and submitted a report entitled "Assessment of qualitative harvest and post-harvest losses of major crops and commodities in India" in March 2015. The AICRP on Plasticulture Engineering and Technologies (PET) also contributed significantly through development and evaluation of multi-tier multipurpose polyhouse for drying of produce and raising of crop nursery/ small height crops, periphyton production on different types of coloured plastic strips in freshwater ponds for enhanced fish production, evaluation of polyhouse covered fish pond for fish rearing under temperate climatic conditions of Kashmir valley, performance evaluation of plastic mulch in Bt cotton etc.

During the reported year, we were blessed with the visits of many eminent personalities in the area of post harvest processing. We are overwhelmed to receive the encouragement for post-harvest research from Mrs. Harsimrat Kaur Badal, Honorable Minister of Food Processing Industries, Govt. of India, New Delhi during her visit in July 2014. I take this opportunity to place on record my sincere thanks and gratitude to Dr. S Ayyappan, Hon'ble Director General, ICAR and Secretary, DARE, Govt. of India, Dr. K Alagusundaram, DDG (Agril. Engg.) for their visits to the institute. The continued guidance, encouragement and support extended by them in executing the mandate of ICAR-CIPHET is duly acknowledged. I also acknowledge the guidance and cooperation by Dr Kanchan K Singh, ADG (Farm Engg.) and Dr KK Singh, Ex-ADG (PE), ICAR New Delhi. I thank Dr PC Sharma, Head (HCP Division), Dr SK Nanda, I/C Head (TOT Division) and I/C Project Coordinator (PET), Dr SN Jha, I/C Project Coordinator (PHT) and Dr SK Tyagi, FG&OP Division for their constant support.

The meticulous and untiring efforts of Dr. Sangita Bansal, Dr. Indu Rawat and Ms Monika Sharma in bringing out this report in its present form are commendable. Officers-in-charge, all the scientists especially Ms. Leena Kumari, Ms. Monika, Er. Kirti Ramesh Jalgaonkar and Er. Arun TV, technical, administrative, audit, and supporting staff of the institute are duly acknowledged for their teamwork, efficiency and dedication towards research as well as other assigned activities.

R. K. Gupta
Director

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कार्यकारी सारांश

भा.कृ.अनु.प.-सीफेट, लुधियाना; कटाई उपरांत अभियांत्रिकी तथा तकनीक के क्षेत्र में अग्रणी संस्थान है, जिसका आधिकारिक उद्देश्य कृषि उत्पादन तथा कृषि प्रसंस्करण उद्योग की आवश्यकताओं को ध्यान में रखते हुए अनुसंधान करना है। संस्थान द्वारा वर्ष 2014-15 में अनुसंधान, प्रसार तथा अन्य संबंधित क्षेत्रों में प्राप्त की गई उल्लेखनीय उपलब्धियाँ निम्नवर्णित हैं:

संस्थान में आलू का छिलका उतारने वाली मशीन को विकास एवं सुधार के द्वारा उत्तम बनाया गया, जिसकी क्षमता 400 कि.ग्रा./घंटा तथा छिलका उतारने की दक्षता 95 प्रतिशत है। अरबी (कचालू) का छिलका उतारना एक कठिन प्रक्रिया है, जिसे आसान बनाने के लिए छिलका उतारने वाली मशीन का प्रारुप तैयार कर मशीन को बनाया गया। इस मशीन की क्षमता 200-250 कि.ग्रा./घंटा तथा छिलका उतारने के लिए दक्षता 95-97 प्रतिशत पाई गई है। जीवित मछलियों के सुरक्षित परिवहन के लिए 110 लीटर की क्षमता वाले परिवहन वाहक को विकसित किया गया। इस वाहक में वायु संचरण के लिए उचित प्रबंध है, जिसमें मछलियों को घनत्व 1:5 (मछली संख्याः पानी की मात्रा लीटर में) के अनुपात में रखा जा सकता है। घुली हुई ऑक्सीजन 4-6 मि.ग्रा./ली., 30 प्रतिशत जल परिवर्तन, ए.सी./डी.सी. वायु प्रवाहक द्वारा लगातार वायु का प्रवाह तथा परीक्षण के द्वारा 24 घंटे के संग्रहण पश्चात 70-80 प्रतिशत मछलियों में उत्तरजीविता पाई गई। पशुओं को उठाने के लिए लिफ्टर के प्रारुप का विकास किया गया, जो कि 1000 कि.ग्रा. तक भार वहन कर सकता है। इसका परीक्षण बीमार गायों को उठाने में किया गया।

मूँगफली की खली से प्रोटीन आइसोलेटों (95.01.5 प्रतिशत प्रोटीन) को विलग करने की प्रक्रिया के मापदण्डों को ओप्टीमाईज़ किया गया (संबंधित प्रक्रिया के लिए खली तथा पानी को 1:10 के अनुपात में मिलाकर पी.एच. स्तर 9.5 पर 2 घंटे तक हिलाया गया व तत्पश्चात इसे छान कर अपकेन्द्रण द्वारा प्रोटीन के अवक्षेप पी.एच. स्तर 4.5 पर प्राप्त किए गए) अजलीय अपघटन द्वारा प्राप्त प्रोटीन अवक्षेपों की जल संग्रहण, तेल बंधनीय तथा झाग बनने की क्षमता 1.12$\pm$0.15, 1.84$\pm$0.17 व 1.1$\pm$0.16 मि.ली./ग्रा. पाई गई तथा एस्परजिलस ओराइज़ा निष्कर्षित क्रूड प्रोटीन रस द्वारा जल अपघटन करने पर इन क्षमताओं में क्रमशः 1.55$\pm$0.02, 2.97$\pm$0.07 एवं 1.35$\pm$0.02 की वृद्धि हुई।

मूँगफली के आटे तथा चुकंदर के रस द्वारा अच्छी संवेदी स्वीकार्यता वाला पोषक पास्ता तैयार किया गया। पास्ता तैयार करने के लिए 80.67 प्रतिशत परिशोधित गेहूँ का आटा, 19.33 प्रतिशत मूँगफली का आटा तथा 17.4 मि.ली./100 ग्रा. चुकंदर रस का इस्तेमाल किया गया एवं इसकी समग्र वांछनीयता 0.905 पाई गई। तैयार पास्ता नमूनों में 19.56 प्रतिशत प्रोटीन, 23.95 (एंटी-आक्सीडेन्ट) ऑक्सीकरण रोधी सक्रियता, तथा 125.89 मि.ली./100 ग्रा. समग्र फीनोल प्राप्त हुए। सब्जी मिश्रित बड़ी (वड़ी) तैयार करने के लिए, बड़ी के लिए तैयार आटे में पालक के बारीक कटे हुए टुकड़ो का इस्तेमाल 10, 20, 30 तथा 40 प्रतिशत के स्तर पर किया गया। बड़ी (वड़ी) के नमूनों का भौतिक, पौषणिक एवं संवेदी गुणों के लिए विश्लेषण किया गया। पालक मिलाने के बढ़ते स्तर के साथ बड़ी के व्यास में वृद्धि, ऊँचाई में कमी तथा स्थूल तथा यथार्थ घनत्व में कमी दर्ज की गई एवं बड़ी के रंग पर भी असर देखा गया। कुटू (बकव्हीट) के आटे को गेहूँ के आटे तथा गाजर के रस के साथ मिलाकर बहिर्वधन द्वारा तैयार खाद्य पदार्थों में 306.748 मि.ली./ 100 ग्रा. समग्र फीनोल, 18.146 प्रतिशत ऑक्सीकरण रोधी सक्रियता, पकाने का समय 4.21 मिनट, पुनः जलमिश्रण (रिहाईड्रेशन) अनुपात 3.69 तथा ठोस पदार्थ हानि 3.32 प्रतिशत पाई गई। चौलाई के दानों से प्राप्त आटे का 0, 20, 40, 60, 80 तथा 100 प्रतिशत के स्तर पर इस्तेमाल कर मफिन बनाए गए। 100 प्रतिशत गेहूँ के आटे का इस्तेमाल नियंत्रित नमूने के तौर पर किया गया। 20 प्रतिशत से अधिक मात्रा में मिलाए गए चौलाई से तैयार नमूनों में नियंत्रित नमूनों की तुलना में प्रोटीन की अधिकता पाई गई। संवेदी विश्लेषण के आधार पर 20 प्रतिशत तथा 30 प्रतिशत मात्रा मिलाने पर मफिन नमूनों को अत्यधिक स्वीकार्य पाया गया। बाजरे में पाई जाने वाली स्टार्च को ऊष्मा व नमी से उपचारित कर परिवर्तित किया गया, जिससे उसके क्रियात्मक गुणों में वृद्धि हुई। ऊष्मा व तापमान से उपचारित करने पर प्रतिरोधी स्टार्च अंश बेहतर हुआ तथा इससे परवर्तित स्टार्च में डैक्सट्रोज़ ईक्वीवेलेंट (डी.ई.) की मात्रा (3.97-8.37) कम हुई। इन नमूनों में डी.ई. की मात्रा 10 से नीचे होना यह इंगित करता है कि इन नमूनों को वसा विस्थापक के तौर पर इस्तेमाल किया जा सकता है। परिवर्तित स्टार्च जैल में लचीले तथा सख्त पदार्थों का संतुलित अनुपात होने के कारण समांगी विरूपण, फैलाव व मृदुता देखी गई। बाजरे द्वारा प्राप्त स्टार्च ऑक्टीनाईल सक्सीनिक एनहाइड्राईड (ओ.एस.ए.) का प्रयोग कर तथा 2, 3, 4, 5 घंटे के विविध ऊष्मायन समय द्वारा तैयार स्टार्च नमूनों में अधिकतम श्यानता (विस्कोसिटी) में 4757 से 5409 सी.पी. तक की भिन्नता देखने को मिली। गाढ़ा घोल बनाने (पेस्टिंग) का तापमान 67.8 से 76.3 डिग्री सेल्सियस तक दर्ज किया गया। प्रतिस्थापन की सीमा 0.018 से 0.0216 तथा तेल अवशोषण की क्षमता 2.37 से 2.66 ग्रा./ग्रा. पाई गई। बाजरे द्वारा प्राप्त स्टार्च में रासायनिक परिवर्तन करने पर प्रतिरोधी स्टार्च अंश की मात्रा में बढ़ोत्तरी हुई। ओ.एस.ए. द्वारा तैयार बाजरा के स्टार्च (डी.एस. 0.02) की रियोलाजिकल तथा पेस्टिंग संबधी विशेषताओं से पता चला कि इसे कार्बोहाइड्रेट आधारित वसा विस्थापक के तौर पर प्रयोग किया जा सकता है। मिलावटी दूध की जाँच करने के लिए एफ.टी.आई.आर. द्वारा प्राप्त स्पेक्ट्रम ने शुद्ध दूध तथा डिटर्जेंट मिले हुए मिलावटी दूध का 1600-995 से.मी. तथा 3040-2851 से.मी. तरंग क्षेत्र में स्पष्ट रूप से अंतर परिभाषित किया। प्राप्त स्पेक्ट्रम ने शुद्ध दूध तथा विभिन्न मात्रा में मिलाए गए सोयाबीन तेल, चीनी तथा लैक्टोज द्वारा तैयार मिलावटी दूध की अवशोषक मात्रा (एबज़ोर्बेंनस) में स्पष्ट अंतर देखा गया। भंडारण के दौरान खाद्य पदार्थो के वातावरणीय कारकों की निगरानी के लिए आर.एफ. आई. डी. यंत्र का निर्माण किया गया। सुपरक्रिटिकल व कार्बन डाई आक्साइड निष्कर्षण तथा सॉक्सेलट विधियों द्वारा कुसुम के बीजों से प्राप्त होने वाले तेल का विभिन्न गुणों के लिए तुलनात्मक अध्ययन किया गया। सुपरक्रिटिकल निष्कर्षण विधि द्वारा प्राप्त तेल में अम्लता की मात्रा दूसरी विधि से प्राप्त तेल की तुलना में पांच गुणा कम पाई गई।

लिमोनेट डी. रिंग. लैक्टोन हाइड्रोलेस (एल.डी.एल.एच.) नामक एंजाइम के निष्कर्षण तथा शुद्धिकरण के लिए प्रक्रिया प्रोटोकल को अनुकूलित (ऑप्टिमाइज) किया गया। सूक्ष्म तरंगों का इस्तेमाल कर किन्नू फल के छिलकों से पेक्टीन निष्कर्षण की प्रक्रिया प्रोटोकाल का विकास किया गया। सूक्ष्म तरंगों से संयोजित निष्कर्षण द्वारा तथा 60 मिनट तक ऊष्मायन करने के पश्चात् पेक्टीन की प्राप्ति मात्रा तथा दृश्यता अच्छी रही। प्रतिरोधी अध्ययन से पता चला कि ग्लिसरोल तथा आइनोसिटोल जैसे प्रतिरोधियों का 1.1 की दर से इस्तेमाल करने पर पी.एल.डी. एंजाइम की सक्रियता रोकी जा सकती है, जिससे लीची के गूदे को

भूरा होने से बचाया जा सकता है। स्ट्राबेरी की एक्टिव पैकिंग का अध्ययन करने के लिए विभिन्न गैस मिश्रणों (5 प्रतिशत ऑक्सीजन + 15 प्रतिशत कार्बन डाई आक्साइड + 80 प्रतिशत नाइट्रोजन, 11 प्रतिशत ऑक्सीजन + 10 प्रतिशत कार्बन डाई ऑक्साइड + 79 प्रतिशत नाइट्रोजन तथा 5 प्रतिशत ऑक्सीजन + 5 प्रतिशत कार्बन डाई ऑक्साइड + 90 प्रतिशत नाइट्रोजन) का इस्तेमाल किया गया। इससे 5 डिग्री सेल्सियस तापमान पर स्ट्राबेरी की इस्तेमाल करने लायक सुरक्षित अवधि (शेल्फ लाइफ) 9-12 दिन तक बढ़ी तथा 10 डिग्री सेल्सियस तापमान पर यह 6-9 दिन तक पाई गई। गैस मिश्रण 5 प्रतिशत ऑक्सीजन + 5 प्रतिशत कार्बन डाई ऑक्साइड + 90 प्रतिशत नाइट्रोजन वाले एक्टिव पैकेज में 3.54 प्रतिशत तक भार हानि पाई गई तथा अन्य गुणों टी.एस.एस., टी.ए. (समस्त अम्लता), रंग तथा दृढ़ता में बारहवें दिन तक कोई विशेष अंतर नहीं पाया गया। सभी भौतिक-रासायनिक मापदण्डों, सूक्ष्मजैविक परिणामों तथा समग्र संवेदी प्राप्तांकों के आधार पर यह पाया गया कि स्ट्राबेरी की उच्च प्रतिरोधी एल्यूमीनियम लैमिनेट में एक्टिव पैकेजिंग के लिए 5 प्रतिशत आक्सीजन + 15 प्रतिशत कार्बन डाई आक्साइड मिश्रण तथा कैल्शियम हाइड्रोक्साइड (15 ग्रा.) का प्रयोग सबसे प्रभावी है, जिस से 10 डिग्री सेल्सियस तापमान पर सुरक्षित अवधि 12 दिनों तक पाई गई। पाँच प्यूटेटिव प्रोबायोटिक कल्चर्स (एंटेरोकोकस फेसियम बी.बी.ई 3, स्ट्रेप्टोकोकस इनफैन्टेरियस बी.बी.ई 2, लैक्टोबेसिलस फरमैन्टम बी.बी.ई 4, लैक्टोबेसिलस प्लेन्टेरम बी.बी.ई 7 तथा लैक्टोबेसिलस फरमैन्टम बी.बी.ई 6) को आई.एम.टी.ई. सी.एच. (इमटेक)- चण्डीगढ़ तथा भा.कृ.अनु.प.-एन.बी.ए.आई.एम., मऊ (उत्तर प्रदेश) में जमा कर पंजीकृत किया गया। संदूषित नमूनों में ऐफ्लाटॉक्सीजेनिक फंफूद का पता करने के लिए प्रक्रिया प्रोटोकाल की प्रामाणिकता जाँची गई। वी.बी. एस.जीन के लिए अनुमानित 459bp आकार का एकल संवर्धित बैंड संदूषित नमूनों में देखा गया। कटाई उपरांत इस्तेमाल होने वाली मशीनों तथा उपकरणों के लिए माई एस.क्यू.एल. संरूप का प्रयोग कर राष्ट्रीय स्तर पर डाटाबेस का निर्माण किया गया। यह डाटाबेस संस्थान (सीफेट) की वेबसाईट पर उपलब्ध है। ए.आइ.सी.आर.पी. (पी.एच. टी.) के अंतर्गत कई मशीनों, उत्पादों तथा प्रक्रिया प्रोटोकॉल जैसे कि बिजली चालित हल्दी स्लाइसर (क्षमता कि.ग्रा./घंटा) ऊर्जा चालित महुआ से पुंकेसर हटाने वाली मशीन, नारियल का छिलका उतारने के लिए मशीन, अखरोट का छिलका उतारने के लिए संवहन योग्य मशीन, अनाजों में कीट प्रबंधन तथा दाल में पाए जाने वाले कीट भृंग (बीटल) के प्रभावी तथा सुरक्षित प्रबंधन के लिए ओजोन आधारित संचरण गृह, फ्लाई ऐश आधारित जैविक कीटनाशी, छेना पेडा के सरंक्षण के लिए रिटोर्टेबल पाऊच तकनीक, आम छिलकों का इस्तेमाल कर पशुओं (कुक्कुट, खरगोश तथा मछली) के लिए खाद्य पदार्थों का निर्माण, मशीन विजन (दृश्यता) तकनीक द्वारा आम के आंतरिक तथा बाहरी गुणों के आधार पर वर्गीकरण के लिए ऑनलाइन वर्गीकरण तंत्र (व्यवस्था), मशरूम (खुम्बी) द्वारा फोर्टिफाइड चपाती निर्माण, नारियल के दूध अवशेष तथा नारियल तेल (वर्जिन) बनाने से प्राप्त खली द्वारा स्वास्थ्यवर्धक खाद्य पदार्थ, पोर्सिन ब्लड प्लाजमा के संयोजन द्वारा तैयार शुकर गोश्त सॉसेज का निर्माण किया गया।

ए.आई.सी.आर.पी-प्लास्टीकल्चर आभियांत्रिकी एवं तकनीकी (पी.इ.टी.) की कुछ प्रमुख उपलब्धियों में शामिल हैं; बहुश्रेणी तथा विविध उद्देश्यों (जैसे उत्पादों को सुखाना, फसलों के लिए पौध (नर्सरी) तैयार करने, कम ऊँचाई वाली फसलों को उगाने) के लिए पॉली हाउस, ताजे पानी वाले तालाबों में मछलियों का उत्पादन बढ़ाने के लिए विभिन्न रंगीन प्लास्टिक पट्टियों पर पेरीफाईटोन का उत्पादन, ड्रिप सिंचाई तथा मल्चिंग द्वारा उगाए गए टमाटरों की जल प्रयोग क्षमता का अध्ययन, भूमिगत तापमान विनियामक (अर्थ हीट एक्सचेंजर) आधारित गरम तथा ठंडा होने वाले पॉली हाउस की संभावना तथा आर्थिक अन्वेषण, कश्मीर घाटी की समशीतोष्ण जलवायु में पॉली हाउस द्वारा आच्छादित मछली पालन के लिए प्रयोग होने वाले तालाबों का अन्वेषण, भूमिगत वायु पाइप व्यवस्था पर आधरित कृषि संबधी ग्रीनहाऊसों के तापन तथा शीतलन संबधी अध्ययन, बी. टी. कपास (काटन) में प्लास्टिक मल्च की प्रर्दशन क्षमता का अन्वेषण आदि।

वर्ष 2014-15 में संस्थान ने कृषि अधिकारियों के लिए 6 प्रशिक्षण कार्यक्रमों, कृषकों (किसानों) के लिए 3 प्रशिक्षण कार्यक्रमों, विद्यार्थियों के लिए 7 प्रशिक्षण कार्यक्रमों तथा विद्यार्थी जागरूकता कार्यक्रम जैसे- राष्ट्रीय विज्ञान दिवस का आयोजन किया। संस्थान में 19-20 दिसंबर 2014 को "कृषि संबंधी उत्पादों के प्रसंस्करण तथा मूल्यवर्धित उत्पाद बनाने के लिए वर्तमान परिदृश्य तथा भविष्य की योजनाऐं" विषय पर राष्ट्रीय संगोष्ठी का आयोजन किया गया। यह आयोजन संस्थान के रजत जंयती वर्ष की महत्वपूर्ण उपलब्धि है। खाद्य प्रसंस्करण उद्योग मंत्रालय, दिल्ली द्वारा आर्थिक सहयोग प्राप्त इस संगोष्ठी का मुख्य उद्देश्य खाद्य प्रसंस्करण क्षेत्र के विभिन्न साझेदारो (कृषकों, व्यवसायिकों आदि) की उम्मीदों को अनुसंधान तथा नवीन तकनीकों के विकास द्वारा पूरा करने की संभावनाओं का पता लगाना था। इसके अतिरिक्त संस्थान ने देश के विभिन्न क्षेत्रों जैसे पंजाब, हिमाचल प्रदेश, हरियाणा, बिहार तथा नई दिल्ली में होने वाली प्रदर्शनियों में भी भाग लिया। प्रदर्शनियों में संस्थान द्वारा विकसित तकनीकों को विभिन्न किसानों, उद्यमियों तथा शोधार्थियों आदि को दिखाया गया। संस्थान ने लघु समाचारों, पाँच प्रसारित बुलेटिनों, मूँगफली पर आधारित सफलता कहानी तथा रेडियों कार्यक्रमों आदि के द्वारा भी तकनीकों का प्रचार एवं प्रसार किया। इस समयावधि के दौरान प्रकाशित समाचारों में तकनीक हस्तांतरण संबंधी कार्यक्रमों, प्रशिक्षण कार्यक्रमों, संस्थान की गतिविधियों, नई तकनीकों पर सफलता की कहानियों, प्रगतिशील किसानों आदि के बारे में उल्लेख किया गया। अनुसंधान के परिणामों को तकनीकों के रूप में वाणिज्यीकरण तथा लाईसेसिंग द्वारा प्रयोगकर्ताओं तक प्रसारित किया गया। प्रतिवेदित समयावधि के दौरान 16 तकनीकों के लाइसेंस देश के अलग-अलग क्षेत्रों के विभिन्न उद्यमियों को दिए गए, जिनमें से प्रमुख हैः मूँगफली आधारित पेय पदार्थ दही तथा पनीर, बाजरे के आटे से बर्हिवेधन द्वारा तैयार मिश्रित खाद्य पदार्थ तथा पास्ता, मखाना खीर मिश्रण, सीफेट इवोपरेटिव कूलिंग पर आधारित भण्डार गृह, सब्जियों का निम्नतम प्रसंस्करण तथा कम वसा वाले माँस इमल्शन। भा.कृ.अनु.प. -सीफेट संस्थान के वैज्ञानिकों को कई सम्मानीय राष्ट्रीय तथा अंतर्राष्ट्रीय पुरस्कार प्राप्त हुए। जिनमें से उल्लेखनीय हैः सामाजिक नवोत्पाद पुरस्कार, आई.सी.ए.आर अंतर्राष्ट्रीय फेलोशिप 2014-15 (पी.एच.डी. हेतु), भा.कृ.अनु.प.-राष्ट्रीय सदस्यता (फेलो) पुरस्कार, आई.एस.ए.ई. फेलो पुरस्कार आदि।

कई प्रतिष्ठित हस्तियों श्रीमती हरसिमरत कौर बादल, (माननीय मंत्री महोदया, खाद्य प्रसंस्करण उद्योग मंत्रालय) भारत सरकार, नई दिल्ली; डॉ. एस. अयप्पन, माननीय महानिदेशक, आई.सी.ए.आर तथा सचिव डी.ए.आर.ई., भारत सरकार; डॉ के. अलगुसुदंरमू, डी.डी.जी. (कृषि अभियांत्रिकी); डॉ. गुरबचन सिंह, अध्यक्ष, ए.एस.आर.बी.; डॉ. केविन डी. गेलागहर, पी.एच.डी. तथा एफ.ए.ओ के भारत में प्रतिनिधि; प्रो. भेष भंडारी, क्वींसलैंड विश्वविद्यालय, आस्ट्रेलिया, डॉ. अनवर आलम, पूर्व कुलपति, एस.के.यू.ऐ.एस.टी., श्रीनगर; डॉ. गजेन्द्र सिंह, पूर्व डी.डी. जी.(कृषि अभियांत्रिकी), डॉ. नवाब अली, पूर्व डी.डी.जी. (कृषि अभियांत्रिकी), डॉ. एस.एम. इलियास, पूर्व निदेशक, सीफेट तथा प्रोजेक्ट निदेशक, एन.आई.आर.डी., हैदराबाद; डॉ बी.एस. बिष्ट, पूर्व कुलपति, जी.बी.पी.यू.ए.टी. पंतनगर, पूर्व ए.डी. जी., आई.सी.ए.आर. नई दिल्ली तथा निदेशक, बिड़ला अनुप्रयुक्त विज्ञान संस्थान, भीमताल, डॉ. आर.टी. पाटिल, पूर्व निदेशक, सीफेट ने गत वर्ष विभिन्न अवसरों पर संस्थान का दौरा किया।

EXECUTIVE SUMMARY

ICAR-CIPHET is a pioneer organization mandated to undertake lead research in the area of post-harvest engineering and technology appropriate to agricultural production catchment and agro-processing industries. The highlights of the research, extension and other accomplishments of the institute for the year 2014-15 are presented below.

Potato peeling machine with 400 kg/h capacity and 95% peeling efficiency was developed, refined and perfected. Taro peeler with 200-250 kg/h capacity and peeling efficiency of 95-97% was designed and developed. The live fish carrier system of 110 litres capacity was developed having an aeration system with fish density of 1:5 (no. of fish: litre of water), container capacity 100 litre, dissolved oxygen 4-6 mg/litre, 30% water exchange and continual aeration by AC/DC aerator and 70-80% fish survival was achieved in 24 hours of storage time. The animal lifter was designed and developed to lift animal up to 1000 kg weight and was tested for lifting sick cows.

Process parameters for preparation of protein isolate (95.0±1.5% protein) from commercial groundnut cake was optimized (with cake: water ratio of 1:10, shaking time 2h at pH 9.5 followed by filtration, centrifugation and protein precipitation at pH 4.5). The water holding, oil binding and foaming capacity of non-hydrolyzed protein isolate were 1.12 ± 0.15, 1.84 ± 0.17 and 1.1 ± 0.16 ml/g, which significantly increased to 1.55 ± 0.02, 2.97 ± 0.07 and 1.35 ± 0.02 ml/g, respectively after hydrolysis with crude protease extract from *Aspergillus oryzae*.

The groundnut meal and beetroot juice incorporated nutritious pasta with good sensory acceptability was developed using 80.67% refined wheat flour, 19.33% groundnut meal and 17.4ml/100g pasta formulation beetroot juice with overall desirability as 0.905. This pasta sample provided 19.56% protein content, 23.95% antioxidant activity and 125.89mg/100g total phenols. Vegetable mix wadi was prepared by incorporating spinach shreds at levels of 10, 20, 30 and 40% in the wadi dough and the wadi samples were analyzed for physical, nutritional and sensory attributes. With increasing level of incorporation of spinach (shreds) the diameter of wadi increased, whereas the height decreased; the bulk and true density both decreased and the colour of the wadi was also affected. Extrudates developed using buckwheat, wheat flour and carrot juice had 306.75 mg/100g total phenols, 18.15% antioxidant activity, 4.21 min cooking time, 3.69 rehydration ratio and 3.32% solid loss. Muffins were developed using flour of pearled amaranth grain at 0, 20, 40, 60, 80 and 100% level. 100% wheat flour was kept as control. Protein content increased above the control sample in the muffins with >20% level of amaranth flour. Based on sensory analysis 20% and 30% incorporation was found to be highly acceptable.

Pearl millet starch was modified by heat moisture treatment to improve the functional properties. HMT improved the resistant starch content and leads to development of low DE (3.97-8.37) modified starch. It indicates that these samples can be utilized as fat replacers as the DE value is below 10. Modified starch gels exhibited the phenomenon of homogeneous deformation, spreadability and gel softness, owing to balanced ratio of elastic and viscous portion. Pearl millet starch was also chemically modified using octenyl succinic anhydride (OSA) with variable incubation time of 2, 3, 4 and 5 hours. The peak viscosity varied from 4757 to 5409 cP for the OSA starch samples. Pasting temperature varied from 67.8 to 76.3°C. The

degree of substitution varied from 0.018 to 0.0216. Oil absorption capacity ranged from 2.37 to 2.66 g/g. Chemical modification also increased the resistant starch content of pearl millet starch. Rheological and pasting characteristics of OSA-pearl millet starch (DS 0.02) showed that it can be used as carbohydrate based fat replacer.

The FTIR spectra of pure (PM) and adulterated milk (0.2-2.0%) samples with detergent revealed clear differences in regions from 1600-995 cm^{-1} and 3040-2851 cm^{-1}. Spectra revealed clear differences in the absorbance values of PM and milk samples supplemented with different levels of soybean oil, common sugar and lactose. RFID system integrated with sensors has been developed at ICAR-CIPET which monitors the environmental conditions of food products during storage. Properties of safflower seed oil obtained using supercritical CO_2 extractor were compared with that obtained by Soxhlet method. Acid value was approximately five times lower for the oil extracted using supercritical CO_2.

\ The process protocol for extraction and purification of limonoate-D-ring-lactone hydrolase enzyme (LDLH) from kinnow seeds was optimized. A process protocol for pectin extraction from kinnow peel/residue using microwave energy was developed. The yield and appearance of pectin were good at 60 min of incubation time during microwave assisted extraction. *In vitro* inhibitor studies have revealed that inhibitors like glycerol and inositol @ 1% were able to inhibit the PLD enzyme activity resulting in controlling litchi pericarp browning. Study on active packaging of strawberry was carried out with various gas combinations i.e. 5% O_2 + 15% CO_2 + 80% N_2 and 11% O_2 + 10% CO_2 + 79% N_2 and 5% O_2 + 5% CO_2 + 90% N_2. All the combinations used in the study, showed a shelf life of 9-12 days at 5°C whereas, it was 6-9 days at 10°C. Active package with gas ratio of 5% O_2 + 5% CO_2 + 90% N_2 showed weight loss of 3.54% and TSS, TA, colour and firmness values were maintained without significant difference up to 12th day. Based on all physico-chemical parameters, microbiological results and overall sensory scores it was observed that, 5% O_2 and 15% CO_2 gas combination was most suitable for strawberry in active package of high barrier aluminium laminates using calcium hydroxide (15g) for maintaining shelf life up to 12 days at 10°C of storage.

Five putative probiotic cultures (*Enterococcus faecium* BBE3, *Lactobacillus fermentum* BBE4 and *Lactobacillus plantarum* BBE 7, *Streptococcus infantarius* BBE2 and *Lactobacillus fermentum* BBE6) were submitted and registered to MTCC, CSIR-IMTECH, Chandigarh and ICAR-NBAIM, Mau. Process protocol of detection of aflatoxigenic fungi in infected samples was validated. A single amplification product of expected size *viz.* 459 bp for vbs gene was observed in all the infected samples.

The National database on post harvest machinery/equipment was developed using mySQL format. This database has been uploaded on ICAR-CIPHET website.

The AICRP on Post-Harvest Technology (PHT) developed various machines, products and process protocols such as power operated turmeric slicer (capacity-250 kg/h), power operated Mahua stamen remover, coconut de-shelling machine, portable walnut dehuller, ozone based storage structure for managing insects in grains, fly ash based organic pesticides for effective and safe management of pulse beetle, low cost retortable pouch technology for preservation of Chhena poda, poultry, rabbit and fish feed based on mango peel, on-line grading system based on internal and external qualities of mango using machine vision technology, mushroom fortified chapatti, health foods from coconut milk residue and virgin coconut oil cake, pork sausage with porcine blood plasma.

The achievements of AICRP on Plasticulture Engineering and Technology (PET) included development and evaluation of multi-tier multipurpose polyhouse for drying of produce and raising of crop nursery / small height crops, periphyton production on different types of coloured plastic strips in freshwater ponds for enhanced fish production, studies on water use efficiency of tomato under drip irrigation and mulching, feasibility and economic evaluation of heating and cooling of polyhouse using earth air heat exchange, evaluation of polyhouse covered fish pond for fish rearing under temperate climatic conditions of Kashmir valley, performance evaluation of plastic mulch in Bt cotton etc.

During 2014-15, ICAR-CIPHET has conducted six agricultural officers' trainings, three farmers' training, seven students' trainings and students' awareness programme e.g. National Science Day. ICAR-CIPHET, Ludhiana organized a National Seminar on "Present scenario and future strategies for processing and value addition of agricultural commodities" during 19-20 December 2014 as an important activity in the Silver Jubilee Year of the institute. Seminar was sponsored by MoFPI, New Delhi to address the future expectations of stakeholders in food processing sector through research and development innovations. The institute participated in various exhibitions held in different states of the country namely Punjab, Himanchal Pradesh, Haryana, Bihar and New Delhi. Institute technologies were demonstrated to the various stakeholders like farmers, entrepreneurs and researchers. Besides, institute technologies were also showcased through news clippings, five extension bulletins, a success story on groundnut and two radio programmes etc. News-items published during this period included the transfer of technology events, training programmes, institute activities, success stories of new technologies, innovative farmers etc. The research outcomes were disseminated in the form of technology licensing and commercialization to various end users. During the reported year, a total of 16 licenses based on technologies *viz.* groundnut flavoured beverage, curd and *paneer*, pearl millet based composite extrudates and pasta, makhana kheer mix, CIPHET evaporatively cooled storage structure, minimal processing of vegetables and low fat meat emulsion were licensed to different entrepreneurs all over the country. ICAR-CIPHET scientists bagged various national and international prestigious awards such as Societal Innovation Award, ICAR- International Fellowship 2014-15 to pursue Ph. D., ICAR-National fellow award, ISAE Fellow award etc.

Many eminent personalities *viz.* Mrs. Harsimrat Kaur Badal, Honorable Minister of Food Processing Industries, Govt. of India, Dr. S Ayyappan, Hon'ble Director General, ICAR and Secretary, DARE, Govt. of India, Dr. K Alagusundaram, DDG (Agril. Engg.) ICAR, Dr. Gurbachan Singh, Hon'ble Chairman, ASRB, Dr. Kevin D Gallagher, Ph.D & FAO Representative India, Prof. Bhesh Bhandari, University of Queensland, Queensland, Australia, Dr. Anwar Alam, Ex-VC, SKUAST, Srinagar, Dr. Gajender Singh, Ex-DDG (Engg.), Dr. Nawab Ali, Ex-DDG (Engg), Dr. SM Ilyas, Ex-Director, CIPHET and Project Director NIRD, Hyderabad, Dr. BS Bisht, Former Vice- Chancellor, GBPUA&T Pantnagar, Former ADG, ICAR, New Delhi and Director, Birla Institute of Applied Sciences, Bhimtal and Dr. RT Patil Ex-Director, ICAR-CIPHET visited ICAR-CIPHET during the reported year.

ICAR-CIPHET - AN OVERVIEW

The ICAR-Central Institute of Post-Harvest Engineering and Technology (ICAR-CIPHET) was established on 29th December 1989 at Ludhiana, Punjab (India); as a nodal institute to undertake lead researches in the area of post-harvest engineering and technology appropriate to agricultural production catchments and agro-industries. The institute's second campus was established on 19th March 1993 at Abohar, Punjab and is primarily responsible for conducting research and development activities on fruits and vegetables. ICAR-CIPHET is also headquartering two All India Coordinated Research Projects (AICRPs) *viz.* AICRP on Post-Harvest Technology (PHT) with 30 Centers and AICRP on Plasticulture Engineering and Technology (PET) with 11 Centers.

Vision

Higher profitability of agricultural production systems ensuring better income to farmer sand 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

- To undertake basic, applied, strategic and adaptive engineering and technology research in post production sector of produce of plant origin, livestock and aquaculture produce including agricultural structures and environmental control, quality and safety.
- To act as national institute for research, education/teaching and training in post-harvest engineering and technology.
- To act as national repository of information on processes, equipment, products and technologies on post-harvest engineering and technology.
- To transfer technology and provide advisory and consultancy services and promote entrepreneurship.
- To develop and strengthen linkages with the growers/farmers, private and public sector food processing enterprises in the mandated areas.

Research Divisions

Ludhiana Campus

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

Abohar Campus

4. Horticultural Crops Processing

Infrastructure

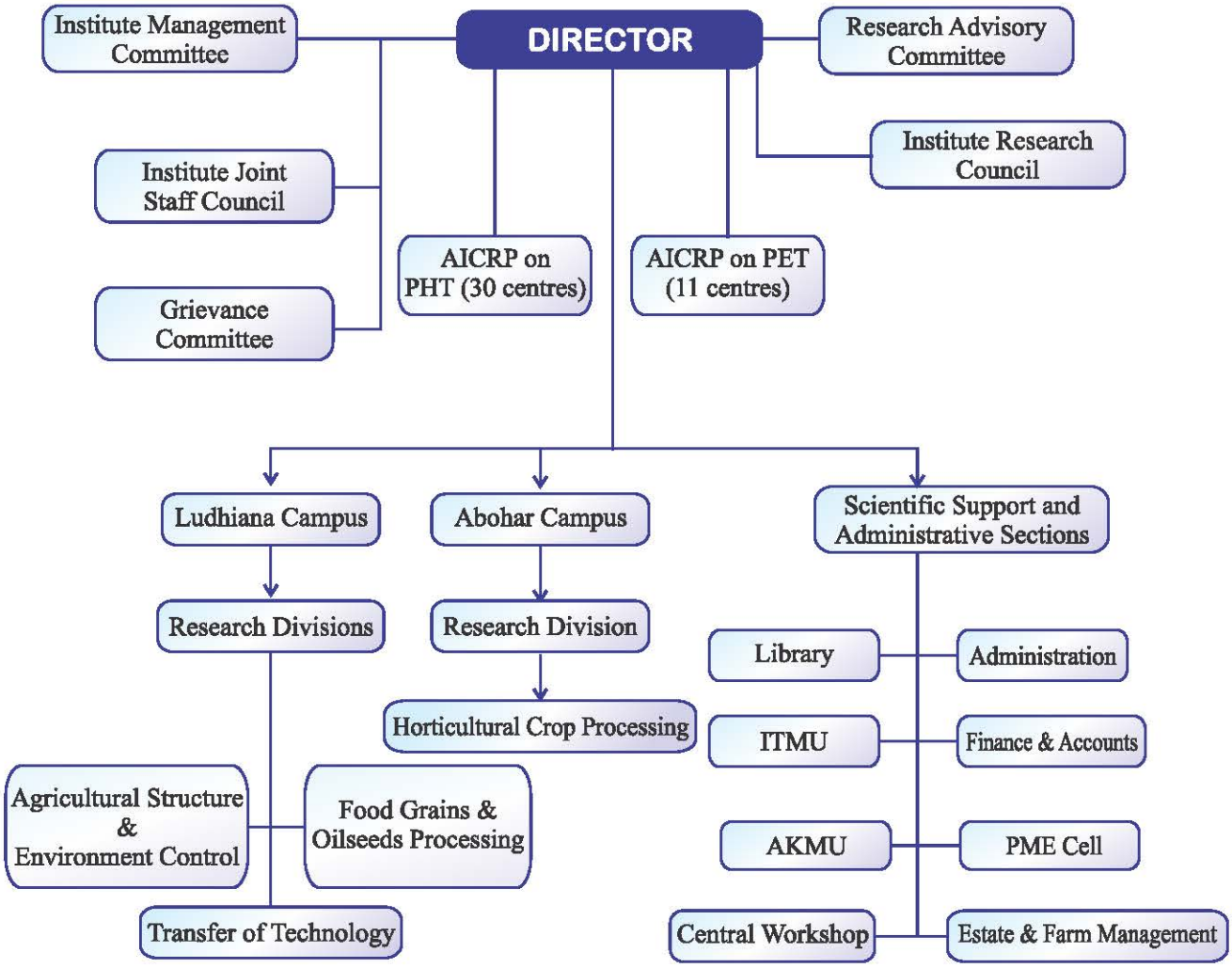
Agro Processing Centre (APC)

Agro-processing center is designed to process the agricultural produce in production catchment with a view to enhance employment and income opportunities in rural areas. At ICAR-CIPHET, Ludhiana modest agro-processing center has been established for processing of bengal gram, green gram, pigeon pea, maize, black pepper, turmeric and coriander. The processed products are being regularly sold to customers in and around the institute. During the reported period, the total purchase of raw materials was worth Rs. 1,62,962/-. The net profit amounts Rs. 61,086 against the sale of processed products like dal, besan, ground spices etc. Besides, the APC facility is also used to impart training to potential small rural entrepreneurs.

Workshop

The workshops at ICAR-CIPHET, Ludhiana and Abhor manage fabrication and modification of post-

ORGANIZATIONAL STRUCTURE



STAFF POSITION (as on 31st March, 2015)

Category	Sanctioned strength	Filled		Total Filled	Vacant
		Ludhiana	Abohar		
Scientific	76*	37	08	45	31
Administrative	21#	16	03	19	03
Technical	29	18	07	25	04
Supporting	04	03	01	04	--
Total	**130**	**74**	**19**	**93**	**38**

* Excluding Director # Including SAO & AF&AO

harvest machineries, designed and developed under different research projects. Workshops also extend service support to repair and maintenance of institute facilities/ work etc. from time to time. Workshops have machines/ equipments to deliver its services such as lathe machines, drilling machine, gas welding set, arc welding set and sheet bending machine etc. Besides, various measuring instruments are also available in workshops, which are useful in day to day research work.

Food Testing Laboratory

The Food Testing Laboratory funded by Ministry of Food Processing Industries (MoFPI) has been setup with a budget of about Rupees two crore and twenty lakhs, at ICAR-CIPHET Ludhiana. The laboratory houses basic and some of the semi-advanced equipments for food analysis and evaluating the safety aspects of food products. This laboratory will cater to the food testing and quality analysis requirements of different stake holders, entrepreneurs in getting their samples tested at the new establishment. Testing protocols for certain parameters like water quality testing, fat, protein and fibre analysis, mineral contents etc. have been validated. This facility will enable the institute to answer the need based test requirement for processers, entrepreneurs, small and medium enterprises and industry at reasonable testing charges.

Library

The library of ICAR-CIPHET has good collection of books and journals in the area of post-harvest engineering, food processing, food engineering, food microbiology and biotechnology that attracts many researchers/ visitors from all over the nation to review the literature in post-harvest technology. It has a huge collection of books and various referred journals. The current stock of books in the library is 4914. Annual Reports and Research highlights etc. 970, 12 Indian and foreign journal were subscribed during the year. The current stock of bound volumes collection is 967. Library also arranged research papers/articles as per request of the readers on a specific subject through CERA. Current content service of journals and list of new arrivals is also being circulated among the ICAR-CIPHET staff.

Guest House

ICAR-CIPHET, Ludhiana and ICAR-CIPHET Abohar have guest house facilities to provide accommodation to ICAR/SAU/Government employees and farmers. ICAR-CIPHET Ludhiana has one guest house consists of 2 VIPs suites with internet facilities, 7 double bed AC and non-AC rooms, and one training hostel having 24 beds. International Training Hostel having one dining hall and 8 AC rooms with wireless internet facility is put in operation during reported period. Guest house of Abohar campus has 4 AC rooms and dormitory to accommodate 10 visitors. New guest house with 4 dormitories is ready for possession. It consists of common kitchen and dining facilities, visitors' room and TV room. Guest house facilities are extended to visitors subjected to availability. Booking of guest house can be made by writing an e-mail, fax or letter well in advance.

Units

Prioritization, Monitoring and Evaluation (PME) Cell

Prioritization, Monitoring and Evaluation concept is the management tool in R&D system to enhance scientific productivity and is the requirement of most of the funding agencies. It helps in setting a unified priority and monitoring of externally funded and in-house projects. PME cell at ICAR-CIPHET conducts Institute Research Council meetings and maintains all research project files. The monthly, quarterly and six monthly reports of individual scientists are collected and compiled into progress reports, results framework document, quarterly and half yearly performance review reports. PME cell 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 dealt by PME

cell. In addition to this, the research information related to ongoing and completed research projects is uploaded through Project Information and Management System (PIMS) software to avoid duplication in research.

Institute Technology Management Unit (ITMU)

The Institute Technology Management Unit is responsible for IP protection, Management and Technology 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 commercialization of Intellectual Property generated by the Institute. A total of 47 patent applications have been filed through ITMU out of which 6 patents have been granted. Vigorous efforts of ITMU lead to 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 18 desktop computers including 3 servers. More than 100 desktop computers of the institute are well connected through Local Area Network (LAN) and Wi-Fi connectivity is available through 100 Mbps line provided by National Knowledge Network (NKN). All the computers are protected by the server based Symantec Anti Virus. 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 softwares such as Front Page 2003, Corel Draw Graphics Suite, Adobe Professional, SAS, Design Expert Software, Leap Office 2000 (Hindi Software). The Institute's website *www.ciphet.in* is also being maintained by AKMU. At present following services are provided by AKMU:

- Electronic communication to all institute staff and trainees
- Data analysis facility
- Assistance in software application in different research works
- Internet browsing
- Software and computer hardware support
- Assistance in online patent search through various databases

AICRP on Post-Harvest Technology (PHT)

The All India Coordinated Research Project on Post-Harvest Technology is currently operating from 34 centres (out of these, 3 centres closed + 01 centre merged *w.e.f.* 1st April 2015 as per XII Plan EFC) covering almost all states and the agro-climatic zones in India. The aims of AICRP on PHT 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, crop/commodity-wise, (ii) Development of need based agro-processing centers (APC) 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 byproducts, (v) Multi-location trial and demonstration of the post-harvest technologies.

AICRP on Plasticulture Engineering and Technology (PET)

The AICRP on Plasticulture Engineering and Technology (earlier Application of Plastics in

STATEMENT OF BUDGET ESTIMATES AND EXPENDITURE (2014-2015)

NON - PLAN

(Rs. in Lakhs)

S.No.	Account Head	Revised Estimate 2014-2015	Progressive Expenditure 2014-2015
1.	Establishment charges	695.01	692.23
2.	Travelling allowances	3.00	2.95
3.	Recurring (incl. equipment) contingencies	44.96	38.31
4.	Works		
	Major works		
	Office building		
	Residential building		
	Minor works		
5.	HRD		
	Total	**742.97**	**733.49**

PLAN

(Rs. in Lakhs)

S.No.	Account Head	Revised Estimate 2014-2015	Progressive Expenditure 2014-2015
1.	Establishment charges	0.00	0.00
2.	Travelling allowances	17.00	17.00
3.	Recurring (incl. equipment) contingencies	305.55	303.78
4.	Works		
	Major works	44.35	43.57
	Office building		
	Residential building		
	Minor works		
5.	HRD	1.00	0.98
	Total	**367.90**	**365.33**

Agriculture) has 11 cooperative centers. In approved 12th Plan EFC, 4 new centers (NRCY, Dirang, Arunachal Pradesh; CIRG, Makhdoom, Mathura, UP; UAS, Raichur, Karnataka and DBSKKV, Dapoli, Maharashtra) were started and one center (CSKHPKV, Palampur, HP) to be dropped *w.e.f.* 1st April, 2015. The project has contributed in the development or modification of technologies related to plasticulture in horticulture, irrigation, intensive fish culture and animal housing as per the mandated area of the centers.

Results Framework Document (RFD)

Results Framework Document (RFD) of ICAR-CIPHET, Ludhiana for the year 2013-14 approved vide F.No. 1(6)/2012-RFDCU dated: 10/06/2014 is enclosed in annexure-I.

RESEARCH ACHIEVEMENTS

RESEARCH ACHIEVEMENTS

AGRICULTURAL STRUCTURES AND ENVIRONMENT CONTROL DIVISION

Development of spectroscopic methods for detection and quantification of adulterants and contaminants in fruit juices and milk

SN Jha, Pranita Jaiswal and K Mondal

The potential of Fourier Transform Infrared (FTIR) spectroscopy (fig.1) together with chemometrics was investigated as a rapid quality monitoring method for detection of adulterants and toxin in milk and juice, respectively.

Fig. 1. FTIR Spectrophotometer

Detection of detergent in milk

The FTIR spectra of pure (PM) and adulterated milk

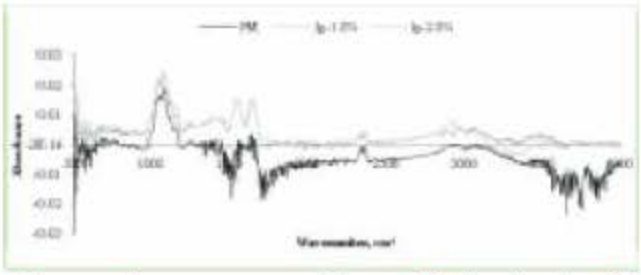


Fig. 2. Reference spectra of pure milk (PM) and milk adulterated (1% and 2%) with anionic detergent (lisapol; lp) in wave number range 4000-500 cm^{-1}.

(0.2-2.0%) samples with detergent revealed clear differences in regions from 1600-995 cm^{-1} and 3040-2851 cm^{-1} (fig. 2).

Principal component analysis (PCA) showed discrete clustering of samples based on level of detergent (*viz.* PM and 0.2%, 0.4-1.4%, 1.6-2.0% detergent adulterated milk; $p < 0.05$). The classification efficiency for test samples were recorded to be >93% using Soft Independent Modeling of Class Analogy (SIMCA) approach (Table 1). Maximum coefficient of determination for

Table 1. SIMCA classification result of pure milk adulterated with different levels of lisapol at 20°C.

Wave number range, cm^{-1}	Lisapol (%)	Total no. of samples	Number of selected classes				Mis-classified	Classification Efficiency (%)
			0	0.2	0.4–1.4	1.6 –2.0		
1086-1056	0	15	15	0	0	0	0	100
	0.2	15	0	15	12	0	12	100
	0.4–1.4	90	0	15	87	39	54	96.67
	1.6 -2.0	45	0	0	11	44	11	97.78
1086-1056,	0	15	15	0	0	0	0	100
1343-1333	0.2	15	0	15	5	0	5	100
	0.4–1.4	90	0	5	86	10	15	95.56
	1.6 -2.0	45	0	0	6	43	6	95.56

prediction of detergent was 0.94 for calibration and 0.93 for validation, using partial least square (PLS) regression in wave number combination of 1086-1056, 1343-1333, 1507-1456, 3040-2851 cm^{-1}.

Detection of oil, common sugar in milk

Spectra of pure milk (PM) samples supplemented with known concentration of soybean oil, common sugar and lactose were acquired using FTIR equipped with attenuated total reflectance (ATR), in wave number range of 4000-500 cm^{-1}.

Spectra revealed clear differences in the absorbance values of PM and milk samples supplemented with different levels of soybean oil (fig. 3), common sugar and lactose.

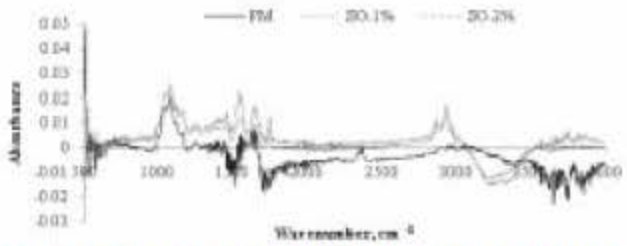


Fig. 3. Reference spectra of pure milk (PM) and milk adulterated (1% and 2%) with soybean oil (SO) in wave number range 4000-500 cm^{-1}.

The classification efficiency for test samples were recorded to be >93% using Soft Independent Modeling of Class Analogy (SIMCA) approach (Table 2). Soybean oil, common sugar and lactose could be best predicted with coefficient of determination (R^2) of 0.88, 0.99 and 0.94 for validation in wave number range of 1342-1390, 1084-982 and 1166-1001 cm^{-1}, respectively.

Detection of patulin in apple juice

Spectra of pure patulin was also acquired at varying pH (3-8) for different time intervals, to study the stability of the mycotoxin under varying pH and find out the specific wave number region for detection of patulin simultaneously using FTIR and HPLC (for validation). Results revealed that patulin was most stable at pH 4, either increase or decrease in pH result in 10-20% decline in patulin concentration within 20 min of incubation. Further increase in pH (6-8) caused 20-30% decline in patulin concentration. FTIR spectra of apple juice spiked with known patulin concentrations (*viz.* 20, 40, 60, 80 and 100 ppb) were analyzed. Spectra revealed clear differences in absorption values between pure

Table 2. SIMCA classification result of pure milk adulterated with different levels of soybean oil

Wave number range, cm^{-1}	Soybean oil (%)	Total no. of samples	Number of selected classes						Mis-classified	Classification Efficiency (%)
			PM	0.2	0.4-0.8	1.0-1.6	1.8	2.0		
1342-1390	PM	15	14	0	0	0	0	0	0	93.33
	0.2	15	0	14	0	0	0	0	0	93.33
	0.4-0.8	45	0	0	45	2	0	11	13	100
	1.0-1.6	60	0	0	0	60	0	15	15	100
	1.8	15	0	0	0	0	15	4	4	100
	2.0	15	0	0	3	4	0	15	7	100
512-538	PM	15	14	0	0	0	0	0	0	93.33
	0.2	15	0	15	0	0	0	0	0	100
	0.4-0.8	45	0	0	45	5	0	21	26	100
	1.0-1.6	60	0	0	2	58	0	9	11	96.67
	1.8	15	0	0	0	0	15	2	2	100
	2.0	15	0	0	6	3	0	15	9	100

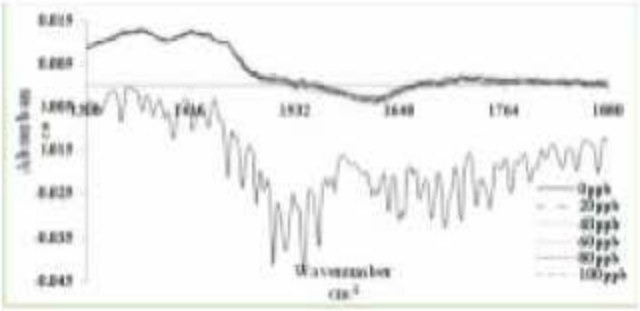


Fig. 4. Typical spectra of apple juice and apple juice-mixed patulin in selected spectral rage of 1880–1300 cm^{-1}

and contaminated juice specifically in the spectral range of 1900 - 950 cm^{-1} (fig. 4).

Principal component analysis (PCA) showed clustering of samples based on level of patulin in apple juice at 5% level of significance (fig. 5). Developed models could successfully classify contaminated and non-contaminated juice into their respective class using Soft Independent Modeling of Class Analogy. The patulin contamination in apple juice could be predicted in the wave number range of 1301-1880 cm^{-1} using PLS with coefficient of determination (R^2) of 0.95 and 0.94 for calibration and validation, respectively.

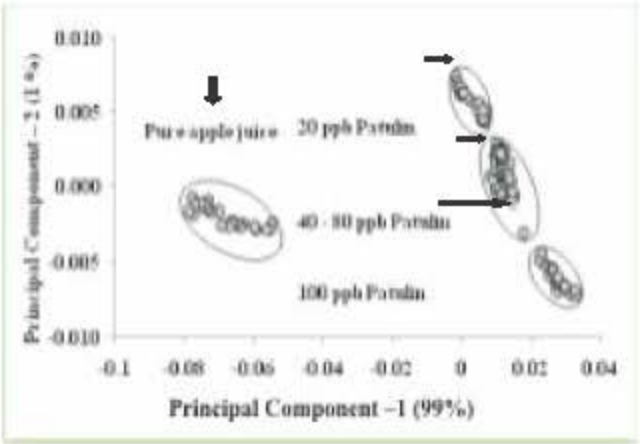


Fig. 5. Principal component scores plot depicting clusters of pure and patulin spiked apple juice in the wave number range of 1141–1020 cm^{-1}

Micro-encapsulation methods for bacteriocins for their controlled release

K Narsaiah, SN Jha, RK Malik and Shilpa Vij

Process optimization for encapsulation of lutein

Extraction of lutein

0.1 g of each sample was mixed with 8 ml solvent (n-hexane/isopropanol, 3:2, v/v), sonicated for 1 min and incubated thereof for 24 h. The sample was then centrifuged (1500g, 5 min) and supernatant was collected in tube. The extraction step was repeated once more using 8 ml solvent and followed twice in each case with 5 ml for 1 h, until the extraction solvent was colourless. The supernatants of all extraction steps were combined in tube and were washed by adding 5 ml 0.1 M NaCl, mixing vigorously, and incubating for 30 min until two layers were separated. The upper hexane layer was transferred to tube. The remaining lutein ester in the lower layer was vigorously washed with 7.5 ml and once more with 5 ml of n-hexane/butylated hydroxy toluene (BHT, 0.05%) in each case for 30 min until two layers were separated. The upper hexane layers were removed to the tube and the volume was made up to 30 ml with n-hexane containing 0.05% BHT.

Encapsulation of lutein

Nanoliposomes were prepared by using three different methods. All the methods lead to the formation of liposomes with different size and distribution. The size of nanoliposomes was around 362, 265 and 321 nm through sonicator, homogenizer and ultraturrax method, respectively (fig. 6). Nanoliposomes prepared by ultraturrax method was selected for further encapsulation studies as it showed the better uniform distribution of liposomes as compared to other two methods.

Effects of light on lutein stability

Light exerts a destructive influence on lutein, therefore, its effect on stability of lutein was determined. The results suggested that encapsulated lutein was protected from direct effect of light and

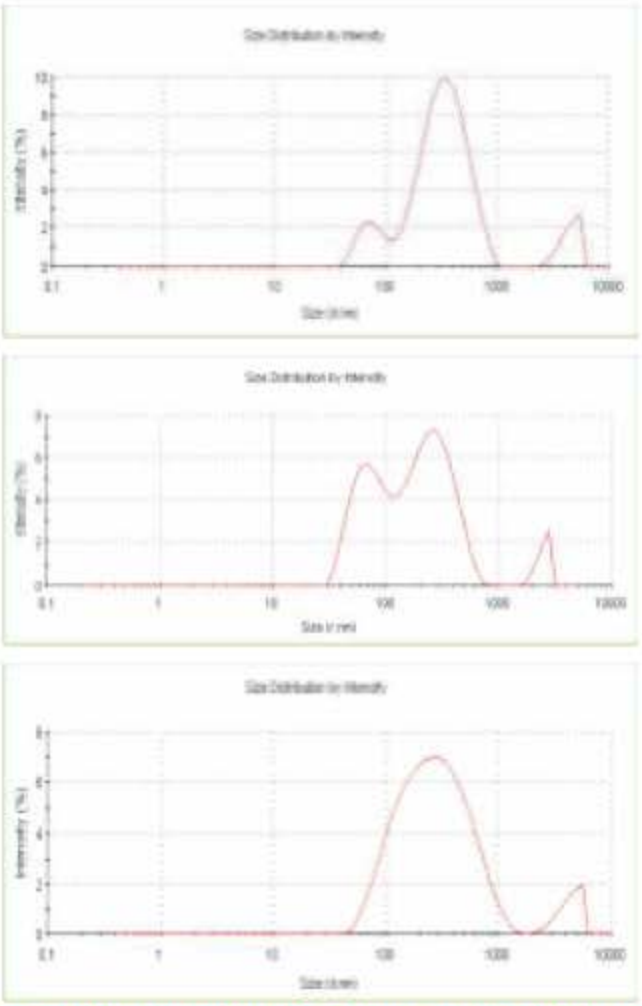


Fig. 6. Prepartion of nanoliposomes using a) Sonicator b) Homogenizer and c) Ultraturrax

showed better stability as compared to free lutein. Encaspsulated form was able to retain more than 75 % lutein whereas it was only 64.2 % in its free form, after 12 days of incubation (Table 3). Same samples revealed 88.6 and 76.5 % stability in encapsulated and free form, respectively, when kept in dark. The results clearly indicate the effectiveness of microencapsulation for stability of lutein.

Effect of temperature on encapsulated lutein

The temperature has remarkable effect on heat sensitive bioactive compounds such as lutein. The stability of lutein was decreased with increase in temperature. It is clear from table 4 that encapsulated form of lutein showed better stability as compared to free form at all tested temperatures. At 4°C, both the free as well as encapsulated form did not lose any significant amount of lutein. At 25°C, the stability of encapsulated and free form was 94.1 and 92.3 %, respectively. On the other hand, increase in temperature up to 50°C caused major damage to lutein. At the end of 12th day, the stability of free and encapsulated lutein was 62.8 and 85.6 %, respectively. The results suggested the potential of encapsulation method for protection of lutein in external environmental conditions.

Table 3. Effect of light on stability of lutein

Days	Light		Dark	
	Free (%)	Encapsulated (%)	Free (%)	Encapsulated (%)
0 Day	100.0	100.0	100.0	100.0
3rd Day	91.4	95.6	92.5	97.2
6th Day	82.6	87.9	87.9	93.5
9th Day	73.4	80.4	80.6	90.7
12th Day	64.2	75.9	76.5	88.6

Table 4. Effect of temperature on stability of lutein

Days	4°C		25°C		58°C	
	Free (%)	Encapsulated (%)	Free (%)	Encapsulated (%)	Free (%)	Encapsulated (%)
0 Day	100.0	100.0	100.0	100.0	100.0	100.0
3rd Day	98.6	99.2	97.2	98.5	95.6	97.4
6th Day	97.9	98.9	95.1	97.3	89.6	93.5
9th Day	96.3	98.1	92.3	95.9	76.3	89.1
12th Day	95.7	97.5	89.0	94.1	62.8	85.6

Development of animal handling and automated cooling systems for dairy farms

K. Narsaiah, Sandeep Mann, Yogesh Kumar, Leena Kumari, Mukesh Bhakat and T.K. Mohanty

Deveopment of animal lifter for cow/buffalo

The animal lifter developed was tested for lifting sick cows at Govind Godham Goshala. Based on the study, the overall length of wrapping and length of side slings was reduced. The straps were stitched crosswise as shown in fig. 7. Refined animal lifter made of polyester web slings developed has following dimensions.

- Width and length of wrapping are 0.83 m and 1.58 m.

Fig. 7. Modified design of animal lifter

- The cross wise sling legs are 1.19 m with adjustable ratchet and self-locking buckle.
- The side sling legs are 0.58 m with heavy duty hooks.
- The animal lifter is made in such a way that sling legs will be almost vertical so that the stress in webbing straps is minimum.
- Designed to lift animal up to 1000 kg weight.

Development of continuous primary processing and shrink packaging line for cauliflower and cabbage

R.K. Vishwakarma, Leena Kumari and Ramesh Kumar

A study was conducted to study the force deformation behavior of cauliflower under quasi static compressive loading between two plates as shown in fig. 8. The compression tests were performed using Texture Analyzer with 500 N compression load cell. Twenty five cauliflowers were randomly taken for each experiment. The force deformation behavior was studied for the two types of cauliflower samples i.e. Cauliflower with petiole; and Cauliflower curd. The average force required for bio-yielding of cauliflower with petiole was 279.83±82.85 N at deformation of 15.93±3.09 mm. The energy required for bio-yielding of cauliflower was 2.18±1.03 J. At bio-yield point, the force, deformation and energy for cauliflower curd without petiole were 242.92±41.52 N, 15.84±3.16 mm and 1.94±0.58 J respectively. Rupture took place at 365.00±87.38 N force with 43.13±7.44 mm

deformation and 10.61±2.70 J energy.

Fig. 8. Compression tests of cauliflower with Texture Analyzer

Another study was conducted for calculation of projected area of cauliflower. Projected area is useful in deciding the top width of curd holder. After preparing the section of cauliflower curd with and without petiole as shown in fig. 9, the outline was traced on paper. The projected shape surface is shown in fig. 10, for curd, cauliflower with petiole and petiole. From the study, it was observed that the

Fig. 9. Section of the cauliflower used for projection on the paper

Fig. 10. Projection area of: a) curd; b) cauliflower without petiole; c) petiole part

projected area of curd was about 50% to that of cauliflower with petiole. Thus, more material will be required for packaging of cauliflower with petiole in comparison to that of curd only. The projection of samples showed that separation of unwanted stem part would lead to removal of petiole also. This study of textural behavior of cauliflower and projected area will be helpful for understanding of deformation in cauliflower undergoing different unit operations during processing and will bring reduction in wastage.

Development of RFID based quality tracing system

Leena Kumari, K Narsaih and Rahul K Anurag

Perishable food products undergo various internal chemical and biological changes in their journey from farm to final consumer. Ensuring the quality and safety of food products in global food chain is of prime concern. It is necessary that the partners involved in management of supply chain should monitor the environmental conditions of food products to know the status of quality. RFID (Radio Frequency Identification) is an emerging technology that is increasingly utilised for effective tracing and tracking of perishables in supply chain. RFID system integrated with sensors has been developed at ICAR-CIPHET which is able to monitor the environmental conditions of food products during storage. The RFID tags shown in fig. 11 are integrated with sensors *viz.* Temperature & RH sensor (temperature range is -40 to 80 °C, RH range is 0 to 100 % RH), ethylene sensor (range 0 to 2000 ppm). The

developed RFID tags can be used for monitoring the fluctuations in environmental parameters (temperature, RH, ethylene) that leads to deterioration of quality and decreased shelf life of fresh produce. A trial was conducted for monitoring the temperature and RH of guava stored in cold store. Guava was procured from local market and packed inside the plastic boxes as shown in fig. 12. Then the guava boxes were stored inside the cold store (14 ± 1 °C & RH 85%). Data recorded at regular intervals with RFID and other means as IR thermometer, temperature probe, RH logger, mercury thermometer, controller of cold store. During the storage period, significant difference was observed between the temperature and RH set for the cold store and actual temperature and RH inside the cold room. Variations for temperature are shown in graph (fig. 13). During the trial conducted, the developed RFID sensor tag has been found efficient for monitoring the environmental conditions (temperature and RH) of guava stored in cold store.

Fig. 11. RFID tag

Fig. 12. RFID tag with guava packed in plastic boxes

Fig. 13. Variations in environmental temperature monitored with RFID and other means

Monitoring the environmental fluctuations using RFID sensor tag can prevent spoilage and quality degradation of perishables. Further, RFID tag is linked with software that can assist in tracing the entire history of food product. Developed RFID system has enormous potential for monitoring real time information at faster speed, which will save time. Collected information can be used among stakeholders involved in supply chain for effective management of supply chain of food products.

Shelf life extension of strawberry and plum fruits using active packaging in high barrier metal laminates

Rahul K Anurag and Pranita Jaiswal

Active modification of gaseous mixture during storage can lower the respiration rate of fruits and can also be used as an alternative for frozen storage and for extending the shelf life significantly. Active packaging was done by modifying gas atmosphere with combinations of 5% O_2 + 15% CO_2 + 80% N_2, 11% O_2 + 10% CO_2 +79% N_2 and 5% O_2 + 5% CO_2 + 90% N_2. The product volume ratio of 1: 6 was optimized, based on respiratory studies of strawberry and the absorption kinetics of calcium hydroxide used for CO_2 scavenging. All the gas combinations

Fig. 14. Samples of strawberry fruit halves on 12th day of storage at 5°C and 85-90% RH (a) control (b) G1(5% O_2 + 15% CO_2 +80% N_2) (c) G2(11% O_2 + 10% CO_2 +79% N_2) (d) G3(5%O_2 + 5% CO_2 +90% N_2)

Fig. 15. (a) Active package of Plum (b) Empty high barrier aluminium laminate with moisture pads and CO_2 scavenger.

used in the study, showed a shelf life of 9-12 days at 5°C, whereas, it was 6-9 days at 10°C. Active package with gas ratio of 5% O_2 + 5% CO_2 + 90% N_2 showed weight loss of 3.54% and TSS, TA, color (fig. 14) and firmness values were maintained without significant difference up to 12th day. Based on all physico-chemical parameters, microbiological results and overall sensory scores, it was observed that, 5% O_2 and 15% CO_2 gas combination was found suitable for strawberry in active package of high barrier aluminium laminates using calcium hydroxide (15g) for maintaining shelf life up to 12 days at 10 °C of storage.

Active packaging of plum fruits

Experiments on active packaging of plums (fig. 15a, b) carried out in Food Packaging and Transportation Laboratory, AS&EC Division, have shown that the high level of TSS%, anthocyanin content, sugars etc. can be maintained in high barrier films. Metal aluminium laminates were used in this study for maintaining bioactive compounds and sensory quality of high value fruits. Active modification or desired gas mixture combinations were used for flushing into the packaging material. Moisture absorbing pads made up of cellulose and carbon dioxide scavenging material were used in the study to increase the shelf life of plums upto 25 days. By minimizing the rate of respiration through the gaseous modification, packaging materials in retail outlets at cold storage can successfully extend the shelf life of high value fruits like plums and strawberry.

Design and development of bael pulper

Rahul KAnurag and Nilesh Gaikwad

Bael (*Aegle marmelos* Correa), an indigenous fruit of India, belongs to family *Rutaceae*. The fruit has tremendous medicinal value as a laxative, tonic etc. Various processed products are also developed from the bael fruit such as preserves, pulp, nectar, squash, slab, toffee and powder. Despite having great potential, it is not popular as a dessert fruit because of its hard shell, mucilaginous texture and numerous seeds. Extraction of pulp from ripe bael fruit is the main hindrance to processing. Keeping in view the above facts, designing and development of bael pulping machine has been carried out. An integrated machine for breaking of bael/ wood apple fruits and extraction of pulp along with separation of broken shell, seeds and fiber thereof is designed in stainless steel shown in fig. 16. The machine has three mechanisms viz. screw conveying mechanism, fruit breaking mechanism and pulp extraction mechanism. The capacity of the machine was found to be 120kg/h and pulp recovery is about 95-97%.

Fig. 16. Bael pulping machine developed at ICAR-CIPHET Ludhiana

Development of meat decontamination methods using pulsed light in conjunction with selected hurdle technology

(Divisional Activity)

Yogesh Kumar

Experiments have been conducted to identify possible hurdle interventions to be used in conjunction with UV light for enhancement of shelf life of different meat products. The decontamination effect of UV light treatment in combination with acidified sodium chlorite (ASC) on fresh chicken meat was analyzed and reduction by log 2, log 1 and log 0.9 in total plate count, Enterobacteriaceae count and yeast and mould count respectively, on zero day was observed. The combined UV and ASC treatment resulted in log 2.3, log 1.1 and log 1.2 reductions, respectively (Table 5 and fig. 17). Pediocin in combination with UV light has also been explored as a synergistic antimicrobial agent. Results showed that combined treatment inhibited the microbial growth more effectively in goat meat. The decontamination effect of UV light treatment in combination with benzoic acid and citric acid on fresh chicken meat was also analyzed and log 2.1, log 1.3 and log 1.1 reductions for total plate count, Enterobacteriaceae count and yeast and mould count respectively, on 4th day was found.

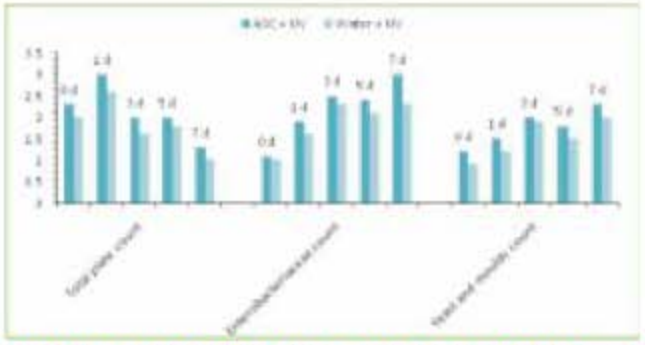


Fig. 17. The inhibition (log_{10} cfu) of microbial counts in the ASC + UVC treated and Water + UVC treated samples, in comparison to negative control samples

Table 5. Average microbial counts (log cfu/g) on the skin of treated and untreated chicken drumsticks

Microbial counts	SD	Treatment			
		ASC + UV	Water + UV	Water	Non-treated
Total plate count	0	2.4	2.7	4.7	4.7
	1	2.5	2.9	5.6	5.5
	3	5.4	5.8	7.5	7.4
	5	6.1	6.3	7.9	8.1
	7	7.1	7.4	8.2	8.4
Enterobacteriaceae count	0	1.1	1.2	2.1	2.2
	1	1.8	2.1	3.6	3.7
	3	3.2	3.4	5.3	5.7
	5	4.8	5.1	6.9	7.2
	7	5.1	5.8	7.6	8.1
Yeast and moulds count	0	2.6	2.9	4.1	3.8
	1	3.2	3.5	4.3	4.7
	3	4.1	4.2	5.9	6.1
	5	4.9	5.2	6.8	6.7
	7	5.1	5.4	7.5	7.4

FOOD GRAINS AND OILSEEDS PROCESSING DIVISION

Technology for enhancing oil recovery and production of edible grade de-oiled meal from sunflower and groundnut and their diversified uses

RK Gupta, Mridula D and Dhritiman Saha

Development of nutritious pasta utilizing groundnut meal and beetroot

The study was undertaken to optimize the level of food materials *viz.* groundnut meal, beetroot juice and refined wheat flour for development of pasta using response surface methodology. Box-benken design of experiments was used to design different experimental combinations considering 10 to 20g groundnut meal, 6 to 16mL beetroot juice and 80 to 90 g wheat flour. Quality attributes such as protein content, antioxidant activity, colour, cooking quality (solid loss, rehydration ratio and cooking time) and sensory acceptability of pasta samples were the dependent variables for the study. The level of different studied food materials *i.e.* refined wheat flour, groundnut meal and beetroot juice significantly influenced the instrumental colour, cooking quality as well as nutritional parameters of pasta samples (Table 6). The results revealed that pasta samples with higher levels of groundnut meal and beetroot juice were high in antioxidant activity and overall sensory acceptability. The samples with higher content of groundnut meal indicated higher protein contents. On the other hand, the samples with higher beetroot juice content were high in rehydration ratio and lesser cooking time along with low solid loss in cooking water. The groundnut meal and beetroot juice incorporated nutritious pasta (fig. 18a) with good sensory acceptability can be developed using 80.67% refined wheat flour, 19.33% groundnut meal and 17.4mL/ 100g pasta formulation beetroot juice with overall desirability as 0.905. This pasta sample required 5.5 min to cook with 1.37% solid loss and rehydration ratio as 6.28 and 8.71 overall acceptability. This pasta sample provided 19.56% protein content, 23.95% antioxidant activity and 125.89mg/100g total phenols. It can be inferred from the study that groundnut meal and beetroot juice could be rightfully exploited as useful food materials for

Table 6. Analysis of variance of independent variables on quality responses

Particulars	Yellowness Index (YI)	Cooking Time, min	Protein content, %	Total Phenols, mg/100g	Antioxidant activity, %	Overall Acceptability
Model	5.61**	5.87**	6.09**	6.92**	8.18**	7.09**
Beetroot Juice (A)	4.73*	32.63**	16.21**	41.98**	69.03**	55.26**
Groundnut Meal (B)	2.92	11.29**	31.89**	0.016	0.40	5.51*
Wheat Flour (C)	22.96**	0.11	9.242E-003	7.57**	6.302E-003	0.43
A*B	12.01**	0.90	0.045	1.02	0.95	0.85
A*C	1.31	2.03	3.938E-005	4.52*	0.88	0.85
B*C	1.63	3.61*	1.63	4.93*	3.606E-003	0.31
A*A	0.11	1.49	0.50	0.090	0.65	0.63
B*B	0.062	0.53	3.81*	1.15	1.32	0.37
C*C	4.71*	0.059	0.75	0.91	0.42	0.17
Lack of fit	0.16	0.39	0.34	0.22	0.57	0.18
C.V. %	5.88	7.27	8.48	3.13	.BB	3.59
R^2	0.878	0.883	0.887	0.899	0.913	0.901

*Significance: ** ($P<0.05$), * ($P<0.1$)*

development of nutritious pasta to fulfill the demand of antioxidant rich nutritious products for health conscious consumers. Such pasta would also fulfill 50% of the protein requirement of a 10-12 year old Indian child as per recommended dietary allowances (RDA) and also enhances the intake of less familiar nutritious vegetables among children, a potential group of consumers of pasta products.

Fig. 18. Groundnut meal based pasta, incorporated with a) beetroot and b) capsicum juice

Groundnut meal and capsicum juice based protein and antioxidant rich pasta

Capsicum annuum L. is a rich source of vitamin C, carotenes, phenols, capsaicinoids, xanthophylls, and flavonoids, in addition to having high antioxidant activity but the utilization of this valuable vegetable in processed food products was rarely seen. Hence, the present study was carried out to develop protein and antioxidant rich pasta utilizing groundnut meal and capsicum juice (fig. 18b) using response surface methodology to fulfill the nutritional expectation of health conscious consumers. Box-benken design of experiments was used for designing different experimental combinations considering groundnut meal from 10-20g, capsicum juice from 14-30mL and wheat flour from 80-90g, respectively. Effect of independent variables on various quality responses is mentioned in Table 7. Antioxidant activity and phenolics content was increased with increasing

Table 7. Analysis of variance of independent variables on quality responses of groundnut meal and capsicum juice incorporated pasta

Particulars	Protein content (%)	Total phenols (mg/100g)	Antioxidant activity (%)	Cooking time (min)	Rehydration ratio	Solid loss (%)	Overall acceptability
Model	4.88**	4.02**	7.70**	6.88**	7.53**	3.81**	24.31**
Capsicum juice (A)	8.51**	15.57**	49.15**	49.64**	36.02**	29.06**	172.35**
Groundnut meal (B)	33.39**	0.25	1.62	0.17	0.52	0.047	39.20**
Wheat flour (C)	3.396E-003	1.72	6.58**	1.34	12.61**	0.47	0.16
A*B	0.31	0.64	0.056	6.87**	0.70	0.25	2.94
A*C	0.019	10.73**	0.27	0.27	10.26**	0.027	2.04
B*C	0.79	2.88	8.32**	3.960E-003	0.16	0.053	0.73
A*A	0.46	0.69	0.20	0.33	3.36	2.23	0.055
B*B	0.074	2.48	2.58	2.30	0.47	0.27	0.12
C*C	0.26	0.84	0.28	0.95	4.01*	2.08	1.24
Lack of fit	.83	0.76	0.55	0.084	1.09	7.43	0.83
C.V. %	3.36	4.84	9.66	8.46	8.25	8.25	2.27
R^2	0.863	0.838	0.908	0.898	0.906	0.830	0.969

level of groundnut meal and capsicum juice in the samples. Pasta samples having higher level of groundnut meal showed higher protein contents. Conversely, the pasta samples with higher capsicum juice showed high rehydration ratio with low solid loss. The colour and cooking quality of pasta samples was also affected with different levels of groundnut meal, capsicum juice and wheat flour. Optimization was done to obtain the best experimental combination for development of groundnut meal and capsicum juice for developing pasta with enhanced protein and antioxidant activity. Optimized groundnut meal and capsicum fortified pasta consisted of 20g groundnut meal, 30mL capsicum juice and about 90g refined wheat flour. This pasta sample showed 4.72 min cooking time, 2.58 rehydration ratio and 2.46 % solid loss with overall desirability of 0.879. The total protein content, phenolics content and antioxidant activity in the pasta with optimized formulation were 17.81%, 341.68 mg/100g and 18.11%, respectively with overall sensory acceptability as 8.53.

Development of non dairy based probiotic foods

Sangita Bansal, Satish K Sharma and Manisha Mangal

Isolation and characterization of probiotic bacteria

Three putative probiotic cultures *viz*. *Enterococcus faecium* BBE3, *Lactobacilluc fermentum* BBE4 and *Lactobacillus plantarum* BBE 7 were submitted and registered to MTCC, IMTECH-Chandigarh with MTCC No. 12104, 12061 and 12062, respectively. Two putative probiotic cultures *viz*. *Streptococcus infantarius* BBE2 and *Lactobacillus fermentum* BBE6 were submitted to ICAR-NBAIM, Mau with accessions nos. NAIMCC-B-01798 and NAIMCC-B-01799.

Development of per based diagnostic process for the detection of potential aflatoxin producing molds during post harvest handling in rice

Sangita Bansal, Manisha Mangal and Surya Tushir

Process protocol for amplification aflD gene involved in aflatoxin biosynthesis

DNA was isolated from aflatoxin producing and non producing *Aspergillus* fungi following the method of Moller et al., 1992 by scaling it up to isolate DNA from 1 g of wet weight of submerged fungal culture. The genomic DNA was isolated from all the samples and was quantified using Nanodrop, starting with 2 µl of DNA samples. The primers aflDFP and aflDRP for *aflD* genes were designed based on the published sequence of genes encoding for these in *A. flavus* and *A. parasiticus*. The PCR mix used for amplification of all the above genes included 1x Standard Taq Reaction Buffer, 200µM Deoxynucleotide solution Mix, 0.2 µM Upstream Primer, 0.2 µM Downstream Primer, 0.75 units of Taq DNA Polymerase/25µl PCR reaction, 100 ng of DNA Template and the volume was brought to 25µl with Nuclease free water. PCR amplifification was performed in 25µl of a reaction and PCR was carried out as follows: 1 step at 94°C for 10 min and 35 cycles of the three steps; 1 min 94°C, 2 min at 58°C for *aflD*, 90 sec at 72°C; one final 5 min step at 72°C and then hold at 4°C. PCR products were separated by electrophoresis on a 2% agarose gel with 0.5% ethidium bromide in 1x TAE buffer and visualized under UV light in a gel documentation system. A single amplification product of expected size *viz*. 410 bp for *aflD* gene was observed which could specifically differentiate aflatoxin producing *i.e. A.*

Fig. 19. Amplification of *aflD* gene in various target samples. Lane no. M: 2-Log DNA ladder; LANE 1-6: *A. oryzae* (MTCC 1846), *A. parasiticus* (MTCC 2796), *A. parasiticus* (MTCC 2797), *A. flavus* (MTCC 2799), Groundnut, Rice

parasiticus and *A. flavus* fungi from non producing A.oryzae (fig. 19).

Process protocol for amplification vbs gene involved in aflatoxin biosynthesis

DNA was isolated from aflatoxin producing and non producing *Aspergillus* fungi following the method of Moller *et al.*, 1992 by scaling it up to isolate DNA from 1 g of wet weight of submerged fungal culture. The genomic DNA was isolated from all the samples and was quantified using Nanodrop, starting with 2 µl of DNA samples. The primers namely vbsFP and vbsRP for vbs genes were designed based on the published sequence of genes encoding for these in *A. flavus* and *A. parasiticus*. The PCR mix used for amplification of all the above genes included 1x Standard Taq Reaction Buffer, 200µM Deoxynucleotide solution Mix, 0.2 µM Upstream Primer, 0.2 µM Downstream Primer, 0.75 units of Taq DNA Polymerase/25µl PCR reaction, 100 ng of DNA Template and the volume was brought to 25µl with nuclease free water. PCR amplification was performed in 25µl of a reaction and PCR was carried out as follows: 1 step at 94°C for 10 min and 35 cycles of the three steps; 1 min 94°C, 2 min at 52°C for *vbs*, 90 sec at 72°C; one final 5 min step at 72°C and then hold at 4°C. PCR products were separated by electrophoresis on a 2% agarose gel with 0.5% ethidium bromide in 1x TAE buffer and visualized under UV light in a gel documentation system. A single amplification product of expected size *viz.* 459 bp for *vbs* gene was observed which could specifically differentiate aflatoxin producing *i.e. A.parasiticus* and *A. flavus* fungi from non producing *A.oryzae* (fig. 20).

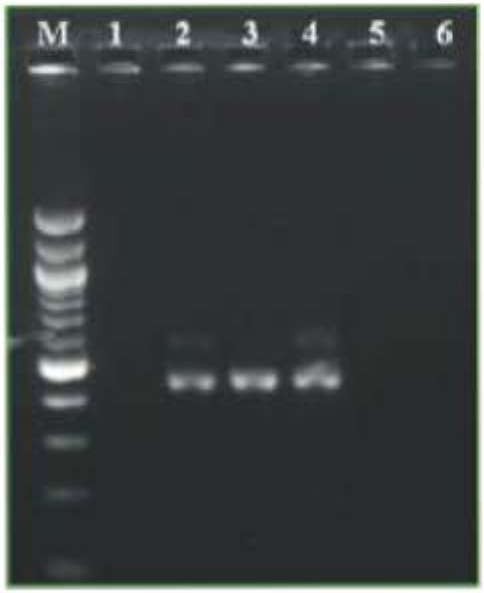


Fig. 20. Amplification of *vbs* gene in various target samples
LANE 1-6: *A. oryzae* (MTCC 1846), *A. Flavus* (2796), *A. parasiticus* (MTCC 2797), *A. flavus* (MTCC 2799), Groundnut, Rice; Lane no.M: 100bp DNA ladder

Process protocol for amplification aflO gene involved in aflatoxin biosynthesis

DNA was isolated from aflatoxin producing and non producing *Aspergillus* fungi following the method of Moller *et al.*, 1992 by scaling it up to isolate DNA from 1 g of wet weight of submerged fungal culture. The genomic DNA was isolated from all the samples and was quantified using Nanodrop, starting with 2 µl of DNA samples. The primers namely aflOF and aflOR for *aflO* genes were designed based on the published sequence of genes

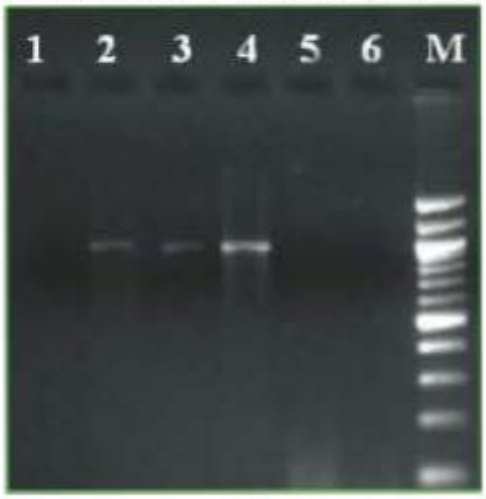


Fig. 21. Amplification of *aflO* gene in various target samples
LANE 1-6: *A. oryzae* (MTCC 1846), *A. Flavus* (2796), *A. parasiticus* (MTCC 2797), *A. flavus* (MTCC 2799), Groundnut, Rice; Lane no.M: 100bp DNA ladder

encoding for these in *A. flavus* and *A. parasiticus*. The PCR mix used for amplification of all the above genes included 1x Standard Taq Reaction Buffer, 200µM Deoxynucleotide solution Mix, 0.2 µM Upstream Primer, 0.2 µM Downstream Primer, 0.75 units of Taq DNA Polymerase/25µl PCR reaction, 100 ng of DNA Template and the volume was brought to 25µl with Nuclease free water. PCR amplification was performed in 25µl of a reaction and PCR was carried out as follows: 1 step at 94°C for 10 min and 35 cycles of the three steps; 1 min 94°C, 2 min at 60°C for *aflO*, 90 sec at 72°C; one final 5 min step at 72°C and then hold at 4°C. PCR products were separated by electrophoresis on a 2% agarose gel with 0.5% ethidium bromide in 1x TAE buffer and visualized under UV light in a gel documentation system. A single amplification product of expected size *viz.* 956 bp for *aflO* gene was observed which could specifically differentiate aflatoxin producing *i.e. A.parasiticus* and *A. flavus* fungi from non producing *A.oryzae* (fig. 21).

Process protocol for amplification aflP gene involved in aflatoxin biosynthesis

DNA was isolated from aflatoxin producing and non producing *Aspergillus* fungi following the method of Moller *et al.*, 1992 by scaling it up to isolate DNA from 1 g of wet weight of submerged fungal culture. The genomic DNA was isolated from all the samples and was quantified using Nanodrop, starting with 2 µl of DNA samples. The primers namely aflPF and aflPR of *aflP* genes were designed based on the published sequence of genes encoding for these in *A. flavus* and *A. parasiticus*. The PCR mix used for amplification of all the above genes included 1x Standard Taq Reaction Buffer, 200µM Deoxynucleotide solution Mix, 0.2 µM Upstream Primer, 0.2 µM Downstream Primer, 0.75 units of Taq DNA Polymerase/25µl PCR reaction, 100 ng of DNA Template and the volume was brought to 25µl with nuclease free water. PCR amplification was performed in 25µl of a reaction and PCR was carried out as follows: 1 step at 94°C for 10 min and 35 cycles of the three steps; 1 min 94°C, 2 min at 60°C for *aflP*, 90 sec at 72°C; one final 5 min step at 72°C and then hold at 4°C. PCR products were separated by electrophoresis on a 2% agarose gel with 0.5% ethidium bromide in 1x TAE buffer and visualized under UV light in a gel documentation system. A single amplification product of expected size *viz.* 1418 bp for *aflP* gene was observed which could specifically differentiate aflatoxin producing *i.e. A. parasiticus* and *A. flavus fungi* from non producing *A.oryzae* (fig. 22).

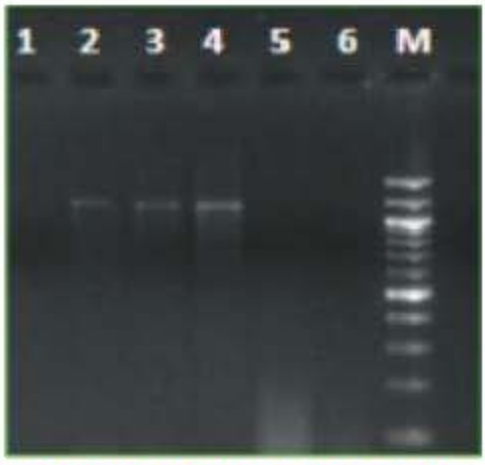


Fig. 22. Amplification of *aflP* gene in various target samples
Lane no. M: 100bp DNA ladder; LANE 1-6: *A. oryzae* (MTCC 1846), *A. parasiticus* (MTCC 2796), *A. parasiticus* (MTCC 2797), *A. flavus* (MTCC 2799), Groundnut, Rice

Validation of process protocol for detection of aflatoxigenic fungi in infected samples

Infected samples were prepared by artificially infecting the rice grains with *A. flavus* (MTCC 2799) spores in known concentrations *i.e.* 10^5 spores/g, 10^4 spores/g, 10^3 spores/g, 10^2 spores/g and after incubation for 2 days. DNA was isolated from aflatoxin producing *Aspergillus* fungi and infected samples following the method of Moller *et al.*, 1992 by scaling it up to isolate DNA from 1 g of wet weight of submerged fungal culture. The genomic DNA was isolated from all the samples and was quantified using Nanodrop, starting with 2 µl of DNA samples. The primers for *vbs* genes were used in the validation. The PCR mix used for amplification of all the above genes included 1x Standard Taq Reaction Buffer, 200µM Deoxynucleotide solution Mix, 0.2

µM Upstream Primer, 0.2 µM Downstream Primer, 0.75 units of Taq DNA Polymerase/25µl PCR reaction, 100 ng of DNA Template and the volume was brought to 25µl with Nuclease free water. PCR amplifification was performed in 25µl of a reaction and PCR was carried out as follows: 1 step at 94°C for 10 min and 35 cycles of the three steps; 1 min 94°C, 2 min at 52°C for *vbs*, 90 sec at 72°C; one final 5 min step at 72°C and then hold at 4°C. PCR products were separated by electrophoresis on a 2% agarose gel with 0.5% ethidium bromide in 1x TAE buffer and visualized under UV light in a gel documentation system. A single amplification product of expected size *viz.* 459 bp for *vbs* gene was observed in the infected samples (fig. 23).

Fig. 23. Validation with *vbs* gene in various infected samples
Lane no.M: 100bp DNA ladder; LANE 1-7: *A. flavus* (MTCC 2799), Infected Groundnut, Infected Rice, Infected Rice having spore count 10^5 spores/g, Infected Rice having spore count 10^4 spores/g, Infected Rice having spore count 10^3 spores/g, Infected Rice having spore count 10^2 spores/g

Technology for production of protein concentrate /isolate from commercial groundnut cake

DN Yadav, Mridula D and RK Gupta

Groundnut protein isolate with improved functional properties

The importance of proteins in the human diet is based not only on the nutritional quality but also on the functional properties. Processing of oilseed affects the functional properties of the proteinic products. Defatted peanut flour is a by-product of peanut oil extraction industry, contains 35-45% of protein with high nutrition value. It is dark in colour and has fibre, bitter compounds, which limit its food applications. The isolated groundnut protein has certain functional limitations *i.e.* low solubility, dispersibility, wettability etc. The functional properties can be modulated by carefully selecting operational variables during extraction (pH, temperature, solvent, presence of salts, ionic strength etc.). Further, enzymatic hydrolysis can be used to obtain products with desirable properties for food applications.

Commercial groundnut cake was purchased from local market, pulverized and sieved through 60 BSS sieve to obtain hull-less cake flour. Extraction of protein from purified ground nut flour was carried out at different cake water ratio (1:8, 1:10, and 1:12), shaking time (1, 2, 3 h) and pH 8.0, 9.0, 9.5 followed by filtration, centrifugation and protein precipitation at pH 4.5. The functional properties *i.e.* solubility, water holding capacity, oil binding capacity, foaming ability, dispersibility, wettability were determined. Crude protease extract from *Rhizosporus oligosporus* and *Aspergillus oryzae* were produced and used for hydrolysis of protein in order to improve the functional properties. Process parameters for preparation of protein isolate (95.0±1.5% protein) from commercial groundnut cake is optimized as cake water ratio 1:10, shaking time 2h at pH 9.5 followed by filtration, centrifugation and protein precipitation at pH 4.5. The protein suspension (16-18% solids) was spray dried to get free flowing powder. The water holding, oil binding and foaming

capacity of non-hydrolyzed protein isolate was 1.12 ± 0.15, 1.84 ± 0.17 and 1.1 ± 0.16 ml/g, which were significantly increased to 1.55 ± 0.02, 2.97 ± 0.07 and 1.35 ± 0.02 ml/g, respectively after hydrolysis with crude protease extract from *Aspergillus oryzae* (Table 8). The protein solubility of hydrolyzed protein sample was increased up to 60% in water at pH 6.0 against 9.6% for control. Dispersibilty and wettability were also significantly improved after hydrolysis with fungal protease extract. The ability of groundnut protein isolate to be functional is primarily due to their soluble protein contents. The solubility of proteins can be increased by enzymatic hydrolysis as evident from the results (Table 9, fig. 24). Hydrolyzed peanut protein (fig. 25) showed better functional properties, particularly, solubility, water holding and oil binding capacity and would be suitable for use in products like meats and sausage.

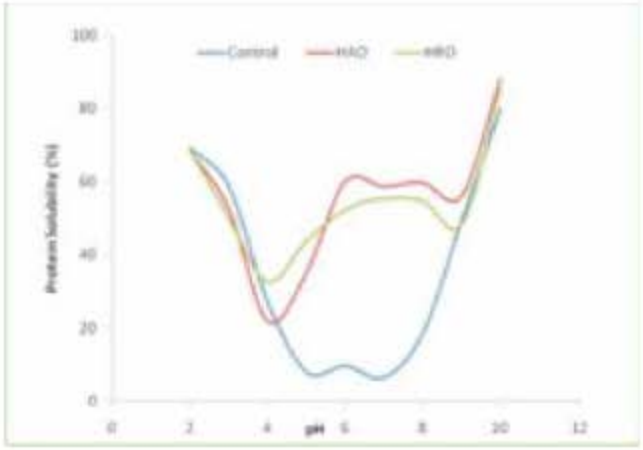


Fig. 24. Solubility of groundnut protein isolate at different pH as affected by hydrolysis.

Table 8. Effect of hydrolysis on functional properties of groundnut protein isolate

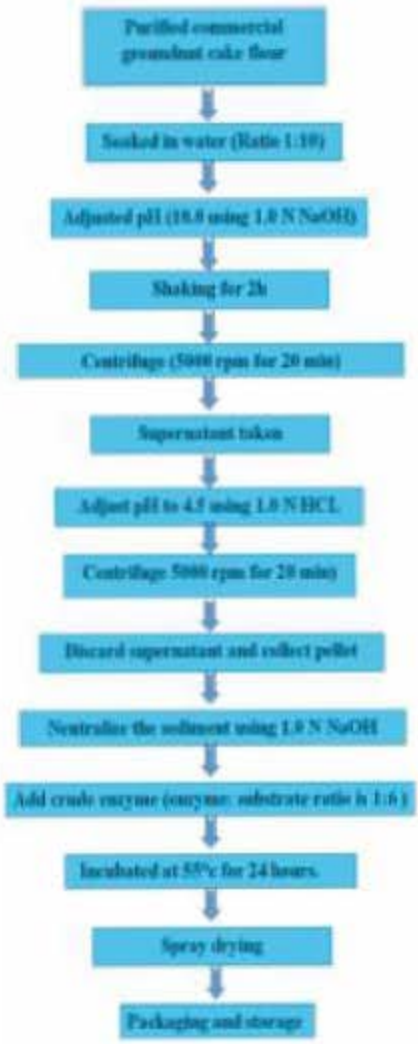
Sample	WHC (ml/g)	OBC (ml/gm)	FC (ml/g)	Dispersibility (%)	Wettability (s/0.1g)
Control	1.12 ± 0.05	1.87 ± 0.04	1.14 ± 0.06	26.89 ± 1.63	19.1 ± 2.4
HAO	1.55 ± 0.02	2.97 ± 0.07	1.35 ± 0.02	50.39 ± 1.03	11.9 ± 1.9
HRO	1.72 ± 0.01	2.94 ± 0.05	1.29 ± 0.03	41.92 ± 1.44	13.0 ± 2.0

HAO: Hydrolysed with crude extract of *Aspergillus oryzae;* HRO: Hydrolysed with crude extract of *Rhizosporus oligosporus;* WHC; Water holding capacity, OBC; Oil binding capacity, FC; Foaming capacity

Table 9. Effect of hydrolysis on solubility (%) of groundnut protein isolate at different pH

Sample	pH								
	2	3	4	5	6	7	8	9	10
	Solubility (%)								
Control	69.2	58.7	27.1	7.9	9.6	6.4	18.6	49.3	79.7
HAO	65.4	42.4	21.8	35.2	60.1	55.7	59.7	58.1	88.1
HRO	58.6	50.1	32.5	43.8	52.3	55.7	45.0	48.4	85.3

HAO: Hydrolysed with crude extract of *Aspergillus oryzae;* HRO: Hydrolysed with crude extract of *Rhizosporus oligosporus*



Crude protease extract from *Aspergillus*

Hydrolyzed groundnut protein isolate

Fig. 25. Process flowchart for preparation of hydrolysed groundnut protein isolate

Primary processing and value addition of pseudocereals

Alekshn Kadoo SK, Mridula D and RK Gupta

Performance evaluation of graders with modified screens for buckwheat grading

The mild steel screens of 3.5 mm diameter was fabricated according to the requirement of the machines adopted for buckwheat grading namely, pedal cum power operated air screen grain cleaner cum grader and indented cylinder separator (fig. 26 and 27). Experiments were conducted to determine the efficiency of the flat and circular screens in separating the buckwheat seeds and kernel. The screen in air screen grain cleaner cum grader has horizontal oscillating motion and slight vertical motion. These two motions in combination moved the kernel down the screen and at the same time slightly toss above the screen so that the mix of seed and kernel is properly stirred. The buckwheat kernels dropped through the screen opening by gravity and collected at one end. The seeds passed over the inclined screen and collected at the other end. The grading efficiency given by this machine was 53.43% when operated by electric motor (1470 rpm) and 83.82% during manual operation (60 rpm). In the indented cylinder separator, the horizontal rotating

cylinder was made using 3.5mm screen and used for grading. The mixture of seed and kernel was fed at one end of the cylinder. Due to gravity and centrifugal force, the kernels dropped into a trough placed below the cylinder and the seeds flew through the inclined cylinder and collected at the seed outlet. The efficiency in separating the seeds and kernels using this cylinder was determined as 78.50% (at 60 rpm). The flat screen (3.5 mm round openings) with horizontal oscillation may perform well at low operating speed for efficient separation of buckwheat seeds from the kernels.

Fig. 26. Pedal cum power operated air screen grain cleaner cum grader

Fig. 27. Indented cylinder

Mechanical behaviour of buckwheat (*Fagopyrum esculentum*) seed under compression loading

Fracture resistance of buckwheat seed was measured in terms of average compressive force, seed rupture force and energy absorbed at different moisture contents ranging from 7.53% to 23.46% db. Force and deformation curves were obtained using Texture Analyzer by compressing single seed with SMSP/25 probe. The results showed that the force required for initiating seed crack increased from 0.39 to 0.57 kg, and the energy absorbed at seed crack increased from 0.25 $x10^{-2}$ to 1.23 $x10^{-2}$ kg_f-cm with increase in moisture content from 7.53% to 23.46% db. But the rupture force decreased from 4.6 to 2.29 kg, with increase in moisture content and the rupture energy increased from 9.13 $x10^{-4}$ to 10.18 $x10^{-2}$ kg_f-cm up to the moisture content of 14.94% db followed by a decreasing trend with further increase in moisture content.

Grain amaranth cleaning

The size of the Amaranth grain is less than 1mm (~0.698mm) and the cleaning was achieved by using BSS sieve no. 14 (size of sieve opening is 1.201 mm) which removed all the mud and trash materials and BSS sieve no. 44 (size of sieve opening is 0.351mm) removed all the dust particles and powdered trash materials. Grading of grain amaranth seeds was achieved by using BSS sieve nos. 18 and 30. Hence for the development of cleaner cum grader for grain amaranth seeds, the sieves with opening sizes 1.2 mm, 0.9 mm, 0.4 mm may be employed.

Development of pseudocereal products

Buckwheat based extruded products

Dehulled buckwheat based expanded snack food (fig. 28) was developed with maize, sorghum and defatted soy flour. Extrusion was performed on co-rotating twin screw extruder (7.5 hp motor, 400 V, 50 cycles, L-TSE model, Basic Technologies Private Ltd., Kolkata) with die opening 3 mm. The process parameters *viz.* die head temperature (100-120°C), screw speed (275-325 rpm) and feed moisture

content (14-18% wb) were optimized using response surface methodology, following Box-Benken design (Table 10). Different experimental combinations of extrusion process variables *i.e.* screw speed (275-325 rpm), die temperature (100-120°C), moisture content (14-18%) were tried using a grain formulation, consisted of 40% buckwheat, 32% maize, 20% sorghum and 8% defatted soy flour. The results indicated that moisture content followed by die temperature had the most significant effect on expansion in diameter, bulk density, hardness and toughness. On the other hand, total phenols, antioxidant activity and overall acceptability were in turn significantly affected by moisture content of the feed material. The optimum operating conditions using selective quality parameters for screw speed, die temperature and moisture content were 315 rpm, 100°C and 14%, respectively, which indicated 54.961 kg/m^3 bulk density, 84.410 N hardness, 55.513 Nm toughness with 5.176 expansion in diameter, 5.176 mg/100g total phenols, 32.261% antioxidant activity and 7.913 overall acceptability thereby giving desirability of 0.835.

Table 10. Optimized process parameters for buckwheat extrudates

Parameters	Optimized value	Desirability
Screw speed (rpm)	315.954	
Temperature (°C)	100.906	0.835
Moisture content (%)	14.00	

Fig. 28. Buckwheat extrudates

Antioxidant rich buckwheat based pasta

Process parameters for development of antioxidant rich pasta (fig. 29) utilizing buckwheat, wheat and carrot following response surface methodology were optimized. Different experimental combinations involving variation in buckwheat flour from 20-40 g, carrot juice from 14-30 ml and wheat flour from 60-80 g were designed using Box-Benken design of experiments. The results revealed that pasta samples containing higher levels of buckwheat and carrot juice were high in total phenols and antioxidant contents. On the other hand, the samples with higher buckwheat content were also high in rehydration ratio and also took minimum cooking time along with low solid loss. Optimization was done in order to analyze the best experimental combination for pasta preparation. Optimization revealed that the samples containing 40 g buckwheat with 80 g wheat flour and 14 ml carrot juice indicated 306.748 mg/100g total phenols, 18.146% antioxidant activity, 4.21 min cooking time, 3.69 rehydration ratio and 3.32 % solid loss thereby giving desirability of 0.886 (Table 11).

Table 11. Optimized parameters for buckwheat pasta

Parameters	Optimized value	Desirability
Carrot juice (ml)	14.00	
Buckwheat flour (g)	40.00	0.886
Wheat flour (g)	80.00	

Fig. 29. Antioxidant rich buckwheat based pasta

Baked amaranth product

Muffins were developed using flour of pearled amaranth grain at 0, 20, 40, 60, 80 and 100% level. 100% wheat flour was kept as control (fig. 30). Muffin properties such as moisture content, height, colour, gas cell quantification, sensory evaluation and nutritional qualities were determined. Incorporation of amaranth flour (20%) resulted in 64% increase in height and further increment in flour level decreased the height of muffin. Ash content was more at 20% level. Protein content increased above the control sample in the muffins with >20% level of amaranth flour. Based on sensory analysis, 20% and 30% incorporation was found to be highly acceptable.

Fig. 30. Amaranth based muffins

Development of vegetable mixed-wadi making system

Sandeep Mann and Deepika Goswami

Quality characteristics of vegetable mix wadi prepared from spinach and radish

Wadi or *bori* is a popular traditional indigenous culinary item in many Indian dishes. Its typical hemispherical–conical shape is a strong aesthetic component of the product. It is generally prepared in rural areas using black gram (*Phaseolus mungo*) pulse. Vegetable mix *wadi* was prepared by incorporating spinach shreds at levels of 10, 20, 30 and 40 % in the *wadi* dough and the *wadi* samples were analyzed for physical, nutritional and sensory attributes. With increasing level of incorporation of spinach (shreds), the diameter of *wadi* increased whereas the height decreased (fig. 31); the bulk and true density both decreased and the colour of the *wadi* was also affected as evident by the decreasing 'L' value of *wadi* samples. Addition of spinach shreds increased the moisture content of the *wadi* dough and reduced the protein content and fat content in the vegetable mix *wadi*. However, an increase in mineral content was also observed which might be attributed

Fig. 31. *Wadi* prepared from spinach (shreds)

to higher mineral content in spinach than black gram.

Radish based vegetable mix *wadi* (fig. 32) were prepared by incorporating radish shreds at levels of 5, 10, 15, 20 and 25% and the formulation were evaluated for physico-chemical quality characteristics. The *wadi* samples were prepared from 20 g batter each. The height (mm) and diameter (mm) of *wadi* samples decreased from 23.64 mm and 33.20 mm in control to 19.90 mm and 32.06 mm, respectively. The weight loss in drying was also higher in radish *wadi* (Fig. 32) than that in control. However, the true density and bulk density increased with radish incorporation. The lightness indicated by 'L' value was higher for radish *wadi* as compared to that of control. The protein content of *wadi* samples

Fig. 32. *Wadi* prepared with mix vegetable (Radish)

decreased from 24.94 % in control to 19.54% in 25% radish *wadi*.

Design and development of Taro peeler

Sandeep Mann, SK Tyagi and Anil Dixit

A Taro peeler was designed and developed for peeling of Taro. The machine was fabricated in the ICAR-CIPHET Workshop. Taro peeling machine consists of five rollers having 102 mm diameter and 450 mm length each. The rollers are mounted over shaft of 25 mm diameter. The main components of the unit are (1) peeling chamber; (2) power transmission system (2) water spray system. The hollow pipe frame of the machine was fabricated in a rectangular shape to provide the strength and firmness to the machine. The prototype is 470 mm wide, 750 mm long, 960 mm high and fabricated with mild steel square pipe 25mm x 25mm x 1.25 mm. The body was covered by using stainless steel sheet of 0.95 mm thickness to avoid rusting. Five numbers of 102 mm diameter brush rollers were installed in concave shape to enhance the effect of friction. Conceptual design of machine is shown in fig. 33. A provision was made to spray water while running the machine as shown in fig. 34. It receives torque from 1 HP electric motor with speed of 1500 rpm. The drive system consists of belt and pulley arrangement with maximum machine speeds (SP) of 750 rpm. Moreover, variation in speed was achieved by speed changer device.

Fig. 33. Taro peeling machine design

Fig. 34. Water spraying mechanism for washing

Fig. 35. Taro available in market

Fig. 36. Peeled taro

Different sizes of Taro (five kg, fig. 35) per batch were put into the peeling chamber manually. The peeling at 100 rpm speed gave the best result with peeling efficiency of 95% (fig. 36). Per batch peeling takes about 1 minute for peeling with water consumption of 1.25 litre. Peeled taro can be transferred to the collecting container by opening shutter of outlet chute. The capacity of the machine was found to be 200-250 kg/h with peeling efficiency of 95-97% with negligible breakage of taro. An estimated processing time of this machine is about 1minute/ 5kg. The performance test results are encouraging in terms of lower energy and water consumption and negligible breakage rate with good peeling quality. The machine is easy to use, safe to operate, easy to repair and easy to maintain, low

operating cost, small in size, has low weight with low noise and vibration.

Development of fat replacer & hydrocolloid from pearl millet and barley

Monika Sharma, DN Yadav and AK Singh

Heat moisture treated pearl millet starch

Heat moisture treatment (HMT) of pearl millet starch was carried out at three moisture levels (20, 25, and 30%) for two different treatment durations (4 & 8h) at 110 °C. The effect of HMT conditions on colour values, functional, structural, rheological and thermal properties was studied and observed that it improves the functional properties of native pearl starch (Table 12, 13). The moisture content and treatment time of heat moisture treatment (HMT) significantly affects all the functional, structural, rheological and thermal properties of pearl millet starch. Dextrose Equivalent (DE) value was in the range of 3.97-8.37 for all the heat moisture treated samples. Modified starches with low DE are potential fat replacers owing to good water binding properties. It indicates that these samples can be utilized as fat replacers as the DE value is below 10. It was observed that HMT improves the resistant starch content in pearl millet starch. The gelatinization temperature of native pearl millet starch was 62.59°C and increased to 84.05°C after HMT at 30% moisture. Scanning electron microscope studies showed HMT at higher moisture level (30%) caused cavity on starch granules and also induced some dents/holes on the starch granule surface (fig. 37). Yield point and flow point of starch gels also decreased after HMT of starch, indicating

Table 12. Functional properties of HMT pearl millet starch

Sample	Resistant starch (%)	Dextrose equivalent	Water absorption index (%)	Water solubility index (%)	Oil absorption capacity
Native	2.41	0.00	208.66	5.96	1.31
20%, 4h	4.08	3.97	198.43	2.45	2.54
20%, 8h	4.97	6.73	214.97	3.00	2.39
25%, 4h	5.38	7.68	245.33	3.39	2.80
25%, 8h	5.97	5.67	240.67	1.51	2.40
30%, 4h	6.14	7.35	283.67	1.36	3.15
30%, 8h	7.07	8.37	266.67	1.85	2.70

Table 13. Colour values of HMT pearl millet starch

Sample	L	a	b	z	Hue	Chroma	ΔE
Native	96.90	-0.27	2.00	89.59	82.44	2.02	0.34
20%, 4h	93.44	0.27	3.42	79.68	85.56	3.43	3.78
20%, 8h	92.33	0.44	4.38	76.05	84.30	4.40	5.20
25%, 4h	93.25	0.36	4.61	77.76	85.51	4.63	4.54
25%, 8h	91.67	0.75	4.55	74.42	80.57	4.61	5.91
30%, 4h	91.74	0.61	4.81	74.27	82.79	4.85	5.95
30%, 8h	90.31	0.89	5.48	70.49	80.76	5.55	7.55
Significance	***	***	***	***	***	***	***

reduced gel rigidity. Heat moisture treated (HMTd) starch gels exhibited the phenomenon of homogeneous deformation, spreadability and gel softness, owing to balanced ratio of elastic and viscous portion (fig. 38-41). HMTd pearl millet starch may find applications in heat processed food as well as in frozen food products. Outcomes of this research will form the platform for future

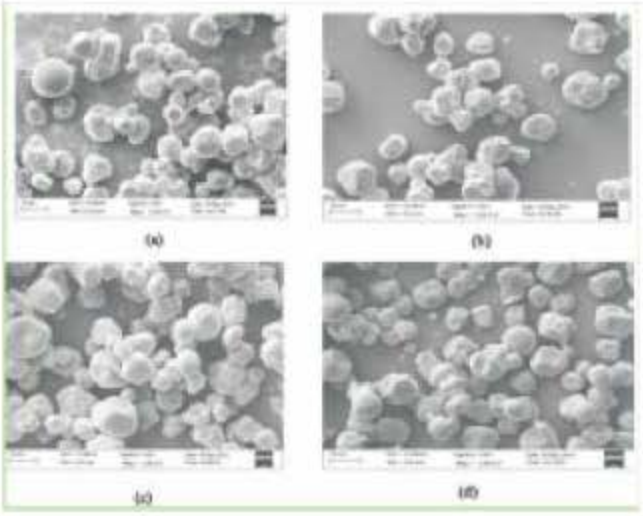


Fig. 37. Scanning electron micrographs of native (a) and HMTd pearl millet starches; HMT-20 (b), HMT-25 (c); HMT-30 (d)

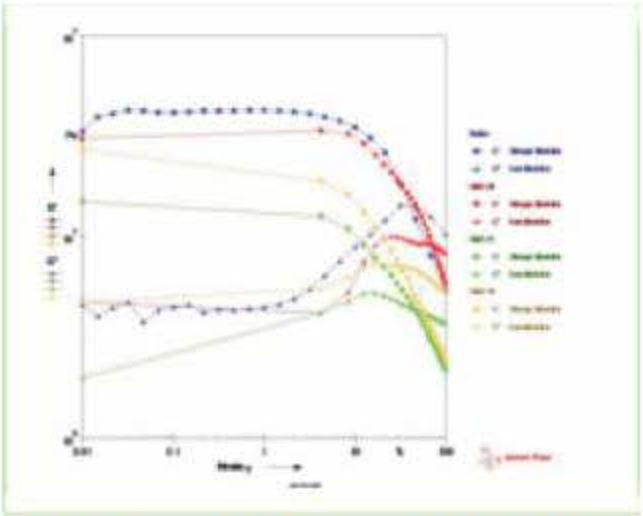


Fig. 38. Changes in G' (storage modulus) and G'' (loss modulus) as a function of variable strain for native and HMTd pearl millet starch gels (5%)

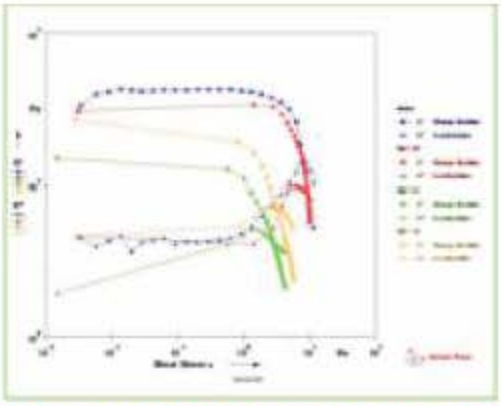


Fig. 39. Changes in G' (storage modulus) and G'' (loss modulus) as a function of variable stress for native and HMTd pearl millet starch gels (5%)

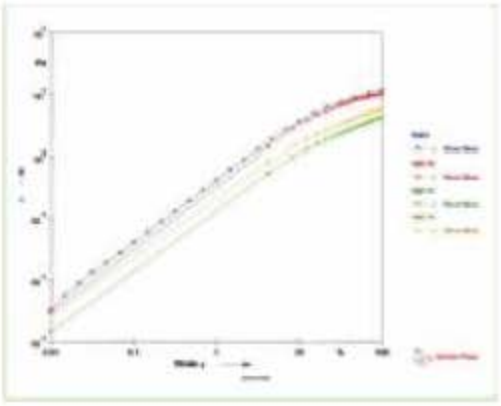


Fig. 40. Relationship between shear stress and strain for native and HMTd starch gels (5%)

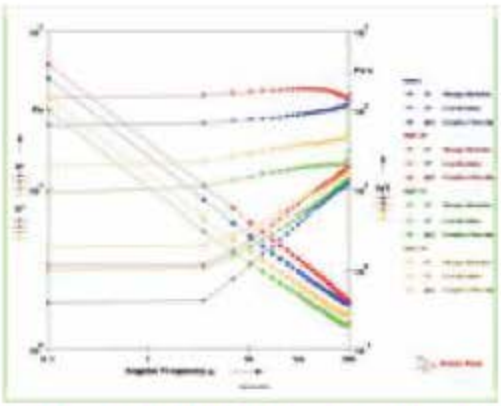


Fig. 41. Visco-elastic behaviour of native and HMTd starch gels (5%) as a function of frequency

investigations and applications of heat moisture treated pearl millet starch in food industry.

Chemically modified pearl millet starch

Chemically modified pearl millet starch using octenyl succinic anhydride with variable incubation time of 2, 3, 4 and 5 hours. The samples were analyzed for rheological, functional, pasting and chemical properties (fig. 42-43). The peak viscosity varied from 4757 to 5409 cP for the OSA starch samples. Pasting temperature varied from 67.8 to 76.3 °C. The degree of substitution varied from 0.018 to 0.0216. Oil absorption capacity ranged from 2.37 to 2.66 g/g. Chemical modification also increased the resistant starch content of pearl millet starch (Table 14).

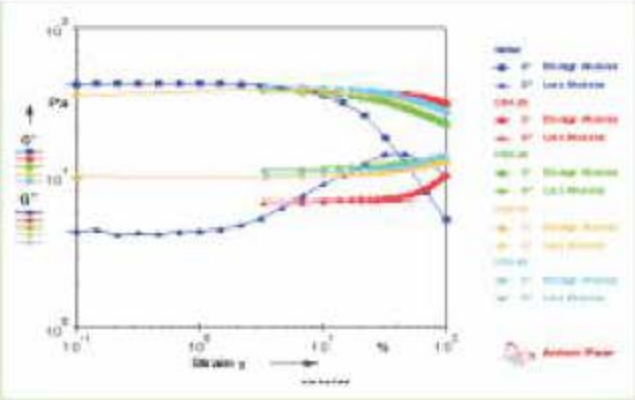


Fig. 42. Changes in G' (storage modulus) and G" (loss modulus) as a function of variable strain for native and OSA modified pearl millet starch gels (5%)

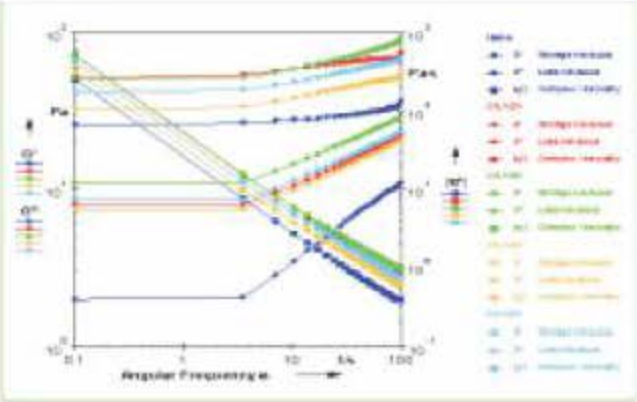


Fig. 43. Visco-elastic behaviour of native and OSA modified pearl millet starch gels (5%) as a function of frequency

Development of taste enhancer using mustard protein isolate

(Divisional Activity)

SK Tyagi, Sangita Bansal and Monika Sharma

Process protocol for de-hulling of mustard seeds

Mustard/ rapeseed is one of the major oilseed crops of India. Most of the mustard seeds are used for oil extraction in Ghanies or expellers. In the traditional processing of mustard/ rapeseed, the material is crushed without dehulling. The hull imparts dark color and contributes high amount of crude fiber (27%) in the meal. The dark color cake finds very limited use in the food/ feed purposes

Table 14. Functional properties of OSA pearl millet starch

	OAC	RS	DS	RE
Native	2.407±0.029	2.48±0.055	0.00	0.00
OSA,2H	2.602±0.015	13.28±1.178	0.018±0.00	79.28±1.398
OSA,3H	2.616±0.0078	12.35±0.176	0.0208±0.0003	90.58±1.33
OSA,4H	2.52±0.061	10.364±0.744	0.0213±0.0001	92.61±0.435
OSA,5H	2.67±0.017	11.72±0.149	0.022±0.0001	93.91±0.435

(Bell, 1984). Therefore, efforts were made to develop a method for dehulling of mustard seeds. The mustard seeds were ground either coarsely or finely. Coarse grinding using mortar and pestle (fig. 44a) and fine grinding using Sujata mixi grinder (fig. 44b) was done. After grinding the seeds were boiled with water for about 15 min. This mixture was incubated for 24 hrs, the light hull settles at the bottom and de-hulled seeds form layer above the hull as shown in fig. 45. After this the de-hulled seed powder was separated by slowly sieving out using U.S. mesh 100. The wet de-hulled seed powder was spread and dried in a tray (fig. 46). Coarsely grinded seeds have better dehulling efficiency of 73.5% as compared to 65% efficiency of the fine grinded seeds.

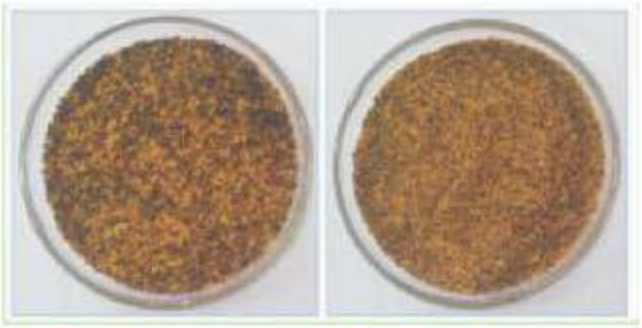


Fig. 44. Mustard seeds grinded using a) mortar and pestle and b) Sujata mixi grinder

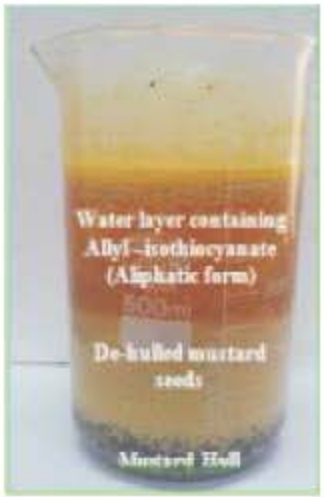


Fig. 45. Mustard seeds soaked in water

Fig. 46. De-hulled mustard flour

Process protocol for de-hulling of mustard cake

For de-hulling, mustard cake was grinded using Sujata mixi grinder as grinding was found to be difficult using mortar and pestle (fig. 47). For de-hulling, the boiling and soaking method as described in previous section for de-hulling of mustard seeds was tried. Unlike previous results with coarsely grinded seeds, this time a homogeneous mixture of mustard hull and de-hulled mustard cake powder was obtained. So, sieving method was tried to separate hull. The grinded mustard cake was sieved sequentially using U.S. mesh 30 and 52. The mustard cake powder along with some hull was obtained in the pan. Much of the mustard cake hull (fig. 48a) from the mustard cake seed powder (fig. 48b) was separated by this method. The recovery of low hull mustard cake powder was found to be 52.73%. The fractionation and recovery efficiency of mustard cake powder is shown in Table 15.

Fig. 47. Mustard cake after third pass and Grinded Mustard cake

Fig. 48. a) Low hull and b) High hull fraction of mustard cake

Table 15. Fractionation of mustard cake powder

S.No.	Sample		Weight (gm)	Efficiency of recovery (%)
1.	Mustard cake powder		1650	100
2.	Low hull fraction of mustard cake powder (mustard cake flour)		870	52.73
3.	High hull fraction of mustard cake powder	Mustard cake on U.S mesh 30	272	16.48
		Mustard cake on U.S mesh 52	470	28.48
4.	Fines and wastage		38	2.30

Production of potato flour and starch and its use for product diversification and value addition

SK Tyagi, RK Gupta, Mridula D, Sandeep Mann and Chandan Solanki

Development of potato peeler cum washer

For processing of potatoes in any form, peel removal is an important unit operation. Hence, a power operated potato peeler two in one in action (fig. 49) was designed and developed by ICAR-CIPHET for peeling and washing of potatoes. The main components of the machine are (1) abrasive roller (2) power transmission system (3) water spray system (4) water lifting pump. The peeling drum with protrusions on the inside surface rotates and detaches peel from potatoes by abrasion. The machine works on the principal of abrasive peeling. The water spraying unit washes the potatoes and simultaneously peel is removed from the drum through the perforation along with the flow of water.

Potato peeling machine consists of abrasive roller with 355.6 mm diameter and a steel drum having 487.7 mm diameter and 956.2 mm long each. The roller is surrounded with steel drum and both rotate in opposite direction. The frame is fabricated in a rectangular shape to provide the strength and stability to the machine. The prototype is 660.4 mm wide, 1143 mm long, 1192.8 mm high and fabricated with mild steel angle iron 40 mm x 40 mm x 5 mm. The body was covered by using m.s. steel 0.95 mm thick and painted with enamel paint to avoid rusting. It receives torque from 1 HP electric motor with speed of 1440 rpm. The drive system consists of belt and pulley arrangement with maximum machine speeds (SP) of 432 rpm. Moreover, reduction in speed was achieved by larger size pulley.

Fig. 49. Potato peeler cum washer

The machine is very efficient with very less water consumption *i.e.* 6kg/liter. Peeled Potato can be transferred to the collecting container by opening shutter of outlet chute. The capacity of the machine was found to be 400 kg/h with peeling efficiency of 97%. The machine cost around Rs. 50,000/- along with an electric motor. The performance test result are encouraging in terms of lower energy and water consumption and negligible breakage rate with good peeling quality and is suitable for small scale processing of potato chips and other products.

Physicochemical characterization of safflower oil using supercritical and solvent extraction

(Divisional Activity)

Manju Bala and SK Tyagi

A study was undertaken to optimize the extraction of safflower seed oil by using supercritical carbon dioxide. Response surface methodology was used to evaluate the effects of the process parameters, namely extraction pressure, temperature and static extraction time on the yield of safflower seed oil. The linear term of pressure, followed by the quadratic term of pressure, had significant effects on the oil yield ($p < 0.05$). Optimum yield of safflower seed oil from the mathematical model was predicted to be 26.78% on dry weight basis under the conditions of pressure 449.2 Bars, temperature 80°C and static extraction time of 75 min. Colour, acid value, saponification value, induction time of safflower seed oil extracted using supercritical CO_2 were compared with that obtained by Soxhlet method. Minor differences were found in all the studied parameters of the oils extracted by the two methods. Acid value of oil extracted using supercritical CO_2 was approximately 2½ times lower than the value obtained for the oil from solvent extraction (Table 16). However, a slightly shorter induction period was recorded for the supercritical CO_2 extracted safflower seed oil as compared to the solvent extracted oil at all the studied temperatures *i.e.* 120°C, 140°C, 160°C and 180°C.

Extraction of bioactive compounds from safflower defatted seed meal and utilization in food matrix

(Divisional Activity)

Manju Bala and Deepika Goswami

The present study was undertaken to optimize a procedure for extraction of phenolics from safflower defatted seed meal using response surface methodology (RSM) and assess its antioxidant potential. The response surface methodology by applying Box–Behnken design was used to optimize and evaluate three independent variables; temperature (60-80°C), solvent concentration (50-80%), and extraction time (1-3 h) on the extraction yield, total phenolic content and DPPH radical scavenging activity of the extract. Minimum concentration of extract to inhibit 50% activity of DPPH was calculated. RSM was applied, and the coefficients R^2, adjusted R^2, standard deviation (SD), Mean, and CV% were computed.

Table 16. Comparison of physicochemical properties of hexane and SCFE extracted safflower seed oil

Parameters	Hexane Extracted	SCFE Extracted (P:450bars, T:80°C, static extraction time:75 min)
Oil (%)	24.28	26.62
Colour Reading	16.90	14.40
Saponification value	188.00	185.98
Peroxide value (meqv./kg)	9.78	8.04
Acid value (%)	1.77	0.73
Induction time (h)		
at 120°C	0.49	0.40
at 140°C	0.20	0.05
at 160°C	0.16	0.03
at 180°C	0.03	0.02

The results obtained for yield (Y_1, %), phenolic content based on dry weight of the extract (Y_2, gGAE/100g extract) and DPPH radical scavenging IC_{50} (Y_3, µg/ml) were in the range of 10.8-14.25%, 12.62-19.91 gGAE/100g extract, and 83.0-122.0 µg/ml, respectively. Analysis of variance (ANOVA) showed that the resultant second order polynomial model adequately represented the experimental data with the coefficient of multiple determinations (R^2) for the responses of phenolic content and DPPH radical scavenging IC_{50} yields being 0.888 and 0.924, respectively.

Response surface analysis

The best way to visualize the effect of the independent variables on the dependent ones is to draw surface response plots of the model, which were done by varying two variables within the experimental range and holding the one constant at the central point. The results showed that significant models were found for the two dependent variables phenolic content based on dry weight of the extract (Y_2, gGAE/100g extract), and DPPH radical scavenging IC_{50} (Y_3, µg/ml). In present model, yield (Y_1, %) of the extract showed minor variations under different conditions and was not affected significantly. However, quadratic effect of temperature and interaction effect of temperature and percentage of solvent significantly affected the yield of extract. The variable with the largest effect on the phenolic content was the quadratic term of temperature ($p<0.01$). All quadratic effects as well as interaction effect of percentage of solvent and time, also significantly affected the phenolic content (Table 17). The results revealed that in linear terms, only temperature had the significant ($p< 0.05$) effect on the phenolic content gGAE/ 100g extract (Y_2) response as compared to other independent variables studied. However, the variable with the largest effect on the DPPH activity (IC_{50}) was the linear term of temperature ($p<0.001$).

Multiple regression coefficients were determined by the least-squares technique in order to predict quadratic polynomial models for the tested response variables and the regression equations were obtained as shown below:

$$Y_1 = +13.18 - 0.65\,T - 0.16\,C - 0.081\,t - 0.40\,TC + 0.16\,Tt - 1.09\,Ct + 0.38\,T^2 - 0.80\,C^2 - 0.42\,t^2$$

$$Y_2 = +13.41 + 1.35\,T - 0.11\,C + 0.48\,t + 0.87\,TC + 0.79\,Tt + 1.37\,Ct + 2.43\,T^2 + 1.56\,C^2 - 1.43\,t^2$$

$$Y_3 = +101.67 + 16.46\,T - 2.25\,C - 0.041\,t + 2.00\,TC - 0.41\,Tt - 1.17\,Ct + 1.12\,T^2 + 1.71\,C^2 + 2.79\,t^2$$

and regression coefficients have been shown in Table 17.

Fig. 50 represents response surface plots showing the effect of percentage of solvent used and temperature. The results showed that by increasing the temperature and solvent fraction, total phenolic content decreased. This could be due to the degradation of polyphenols and decrease in the polarity of solvent at higher temperatures.

IC_{50} is the concentration of extract which is required to inhibit DPPH activity. For the extract to be more active IC_{50} should be low. The more potent the antioxidant activity of the extract, less is the IC_{50} value. From a 3D surface plot (fig. 51), it was observed that radical scavenging ability decreased with the increase in temperature in these parameters, and the percentage of inhibition of DPPH radicals started declining. Table 17 represents that all quadratic effects and interaction effect of

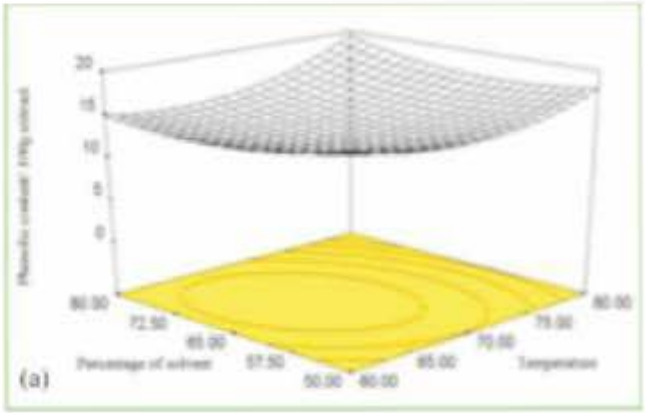


Fig. 50. Surface plot of the phenolic content gGAE / 100g extract (Y2) as a function of temperature and percentage of solvent

Table 17. Regression coefficients of the fitted quadratic equation and standard errors for the yield of extract % (Y1), phenolic content gGAE/ 100g extract (Y2) and DPPH activity IC 50 µg/ml

Regression coefficient	Yield of extract (%), Y_1		Phenolic content gGAE/ 100g extract, Y_2		DPPH activity IC_{50} (µg/ml), Y_3	
	Regression coefficient	Standard error	Regression coefficient	Standard error	Regression coefficient	Standard error
β_0	13.18	0.38	13.41	0.51	101.67	2.26
Linear						
β_1	-0.65	0.3	1.35*	0.4	16.46***	1.78
β_2	-0.16	0.3	-0.11	0.4	-2.25	1.78
β_3	-0.081	0.3	0.48	0.4	-0.041	1.78
Quadratic						
β_{11}	0.38	0.42	2.43**	0.56	1.12	2.46
B_{22}	-0.8	0.42	1.56*	0.56	1.71	2.46
B_{33}	-0.42	0.42	-1.43*	0.56	2.79	2.46
Interaction						
β_{12}	-0.4	0.43	0.87	0.57	2	2.52
β_{13}	0.16	0.43	0.79	0.57	-0.41	2.52
β_{23}	-1.09*	0.43	1.37*	0.57	-1.17	2.52

*$p < 0.05$ **$p < 0.01$ *** $p < 0.001$. β_0 is a constant, β_i and β_{ij} are the linear, quadratic and interactive coefficients of the second order polynomial equation, respectively.

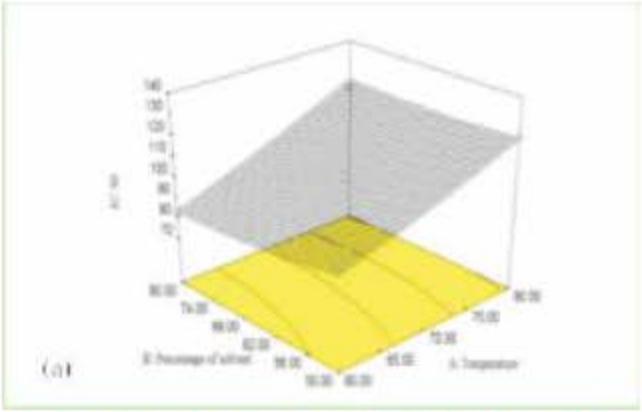


Fig. 51. Surface plot of the DPPH activity IC_{50} (µg/ml) (Y3) as a function of temperature and percentage of solvent

temperature and percentage of solvent had significant effect on DPPH radical scavenging activity IC_{50} (Y_3).

Optimization of extraction conditions

Response optimization was conducted to predict the optimum levels of independent variables leading to the desired response goal. The numerical optimization result showed that the overall optimum area was predicted to be obtained by extraction at the combined level of temp. (60°C), solvent percentage (80%) and extraction time (2.7h) with desirability of 0.700. The corresponding predicted response values based on the final model for, the yield of extract, phenol content and IC_{50} value were selected as optimum 12.50%, 15.09 g GAE/100g extract and of 84.61µg/ml.

Utilization of peanut cream for preparation of mayonnaise

(Divisional Activity)

Swati Sethi

After the extraction of peanut milk, the co-product *i.e.* peanut cream was utilized for preparation of mayonnaise (fig. 52 and 53). The peanut cream at the level of 10%, 20%, 30% and 40% was replaced with peanut oil in the method of preparation. The formulations were prepared with the following ingredients: peanut oil and peanut cream, eggs, vinegar, salt, sugar, mustard powder and white pepper. The mayonnaise emulsions were prepared using a household blender at constant speed. First, the aqueous phase ingredients were mixed for 2 minutes and then slowly peanut oil and peanut cream was added with continuous blending for 3 minutes in order to form a uniform emulsion. To stabilize the emulsion, stabilizer was added at the rate of 0.2% and blended for 1 minute. The quality of mayonnaise was studied in terms of free fatty acids, peroxide value and emulsion stability. The free fatty acids and peroxide value of mayonnaise was found to be 0.51% and 2.032 meq/kg fat with a thermal creaming value of 9.32%.

Fig. 52. (a) Peanut cream, (b) peanut cream mayonnaise

Development of oat-peanut based milk alternative

(Divisional Activity)

Swati Sethi

Cow milk allergy, lactose intolerance, caloric concern, prevalence of hypercholesterolemia, trend towards vegan diets has influenced consumers

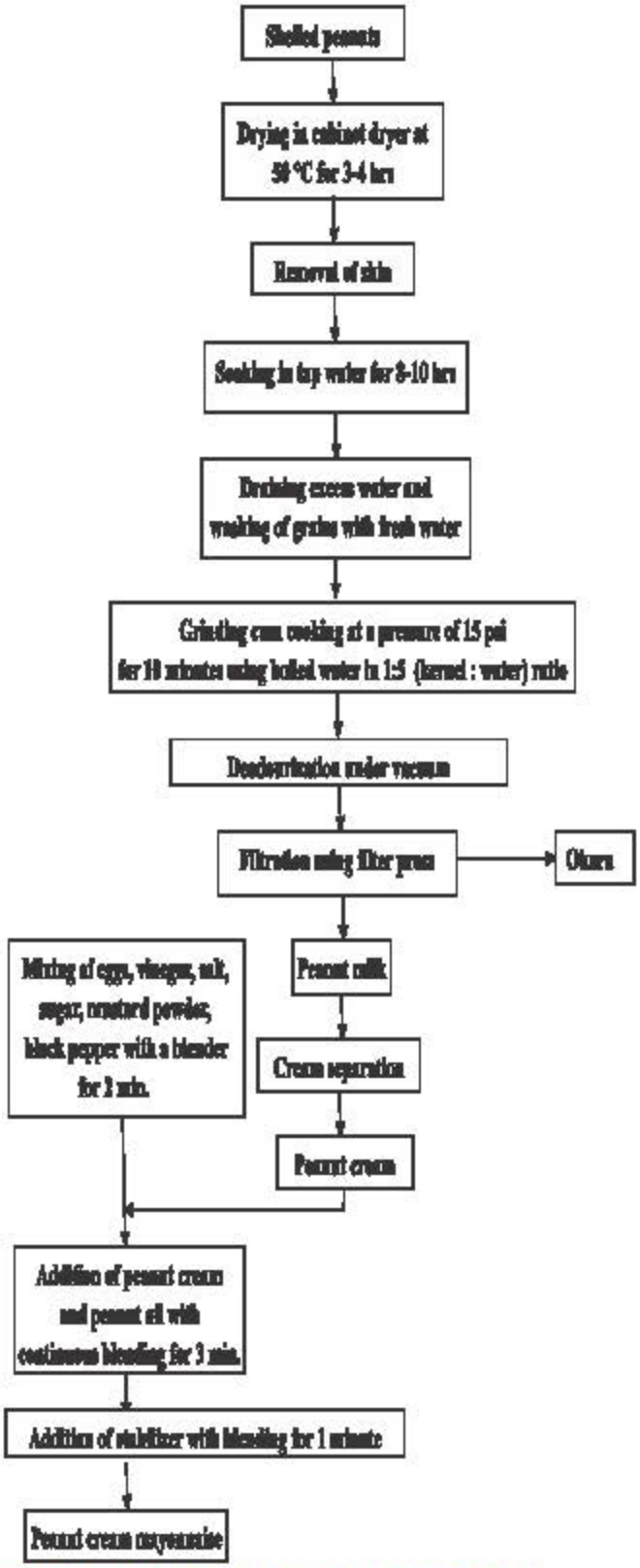


Fig. 53. Process flow chart for preparation of peanut cream mayonnaise

towards choosing cow milk alternatives. In view of this demand, oat milk blended with peanut milk in different combinations was studied. Preliminary trials were conducted to prepare oat-peanut based milk alternative (fig. 54). Oats at a level of 10%, 20%, 30%, 40% and 50% were added to peanut slurry to prepare blended oat-peanut based milk alternative. The flow chart for preparation of blended milk alternative is shown in fig. 55 For preparation of milk alternative, oats and peanuts were soaked separately for 8-10 hrs in tap water at room temperature.

Fig. 54. Preparation of oat-peanut based milk alternative

The grains were then drained and washed with tap water. After draining, the grains were blended with boiled water in a ratio of 1:5 (grains: water) and transferred to a grinder cum cooker vessel for simultaneous grinding and cooking for 10 minutes. The slurry was then subjected to vacuum for partial removal of beany flavor. The extract was then filtered through a filter press to separate okara. The pH, acidity, total solids and ash content of blended milk alternative was found to be 6.82, 0.32%, 13.65% and 0.34%, respectively. Increased settling of solids or sedimentation was observed with increase in the level of oats in the blended milk alternative owing to its high starch content however, addition of oats reduced the occurrence of beany flavor.

Fig. 55. Process flow chart for preparation of oat-peanut based milk alternative

HORTICULTURAL CROP PROCESSING DIVISION

Development of process protocol for de-bittering of kinnow juice

Sunil Kumar, Ramesh Kumar and PC Sharma

Purification and characterization of limonoate-D-ring lactone hydrolase

Kinnow mandarin (*Citrus reticulata)* is one of the major citrus fruit crops of India with an annual production of over 0.5 million metric tonnes. Its fruits are mainly consumed as fresh in the form of juice. But the development of delayed bitterness is the major problem in its processing which is caused by the development of limonin. During juice processing and storage, an enzyme (Limonoate-D-ring lactone hydrolase mainly present in seeds), catalyses the conversion of limonoate A-ring lactone/LARL (a non-bitter precursor) to bitter limonin in acidic condition of juice, resulting in delayed bitterness of extracted kinnow juice. Thus, an experiment was carried out to know the basic biochemistry of enzyme LDLH in development of delayed bitterness in order to remove bitter compound from the processed juice. The purification process comprised sequential preparation of crude extract, saturation by ammonium sulphate and molecular exclusion chromatography using seralose CL-6B. The entire process progressed as given in flow diagram (fig. 56).

Preparation of crude extract of limonoate-D-ring-lactone hydrolase enzyme (LDLH): Kinnow seeds were extracted from kinnow fruits after their juice extraction, washed, dried under shade at room temperature, packed in LDPE bags and stored at ambient and dried place until their intended use. The enzyme was extracted by doing slight modifications of the method adopted by Breska III and Manners (2004). The seeds were ground in 0.1 M Tris (pH 8.0) extraction buffer containing 1% NaCl and 3% polyvinylpyrrolidone (omitting use of sodium dodecyl sulphate). The resulting broth was placed in a shaker (150 rpm) for 3h and filtered through two layers of cheese cloth afterwards. The extract was

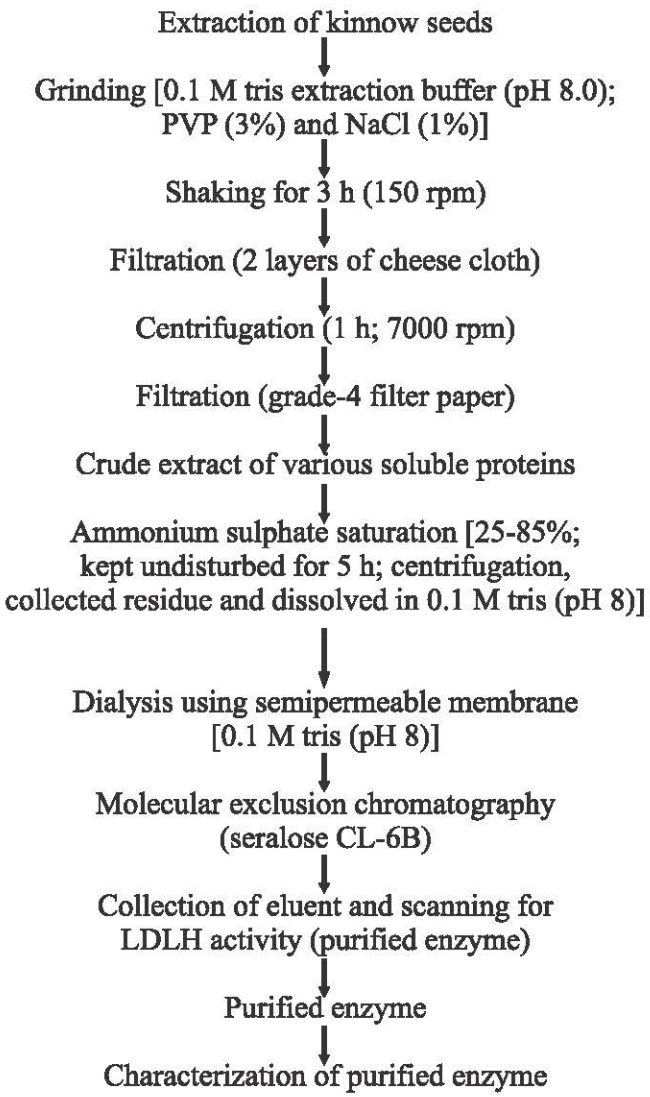


Fig. 56:Process flow chart for purification and characterization of limonoate-D-ring lactone hydrolase enzyme

centrifuged in a refrigerated centrifuge at 7000 rpm for 60 min and then supernatant was filtered sequentially through bloating paper and grade-4 filter paper. Total soluble protein from a lot of 1.5 kg of kinnow seeds was found to be 60440.6 mg for crude extract. The initial specific activity in crude extract was 7.644 units/mg protein.

Estimation of LDLH: High pressure liquid

chromatography/HPLC (Model: D-2000 Elite; Make: Hitachi, Japan) consisted of reverse phase C18 column and diode array detector was used for estimation. For LDLH enzyme, 520 µl of Tris buffer (0.1 M; pH 8.0), 50 µl of 40% acetonitrile, 400 µl of 2 mM limonin and appropriately diluted enzyme extract were mixed thoroughly and incubated at 37°C in a water bath for a defined time. After completion of reaction, 20 µl of 0.25 M EDTA was added to the reaction mixture. A control containing all the above except enzyme was also run simultaneously and 80 µl of each (control and reacted) fed for HPLC analysis. The decrease in limonin concentration was monitored at 210 nm at a flow rate of 1 ml/min through diode array detector (DAD) (Fig. 57). The peak area were quantified and converted to ppm using limonin standard curve and expressed in ppm of limonin degraded/min.

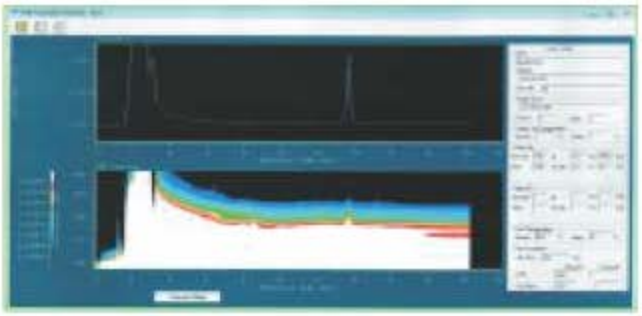


Fig. 57. LDLH estimation by HPLC

Ammonium sulphate saturation of limonoate-D-ring lactone hydrolase: The crude extract prepared as above was subjected to precipitation with ammonium sulphate. Based on the preliminary standardizations, the crude enzyme was subjected to 0-25% $(NH_4)_2SO_4$ saturation, left for 5 h undisturbed and centrifuged at 7000 rpm for 40 min. The precipitate was discarded as it had negligible LDLH activity and the resulting supernatant was brought to 85% $(NH_4)_2SO_4$ saturation. The precipitate collected after 5h by centrifugation (7000 rpm, 40 min) had enough LDLH activity. The 25-85% fraction was dissolved in minimum amount of Tris buffer (0.1 M; pH 8.0), reduced volume osmotically and dialyzed for 24h against the same buffer with repeated changes of buffer while the supernatant left after 85% $(NH_4)_2SO_4$ saturation was subjected to 100% $(NH_4)_2SO_4$ saturation. The broth was left undisturbed for 5h and centrifuged at 7000 rpm for 40 min. The resulting pellet was also analyzed for LDLH activity. The dialyzed fraction (85% saturation) having highest LDLH activity (Table 18) was concentrated by osmosis against solid sucrose and was further fed for molecular exclusion chromatography step. The specific activity (19.67 units/mg protein) was highest in 25-85% saturated fraction with a fold purification of 2.57 and an overall yield of 19.24% (Table 18).

Thus, the 25-85% fraction was selected for further purification. The total volume of this fraction was 1026 ml, so was concentrated via osmosis using solid sucrose; dialyzed against 0.1 M Tris buffer (pH 8.0) using semipermeable membranes for 24 h with slow and constant stirring with repeated changes of buffer (fig. 58a, b). The sample was concentrated by osmosis and loaded onto seralose CL-6B column.

Table 18: Ammonium sulphate activity profile of enzyme limonoate-D-ring lactone hydrolase

Ammonium sulphate saturation	Total volume (ml)	Total protein (mg)	Total activity (units)	Specific activity (units/mg protein)	Fold purification	Yield (%)
0-25%	637.0	28792.4	7955.2	3.62	0.47	6.28
25-85%	1026.0	4485.7	88236.0	19.67	2.57	19.24
85-100%	435.0	1039.3	4923.3	4.74	0.62	1.07

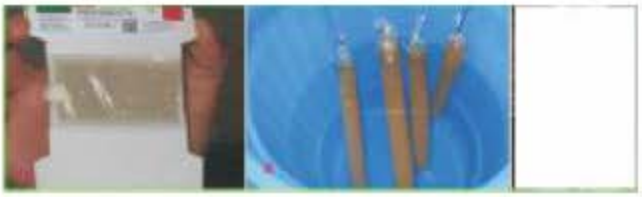


Fig. 58: (a) Dialysis membrane (b) Process of dialysis (c) Molecular exclusion chromatography

Molecular exclusion chromatography using Seralose CL-6B: The osmotically concentrated fraction of step 2 was loaded onto a Seralose CL-6B (1.8 x 22 cm) column (pre-equilibrated with 0.1 M Tris buffer (pH 8.0) for 10 h (Fig. 58c). The enzyme was eluted with same buffer at a flow rate of 25 ml/h. The fractions of 5.0 ml each were collected, analyzed for protein (280 nm) and for LDLH activity via HPLC. The active fractions showing LDLH activity were concentrated using sucrose (osmosis) and used as purified LDLH enzyme. The concentration of protein at every step was determined by the method of Bradford (1976) using bovine serum albumin (BSA) as standard while LDLH estimation at every step was performed as given in step 1.

The elution profile of LDLH enzyme and the distribution of protein on seralose CL-6B column chromatography are shown in fig. 59. The LDLH activity was present in fraction number 68-82. Fractions with LDLH activity were pooled and used for further characterization. The summary of sequential purification procedures and the results for LDLH are given in Table 19. The LDLH was purified about 74.11 fold with 5.02% yield. The specific activity of purified LDLH was 566.52 units/mg protein (Table 19).

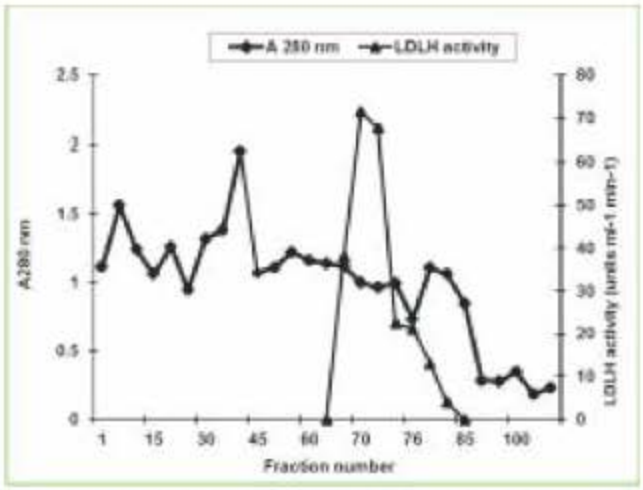


Fig. 59: Elution profile of Limonoate-D-ring lactone hydrolase on Seralose CL-6B column

Determination of molecular weight of LDLH: Molecular weight of the purified enzyme was determined by molecular exclusion chromatography on a Seralose CL-6B column. The molecular weight was determined using a plot of v_e/v_o *vs.* log molecular weights of standard proteins (Whitaker 1963) where V_e is the elution volume and V_o is the void volume. The enzyme LDLH eluted at 350 ml via Seralose CL-6B column chromatography. The molecular weight of purified LDLH as determined by molecular exclusion chromatography was found to be 224 kDa.

SDS polyacrylamide (disc) gel electrophoresis (PAGE) was performed as per the procedure of Laemmili (1970) to find out the subunit composition and molecular weight of LDLH. The samples were loaded onto 4% stacking gel at a current of 20 mA

Table 19: Summary of purification of enzyme limonoate-D-ring lactone hydrolase

Purification step	Total volume (ml)	Total protein (mg)	Total activity (units)	Specific activity (units/mg protein)	Fold purification	Yield (%)
Crude extract	7800.0	60440.6	458640.0	7.64	1.00	100.00
Ammonium sulphate saturation (25-85%)	1026.0	4485.7	88236.0	19.67	2.57	19.24
Molecular exclusion chromatography (Seralose CL-6B)	13.0	40.7	23037.2	566.52	74.11	5.02

while the bands were resolved on resolving gel (10%) at current of 40 mA. The gels were stained using Coomassie Brilliant Blue R250 and then destained the excess dye. Fig. 60 is showing the SDS-PAGE profile of LDLH. The subunit molecular weight of LDLH as judged by SDS-PAGE was found to be 45 kDa, thus indicating that the enzyme LDLH comprises of five subunits of equal molecular weight (45X5 = 225 kDa).

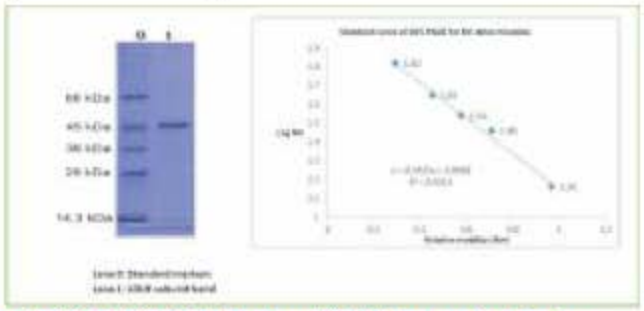


Fig. 60: SDS-PAGE of purified limonoate-D-ring lactone hydrolase

Ultrafiltration of kinnow juice

An experiment on ultrafiltration of kinnow juice was carried out at Division of Dairy Technology, NDRI Karnal for removing bittering factors. The ultrafiltration (Make: Millipore Pellican) was carried out with hollow fibre membrane having molecular weight cut-off 30 kDa at a temperature of 18-20°C. The inlet pressure due to peristalsis was 15-18 psi and the flow rate was 110 ml/min. Permeate and retentate were collected and analyzed via HPLC for limonin and naringin. The naringin mediated bitterness was found more in permeate (164 ppm) while retentate was having naringin below tolerance range (44 ppm). The limonin was however, below permissible level in both permeate and retentate (fig. 61). Thus, retentate can be treated as de-bittered juice. The tolerance range for limonin and naringin are 6 and 50 ppm, respectively.

Fig. 61: Process of ultrafiltration, permeate and retentate

Development of a process for extraction and utilization of low methoxyl pectin from citrus fruit residue

Sunil Kumar and Ramesh Kumar

Microwave assisted extraction of low methoxyl pectin from citrus fruit residue

Pectin is widely used in the food industry as a thickener, emulsifier, texturizer and stabilizer. It is usually added in jams and jellies as a gelling agent. It has also been used as a fat substitute in spreads, ice-cream and salad dressings and is a part of soluble dietary fibre. The estimated annual worldwide production of pectin is 7,250 metric tons, approximately 60% of which is produced from citrus fruits. The commercial process of pectin extraction till date uses inorganic acids like HCl, H_2SO_4 and boiling etc., which consumes a lot of non-renewable energy and the industrial acid effluents pose problem of waste water disposal and cause environmental pollution. Use of harsh chemicals destroys the nature of pectin/ low methoxyl pectin (LMP). Thus, in order to develop a protocol for pectin extraction without using harsh inorganic acids, an experiment was conducted to extract pectin from kinnow peel/residue left after juice extraction using microwave energy.

Fig. 62: Figure showing precipitation of pectin from citrus crude extract

Preliminary experimentation on microwave extraction was conducted at 910 W for extraction of low methoxyl pectin from kinnow peel under acidic conditions (pH 2.0) using HCl (marked as control/T1) for 20, 40, 60, 80 and 100 min. Time treatment of 20 min was insufficient for pectin extraction while the pectin yield and appearance were good at 60 min of incubation time. The residue

to solvent ratio varied with time of treatment. The ratio was 1:10 for 20 min; 1:15 for 40, 60 and 80 min while 1:20 for 100 min. In another two experiments, a pre-treatment step was introduced before microwave extraction. Here, the citrus residue in water was treated with degradative enzyme for 2 h at 40°C; one was acidified using citric acid (T2) while the second one was kept neutral (T3). All the treatment combinations were used for pectin extraction using microwave at 910 W for 60 min of incubation time. After microwave extraction and cooling, the pectin was precipitated from the broth using ethanol, drained, dried in cabinet dryer and stored for further quality analysis. The yield of various treatments is given in Table 20. The yield was 8.2±1, 11.0±1 and 11.1±1, respectively, for T1, T2 and T3. The per cent increase due to enzymatic pre-treatment was 34.1 and 35.3% for T2 and T3 compared to control (Table 20). Fig. 63 is showing the process flow chart for microwave assisted extraction of low methoxypection from citrus fruits residues. Further experiments are in progress for standardization of alternate way of pectin extraction by avoiding harmful chemicals. Fig. 64 shows the pectin obtained from various treatments. The quality analysis is under progress. The process protocol is given in Fig. 63.

Table 20: Per cent yield of various treatments during microwave assisted extraction of pectin from kinnow peel (dry wt. basis; 910 W and time of incubation: 60 min)

Treatment code	Description	pH	Pectin yield (%)	% increase in yield
T1	Control (HCl)	Acidic (2.0)	8.2±1	-
T2	Enzymatic pre-treatment + citric acid	Acidic (2.0)	11.0±1	34.1
T3	Enzymatic pre-treatment	Neutral (7.0)	11.1±1	35.3

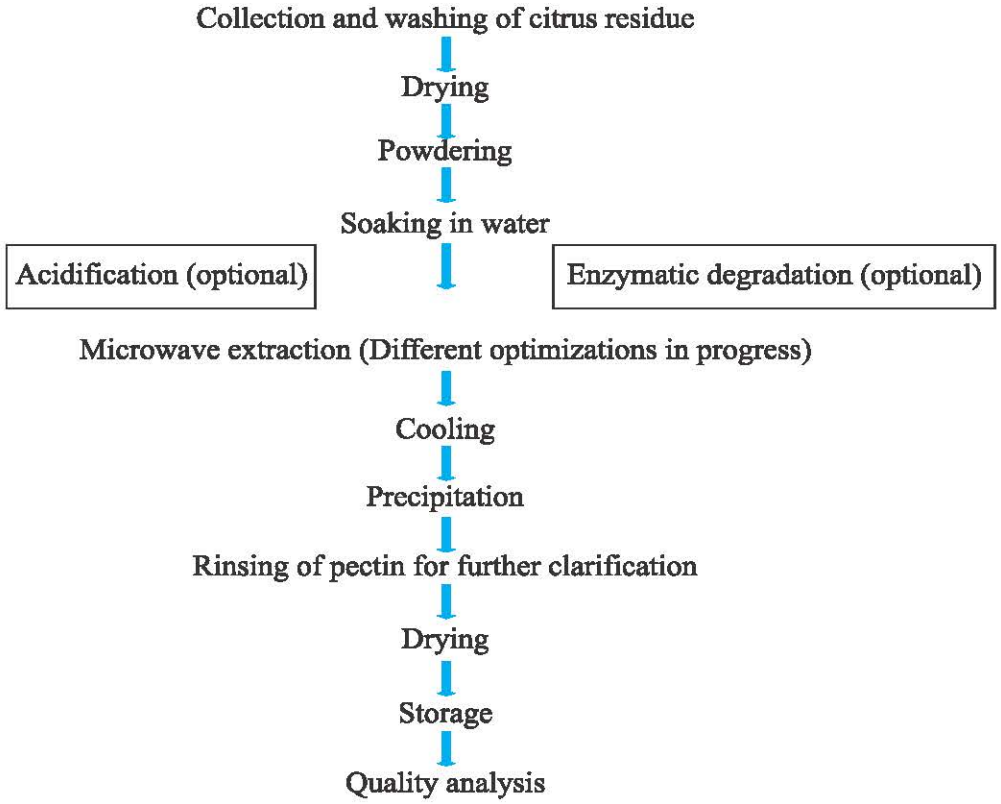


Fig. 63: Process flow chart for microwave assisted extraction of low methoxyl pectin from citrus fruit residue

Fig. 64: Visual appearance of pectins extracted from different experiments (A) T1 (B) T2 (C) T3

Development of process technology for browning inhibition, novel product development and by product utilization of pear

Ramesh Kumar, P C Sharma and Sunil Kumar

Microwave pretreatment for browning inhibition of pear juice

Effect of microwave power at 90, 270, 450, 720 and 900W for 20-180 seconds was investigated for expanding its application in juice processing industry. It was observed that microwave treatment improved the colour of freshly extracted pear juice. The brightness (L* value) of pear juice increased with the increase in the power level and time of exposure to electromagnetic radiations. However, extended microwave treatment (beyond 120s) resulted in dark coloured juice due to excessive cooking. Further, L* values first increased and then decreased when pear juice was obtained from the material treated with higher power level of 720 or 900 Watts even for 120s. The juice processed from the pears treated with 720 Watts for 100 seconds exhibited the highest L value (41.13). Increased microwave radiation resulted in a progressive decline in PPO activity of pear material and reached a minimum of 32 units with 720W for 120 seconds (fig. 65) which is approximately 8% of the initial value and was at par with microwave power level of 900 Watts for 100 or 120s. This indicated that microwave pretreatment could be used as an alternative technique for prevention of enzymatic browning in pear juice processing.

Enzymatic liquefaction of pear pulp

Juice yield is one of the most important parameters in food processing. However, pear is difficult to process by mechanical mean due to its extremely hard texture. Therefore, effect of different enzymatic treatments *viz.* pectinase, cellulase and macerozyme each at 0.10 and 0.20% were assessed

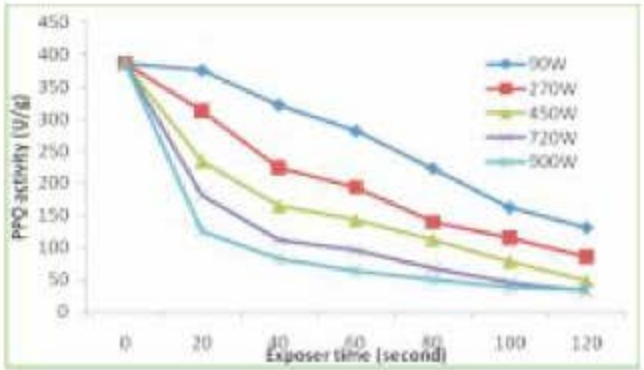


Fig 65. Effect of microwave radiation on PPO activity of pear

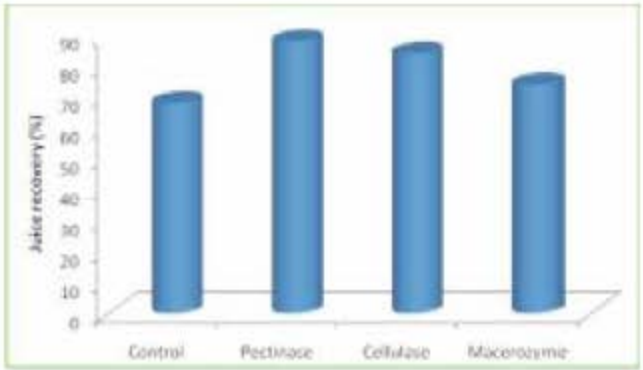


Fig 66. Liquefaction of pear pulp with different enzyme

to improve its juice yield and quality. The result showed that enzymatic treatment caused significant improvement in yield of juice and maximum juice yield was obtained by treating the fruit mash with pectinase whereas maximum TSS and phenol content was found when the fruit mash was treated with cellulase. Average yield of pear juice was recorded to be 67-68% and this yield was increased by 15-20% due to enzyme action, irrespective of their incubation time, temperature and concentration (fig. 66). Among different enzymes, pectinolytic enzyme treatment of pear pulp resulted in maximum recovery (88.34%) of juice with lowest viscosity (94 cP). Cellulase treatment reduced the pulp viscosity by only 20-40 % and yielded very low juice recovery even with the elevated enzyme concentration (0.20 %) and extended incubation period (240 minutes). Thus, enzymatic treatment of pulp can be an important tool for liquefaction of pear fruits.

Optimization of process condition for preparation of clear pear juice

Pear pulps treated with different enzymes (pectinase, cellulase and macerozyme) at the concentration of 0.05, 0.10, 0.15 and 0.20% were incubated at 30, 40 and 50°C for 0.5-4.0 hr in BOD shaker at 150 rpm in order to determine their effect on juice quality. The clarity of juice were significantly affected by enzyme concentration, temperature and time used for different enzymatic treatments. In general, the time required to obtain a clear juice was found to be inversely proportional to the concentration of enzyme used at constant temperature. The rate of juice extraction and clarity increased with increase in enzyme concentration and process temperature with maximum being recorded with pectinase at all concentrations. However, high incubation temperature (above 40°C) reduces the enzyme activity and hence the clarity of juice was decreased (54%) when the enzyme treated pulp was incubated at 50°C. Longer incubation time increased clarity values as enzymatic breakdown of more pectin gave rise to higher clarity. Similarly, the juice became more clear and transparent with the increasing concentration and incubation time of cellulase and macerozyme enzymes. However, best results with respect to high juice yield (88%) and clarity (91%) was obtained when the pulp was treated with 0.15% pectinase enzyme and incubated at 40°C for 2.5 h.

Pear juice quality as affected by fruit storage

The impact of fruit storage on the quality of pear juice was assessed. Both clear and cloudy juices were prepared from fresh and stored fruit (4°C). Pear storage for two months slightly reduced the juice yield as compared to juice extracted from freshly harvested fruit (Table 21). However, total soluble solids were found to be more in juice processed from stored fruits as compared to fresh ones. Fruit storage resulted in decreased acidity of fruit juice. It was also observed that clear juice retained more total solubles over its cloudy juice. However, cloudy pear juice was characterized by higher total phenolic content than the clear ones. Clarification results in 21-36 % decrease in the phenolic content of pear juice. Storage of fruits before processing resulted in a significant increase of antioxidant activity in juices which may decrease PPO activity during storage. Thus pear storage does not affect their suitability for production of both clear and cloudy juices.

Table 21. Effect of fruit storage on juice quality of pear juice

Storage period (months)	Juice type	Recovery (%)	TSS (°B)	Acidity (%)	AOC (mg/ml)
0	Clear	89.13	11.68	0.29	0.76
0	Cloudy	71.32	11.41	0.33	0.10
2	Clear	87.65	13.62	0.28	0.82
2	Cloudy	69.91	12.22	0.30	0.12

Inhibition of pear PPO by radish extract

Pear juice undergoes browning during processing, which is unacceptable to consumers. Thus a study was conducted to examine the effect of radish extract, a natural substance for inhibition of polyphenol oxidase (PPO) and browning of pear juice. Radish extract was prepared by extracting the radish juice with equal quantity of water and its effects were determined on pear polyphenol oxidase. Heated extract was obtained by boiling the extract for various times at 100°C. Results revealed that fresh radish extract inhibit PPO activity by 27% and while heated radish extract exhibited a higher inhibitory effect on PPO (Table 22). This inhibitory effect increased with increase in heating temperature, time and concentrations of radish extract. The extract heated for 8 minutes reduced the PPO activity by 38% and further increase in heating time had little effect on enzyme inhibition. Although mechanism of enzyme inhibition by radish extract is not clear but its utilization as natural food additive is possible to prevent browning caused by PPO.

Table 22. Relative inhibition of pear PPO

Antibrowning agent	Relative PPO activity (%)
None	100.00
Fresh radish extract	38.21
Heated radish extract	27.18
Citric acid	91.64

Efficacy of processing method for pear juice production

Pear juice was prepared by different processing methods and the quality was evaluated in order to have a suitable technique for quality juice production. Among different methods, pulping resulted in highest values for soluble solid (Table 23). Enzymatic extraction induced more acidic taste to the extracted juices. Phenolic content were highest when the fruits were processed with pulping method followed by the conventional method. Pears had high antioxidant capacity reaching the values of almost twice with the enzymatic method compared to any other method. Minimum antioxidant values were recorded in the products produced by centrifugation. Pulping method resulted in cloudy juice while enzymatic process yielded clear juice indicating that pulping method is not suitable until the product is centrifuged as it results in juice with reduced colour intensity.

Optimization of process condition for osmotic dehydration of pear

Osmotic dehydration of pear slices was carried out by using different solute concentration (50-70%), process temperature (30-50°C) and sample geometry (5-15mm) to optimize the process condition for rapid dehydration and quality retention of dehydrated fruits. The results showed that water loss, solid gain, and weight reduction increased with the increase in the solute concentration and osmotic medium temperature while reverse was true with the sample geometry (fig 67). Maximum loss of water occurred during the first 4 hrs of osmosis with continuous lowering of fruit weight. Best results were obtained when 5 mm slices were immersed in 70°B sucrose solution. Dehydration rate of pear was further increased with the increase in immersion time under all process conditions. It was observed that temperature of the medium has increasing effect on osmotic dehydration of pears. Water loss and solid

Table 23. Physico-chemical properties of pear juice extracted by different methods

Juice extraction process	Juice yield (%)	TSS (°B)	Acidity (%)	TPC (mg/lt)	AOC (µM/ml)
Conventional	59.56	11.07	0.31	261	1750
Centrifugation	68.56	10.41	0.31	202	1364
Pulping	65.38	11.63	0.33	380	1747
Enzymatic	87.67	10.22	0.42	276	2967

gains were recorded to be highest in the pears processed at 50°C compared to those at 40°C. Though higher process temperature seems to promote faster water loss due to lower viscosity of the osmotic medium but it resulted in non-enzymatic browning of pear slices and thus a slightly lower temperature of 40°C was recommended for maintaining the quality of pear during osmotic dehydration.

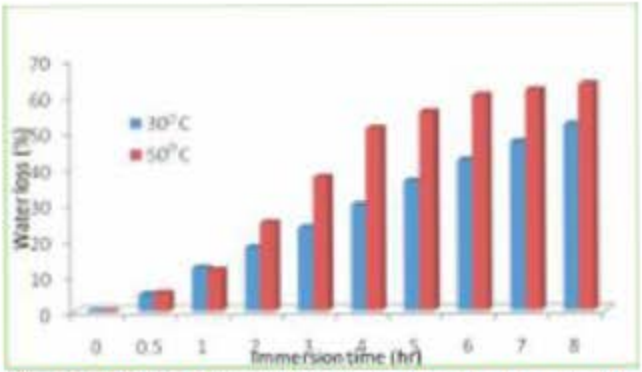


Fig 67. Effect of process temp on WL during osmotic dehydration of pear

Physico-chemical changes during osmotic dehydration of pear

Effects of different process variables like solute concentration, process temperature and immersion time were studied on the nutritional quality (colour, total phenol and ascorbic acid content) of pears after 8 h of osmosis. The result exhibited that ascorbic acid content decreased with the increase in immersion time, solute concentration and process temperature. Immersion time was found to be most important factors affecting the total phenolic content. More than 60 % of the total phenolics were lost at the end of the osmotic process.The highest decrease in total phenolic was observed in the sample that was immersed for the longest time (8 h) in the osmotic solution due to leaching and negative impact of oxygen. However, this loss was reduced by almost 50% when the immersion time was decreased to 2 hours. Colour of the product was the only parameter that had a significant increase during the osmotic process, denoting colour intensification. It was found that redness (a*) and yellowness (b*) were affected more as compared to their brightness (L*) when they were treated in osmotic solution.

Effect of sample geometry on drying behavior of pear

Effect of sample geometry (ring, cube and slice) and drying temperature (50, 60 and 70°C) was studied in order to have a stable product with final moisture content of 12-15%. The results revealed that increasing the drying temperature shortened the drying time irrespective of sample geometry (fig 68a). There was rapid decrease in moisture during first hours of cabinet drying at 70°C and this phenomenon was not observed when drying was performed at lower temperature, indicating that drying temperature is an important factor in drying process. Drying speed significantly increased when drying was performed with cubic sample compared to ring and slice samples due to their greater contact area during drying (fig 68b). Drying was very slow when slices were used as drying material and it still retained more than 21% moisture even after 14 hrs of

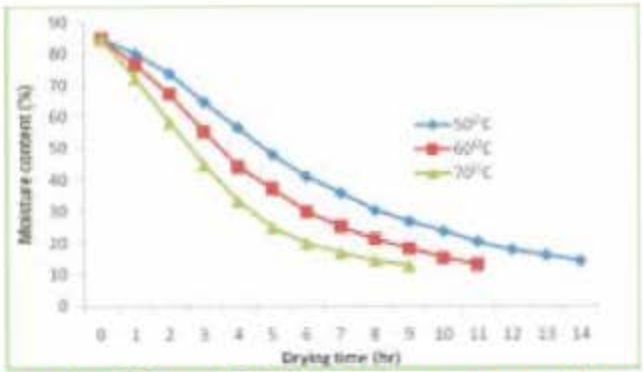


Fig 68a. Effect of drying temperature on moisture evaporation

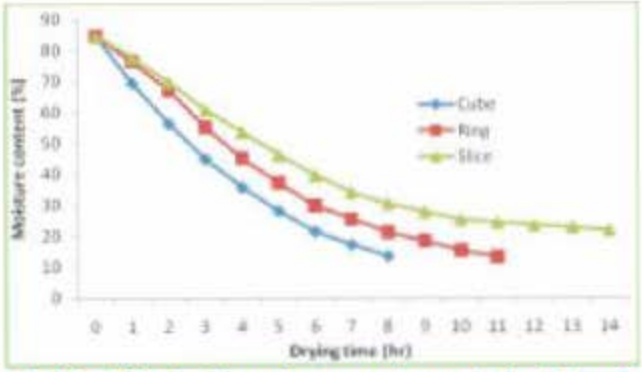


Fig 68b. Effect of sample geometry on drying behavior of pear

drying. Pear ring took almost 11h to reach a moisture content of 13% and this drying time was reduced by 3h when drying was performed further with cubic samples.

Effect of convective drying on quality of dried pear

Cabinet drying (30, 40 and 50°C) of pear slices was carried out in order to produce products with superior quality to the traditional one. Drying properties such as moisture, colour, antioxidant and total phenols were determined. Drying temperature induced an increase in a* and b* value due to NEB reaction which turned the dried pears into more reddish and yellow colour. Brightness value decreased from 72 to 64 showing only a small extension in dark colour during the first 4h of cabinet drying compared to a* and b* chromatic parameters which increased from 1.9-6.0 and 18-30, respectively with the drying process. Total phenol decreased with the drying time, however, no significant difference was observed between different drying temperatures (Table 24). Drying also resulted in 50-66 % loss in antioxidant activity at the end of drying process.

Table 24. Total phenolic and antioxidant capacity of pear during cabinet drying

Cabinet drying time	TPC (mg/g.db)		TAC (µ mol/g.db)	
	68°C	70°C	68°C	70°C
Fresh pear	2.8	2.8	9.9	9.9
Dried pear: 1h	1.6	1.8	4.4	5.8
2h	1.3	1.6	3.1	4.9
4h	1.4	1.4	4.0	3.3
8h	1.2	1.1	3.3	3.1

Process technology for ber canning

(Divisional Activity)

PC Sharma and Ramesh Kumar

The ber fruit is grown in arid and semi-arid regions of the country and is rarely utilized in processing. Therefore, the process protocol for preservation of ber fruits (cv *Umran*) in tin cans was standardized. Both mechanical and chemical treatments were evaluated with respect to biochemical and sensory properties of ber fruit in tin can. Mechanical treatment consisted of peeling and decoring (removal of stone) of fruits while chemical treatments comprised of preserving the fruit in sugar syrup of different concentrations with and without calcium treatment. The results showed that removal of peel and stone improved the overall sensory qualities (colour, appearance, texture, taste) of canned fruit. Unpeeled fruits were rated as unacceptable due to their excessive shriveling during storage (fig 69). Among the sugar syrup concentration, 40°B sugar syrup was found best. Increasing the syrup strength beyond 40°B resulted in browning of canned product. Further, addition of 0.5% $CaCl_2$ to the sugar syrup maintained the firmness of canned fruit near to its initial value. However, the difference in firmness between $CaCl_2$ treated and untreated fruits was not significant. Thus,

Fig 69. Canned ber fruit with and without peeling

a treatment combination comprising of decoring ber fruits followed by lye peeling, filling in tin cans (401 x 411) and covering with hot sugar syrup (40°B) containing 0.5 % $CaCl_2$ prior to exhausting, seaming and processing was found to be the most appropriate process for canning of ber fruits and development of new range of canned products. Further work is in progress.

Development of pneumatic assisted coring device for oblong fruits

(Divisional Activity)

PC Sharma, Ramesh Kumar, Manoj Mahawar and RK Gupta

Removal of stone/core is a pre requisite for utilization of oblong fruits like ber (cv. *Umran*) and fresh date palm in canning, drying and other food processing operations. Therefore, an attempt was made to develop a pneumatic assisted coring device for oblong fruits in general and ber cv. *Umran* in particular. The prototype consists of a machine which operates with the help of four pneumatic air cylinders having maximum working pressure of 10 bar each. The machine comprises of a hopper, moveable wooden roller, extended fruit dropper, coring plunger and stone remover outlet (fig 70). Wooden roller has a capacity to contain 6 fruits at a time, which drops the fruits through dropper into specific groove on wooden fruit holding base for removal of stones. Coring plunger unit made of stainless steel is attached to the main frame. Fruit feeding, frame movement, coring and cored fruit removal plunger devices are controlled by pneumatic air cylinders. The hopper is inclined at an angle of 30° with horizontal which can be altered accordingly. There are four wooden frames of size 18.5 × 2 inch (47 × 5 cm) with 6 fruit openings of one inch (2.54 cm) dia. These frames are mounted on individual mild steel sheet which are further fixed in equidistant manner on circular movable unit which rotates only in clockwise direction. The whole unit is assembled on a main frame made of mild steel (102 × 102 cm). Once feeding is over in first frame, the coring of oblong fruits occurs in third frame via coring assembly from which the stone is separated through the outlet. The cored/destoned fruits are then removed in the fourth frame via opening of wooden

Fig. 70.Prototype view of ber decoring machine

base through plunger mechanism. The machine is also suitable for coring of other oblong fruit like fresh date palm fruits. Further, improvements in feeding mechanism are in progress.

Shelf life enhancement and quality improvement of litchi fruit by controlling pericarp browning using enzyme technology

Bharat Bhushan

Preliminary *in vitro* enzyme studies were conducted using commercial enzyme to evaluate effectiveness of various promising reagents in controlling phospholipase D (PLD) enzyme activity. Screening of various alcohols and aldehydes was carried out for their role as PLD inhibitors. *In vitro* inhibitor studies have revealed that inhibitors like glycerol and inositol @ (1%) were able to inhibit the PLD enzyme activity. Out of different concentration levels of chelating agent like EDTA, addition of 0.3 ppm EDTA have controlled the PLD enzyme activity to an extent of 30 %. It has been found that PLD remains active in the temperature range of 5-15°C. PLD enzyme activity started to decline at temperature 20°C and at 40°C, 85% of the initial enzyme activity used in enzyme assay was lost.

Fig. 71. First week evaluation of Litchi fruit stored at 20°C and 80% RH

Experiment has now been set up to establish effective concentration of glycerol/inositol in controlling litchi pericarp PLD activity at low and ambient temperature. Monovalents or divalent ions (1 mM) have no stimulatory effect. pH optima of PLD is in broad range of 5.5 to 7.5. Slight enhancement in enzyme activity was observed at these two pH values.

Glycerol treated litchi samples were analyzed for flesh firmness and bioyield point after one week of storage at 20-25°C and 70-80 % RH (fig. 71). It has been found that glycerol treated samples have more bioyield point (13.585 N) relative to the control samples (9.125 N). Flesh firmness of glycerol treated samples has also been enhanced from control value of 3.484 N to a value of 5.027 N. Water activity of pericarp samples after first week was 0.917 (glycerol), 0.881 (hexanol) and 0.885 (inositol) as compared to 0.704 of control samples. Approximately 10% increase in lightness of pericarp samples of glycerol treated litchi fruit was observed as compared to control. The phospholipase D activity in presence of glycerol was found to be relatively less than control samples. On 2nd day of ambient storage, 4.829 nkat/gm fresh weight phospholipase activity in glycerol treated samples was observed as compared to 14.939 nkat/gm fresh weight in control samples. Overall results indicate towards glycerol based control mechanism of browning during storage.

TRANSFER OF TECHNOLOGY DIVISION

Impact assessment of technologies of ICAR-CIPHET, AICRP on PHT and AICRP on PET

Anil Kumar Dixit, Indu Rawat, SK Nanda and Ranjeet Singh

The purpose of the study is to understand how technologies of ICAR-CIPHET, AICRP on PHT and AICRP on PET are benefiting the intended beneficiaries and society. The preliminary information on technical and economic aspects were collected from the carrot washer users and also documented success story of 'BatchaBai Meat Store, Medavakkam Tank Road, Kilpauk, Chennai', an entrepreneurs established with the efforts of AICRP on PHT. The economic indicators computed for continuous type carrot washer such as benefit cost ratio (1.6), breakeven point (37.55%), and payback period 7 month 6 days, are found reasonably good. Further, the microbial washing efficiency, mechanical washing efficiency and bruise percentage are found to the tune of 91.70, 78.57 and 9.37 % respectively at farmers' fields indicating technical feasibility of the machine. Nonetheless, entrepreneurs realized the reduction in labour drudgery and saving of cost and time per unit of carrot washing. Importantly, the carrot washing machine is well received by carrot growing farmers of Haryana, Rajasthan, Uttar Pradesh, etc.

The BatchaBai meat shop (Mr. F. Mohamed Batcha and his daughter Ms. Fathima Batcha) (fig. 72) has given solution for handling and transportation of meat, (end to end approach) in hygienic and fresh conditions. Right from procuring the meat to cutting and selling it to the customers, at each stage utmost care is taken to keep the meat fresh and free from microbes. The society is found to be benefited in terms of getting succulent chicken, mutton custom cut and other products such as mutton curry cuts, minced meat, mutton boneless, lamb chops, lamb shanks in hygienically packed in special food grade packaging and transported in refrigerated van, designed by AICRP on PHT. Cryo freeze is being used for small quantity storage and transport. The consumers were found to be attracted since there is an increasing trend towards online order for door delivery at reasonable prices. The technical support/guidance of Chennai centre of AICRP on PHT has helped the entrepreneur in expanding his business by providing an efficient system for transportation and marketing of meat.

Fig. 72 A view of BatchaBai shop

Development of national database on post-harvest technologies

Indu Rawat, Tanbir Ahmad and SK Nanda

Commodity wise data were collected on post-harvest machinery and equipment. The commodities like cereals (wheat, rice, maize), pulses (red gram, chick pea, pigeon pea), fruits (pomegranate, banana, litchi, pineapple, custard apple, mango, citrus),

Fig. 73. The homepage of national database on post-harvest technologies

vegetables (potato, onion, tomato, green pea), oil seeds (soybean, groundnut and mustard), spices (turmeric, coriander, ginger, cardamom, black pepper), meat and fish, and plantation crops (cashew nut, coconut, arecanut) were covered. Information was collected on aspects like maturity indices, harvesting season, equipment and gadgets required for post-harvest processing operations *viz.* harvesting, threshing, shelling, dehusking, peeling, crushing, cleaning, destoning, sorting/grading, washing, drying, grinding, milling, oil extraction, packaging and storage. Each of the machines/ gadgets listed in this database is accompanied with the complete address of the manufacturer(s)/s upplier(s) including phone numbers, e-mails alongwith the photographs and approximate cost of the machine. The front end of database software is developed with use of PHP and HTML and the database is developed with mySQL format. This database has been uploaded on ICAR-CIPHET website. The user can see the data and retrieve it for ready reference. Additional data regarding crops and machines can also be added to the database by the administrator. The whole home page of database is shown in fig. 73.

Development of carrier system for live table carps rohu (*Labeo rohita* Hamilton) and silver carp (*Hypophthelmicthys molitrix* Valenciennes)

A U Muzaddadi, Tanbir Ahmad and Monika

The live fish carrier system (LFCS) was developed with dimensions 660mm X 660mm X 390mm, capacity: 110 Litres (fig. 74, 75) and also with aeration system (fig. 76). Third lab testing of the carrier system with Silver Carp (*Hypophthamichthys molitrix*) (400-600 g individual weight) was carried out successfully. With fish density of 2:10 (no. of fish: litre of water), container capacity 100 liter, Dissolve Oxygen 4-6 mg/Liter, 30% water exchange and continual aeration by AC/DC aerator, 70-80% fish survival was achieved in 24 hours of storage time.

Fig. 74. Stackable live fish transport container

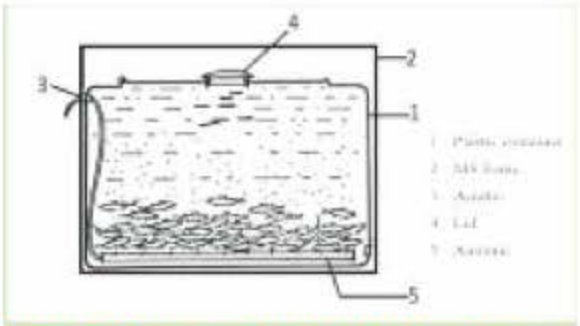


Fig. 75. Diagram of stackable live fish transport container

Fig. 76. Battery operated aerator

Present traditional method: Traditionally, whole backside of truck is converted into a small pool of water with plastic (LDPE/HDPE sheets) linings. Aeration is done with feet; the truck meets with frequent accidents due to water splashing; fish receive injuries due to manual aeration and exhaustive handling, with ultimate fish survivality of 50%.

LFCS Advantages

- Aeration is mechanized by integrating aerator with the container.
- Containers are stackable and facilitate any quantity of fish transportation.
- Different size and species of fish can be separately transported in the same truck and unlike the traditional method, there is no need of species wise or size wise segregation.
- Compartmentalization of truck back reduces the risks of accidents and injuries to fish, gives 70-90% survivality of fish.
- The cuboid shapes facilitate compact loading and handling without touching fish.

Development of portable impedance analyzer for detection of freshness of fish

(Divisional Activity)

Monika and A U Muzaddadi

Fish is sold and priced on freshness criteria; however, there is no fish freshness tester in Indian context. All existing traditional methods are subjective, time consuming, expensive, destructive and also require skilled persons. The research work focused on establishing a universal and sensitive parameter as indicator of fish freshness taking into account the fact that electrical properties of fish tissue are spoilage dependent. Electrodes connected in the system (3M ECG, round) to detect freshness of fish, consist of base lining material, conductive gel, and electrode buckle. It is a transducer that senses ion distribution on the surface of tissue, and converts the ion current to electron current. One side of the electrode is sticky that comes into contact with tissue, while the other side consists of conductive metal attached to a lead wire connected to the instrument (fig.77).

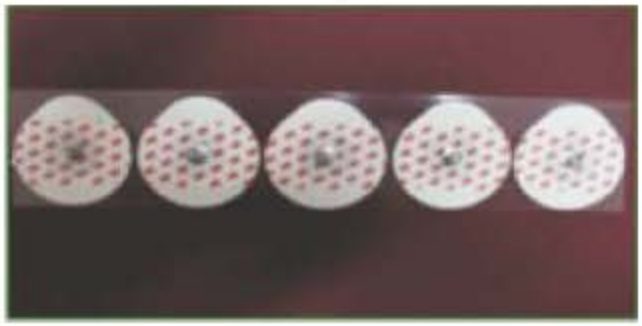


Fig. 77. Non-invasive electrodes used in detecting freshness of fish

Graphical User Interface is being developed for testing fish at different start and delta frequencies (few Hz to Several MHz). Developed Software is able to display the recorded reading in graphs for analysis and further display the result on LCD touch panel.

The instrument being developed will find application in fish grading and sorting operations in fish processing industry and fish markets (wholesale and retail units) (fig. 78).

Fig. 78. Portable impedance analyzer under fabrication

AICRP on Post-Harvest Technology

Food Grains Sector

Development of low cost retortable pouch technology for preservation of traditional *Chhena poda* (Bhubaneswer centre)

The ingredient proportion (30% sugar and 10% *suji* with cheese) baked at 200°C for 1h for preparation of *Chenna poda* (cheese based baked sweet product) (fig. 79) has been standardized based on texture and sensory score using Response Surface Methodology (RSM). Higher proportion of sugar content in *chhena poda* leads to oozing of sugar syrup from the product during retort processing and less quantity sugar affected the texture and sensory attributes. Retort processing time for 200 g *chhena poda* in laminated retortable pouch was found to be 30 min after the retort attained 121°C. It took 15 min to achieve 120°C at the center of *chhena poda* during retort processing. Vacuum inside the pouch (fig. 80) after thermal processing maintained the odour of the product during storage due to prevention of oxidative rancidity. Acidity, total plate count, yeast, mould count and peroxide value increased at a slower rate in retort processed product compared to samples without retort processing. Retort packaged *chhena poda* (fig. 81) could be stored for 28 days under ambient condition with acceptable microbial and sensory quality.

Fig. 79. *Chenna poda* prepared with different composition

Fig. 80. Vacuum packed and sterilized unit packet

Fig. 81. Retort sterilization of *Chenna poda*

Development of ozone based storage structure for managing insects in grains (Coimbatore centre)

The engineering properties of grains at various moisture contents were determined using standard techniques and their effects on storage chamber design were evaluated (Table 25).

Table 25. Engineering properties of grains

Properties	Paddy (ADT 43) (11.86 to 23.61% d.b.)	Rice (ADT-43) (11.55 to 26.84% d.b)	Green gram (CO 8) (10.86 to 22.30% d.b.)
Length, mm	7.78 - 7.97	4.98 - 5.39	4.4 - 4.59
Width, mm	2.36 - 2.55	1.63 - 1.87	3.27 - 3.44
Thickness, mm	1.73 - 1.88	1.33 - 1.52	3.23 - 3.41
Equivalent diameter, mm	3.22 - 3.39	2.30 - 2.48	3.59 - 3.88
Aspect ratio, %	30.55 - 31.91	33.10 - 34.66	-
Thousand grain weight, g	18.24 - 24.07	10.70 - 14.59	38.6 - 46.4
Sphericity	0.41 - 0.42	0.45 - 0.47	0.81 - 0.84
Surface area, mm^2	28.91 - 31.82	14.58 - 16.94	-
Bulk density, kg/m^3	568 - 613	712 to 676	722.78 - 689.95
True density, kg/m^3	1069 - 994	961.89 - 975.24	1159 - 1179
Porosity, %	46.82 - 38.27	26.97 - 29.66	37.64 - 42.32

The experimental set up consisted of oxygen concentrator, ozone generator, fumigation chamber, ozone analyzer and ozone destructor. Closed acrylic fumigation bin was connected with ozone generator to distribute the gaseous ozone evenly throughout a rice grains mass. Fumigation bin was developed using acrylic pipe to carry out the ozone fumigation study. The dimension (height × diameter × thickness) of the bin is 400 × 240 × 5 mm. Both ends were tightly closed with the help of end cap and end seal in order to avoid leakage of ozone gas during fumigation. Ozone gas was injected from the bottom of the grain mass and it exits the bin at a location opposite to the injection point. Ozone analyzer was connected at the top of the bin. Ozone concentration and the saturation time taken for the desired level of fumigant were measured by using ozone analyzer.

The Ozone toxicity was determined using time response bioassays at the dosage rate of 500, 750, 1000, 1250 and 1500 ppm ozone in a continuous flow of 2 L min^{-1}. The experimental results were statistically analyzed using the AGRES (7.01) and Polo Plus (2.0) software.

Ozone fumigation on *T. castaneum* adults caused 100% mortality after 480, 390, 270, 210 and 180 min exposure at 500, 750, 1000, 1250 and 1500 ppmv, respectively. Ozone acts as a toxic chemical that can cause oxidative damage of tissues even at low concentrations. Therefore, changes in the concentration of ozone have the potential to affect the rate of respiration lead to mortality. None of the *T. castaneum* adults showed resistance to ozone, regardless of their susceptibility to phosphine. Finally, the results suggest that ozone is a potential alternative for management of insects resistant to phosphine.

Bio-control of storage insect-pests of rice, green gram and black gram (Jorhat centre)

Botanical 'C' (at 50 ppm or 0.005% concentration) was tested against four storage insect-pests. This botanical, at the given dose, was found to be most effective against the lepidopteron insect *Sitotroga cerealella*, as 100% mortality was observed after 3 hours of exposure. However, the same effectiveness was observed against *Callosobruchus chinensis* and *Tribolium castaneum* after 6 hours of exposure. The botanical "C" was found to be the least effective at the given dose against *Sitophilus oryzae*.

The present trial was conducted at two different dose of botanical 'C' (50 ppm & 25 ppm) at three different storage conditions for the storage of rice. The storage conditions being fully filled containers, 3/4th filled containers and half filled containers with

rice. Botanical 'C' @ 50 ppm and 25 ppm were then added to the containers. Three sets of similarly filled containers with green gram were kept as control. Ten pairs of freshly emerged *Tribolium castaneum* were introduced to each treatment (1/2 filled, 3/4th and full filled container). The observations were made at 3 months intervals (Table 26). It was observed that rice kept half filled in containers with application of botanical 'C' @ 50 ppm showed the best results with only 1.11 damaged grain even after 9 months of storage followed by rice kept 3/4th filled containers with the application of botanical 'C' @ 25 ppm (Table 26). The control treatments (without application of botanical 'C') showed substantial damage by *Tribolium castaneum*.

180, 190, 200°C with an extruder screw speeds of 80, 100 and 120 rpm. Quality of the extrudates assessed in terms of bulk density, expansion ratio, water activity, water absorption index, water solubility index and textural property (crispness) and browning index.

Extruded samples were packed in laminated aluminum pouches with nitrogen flushing and were kept for storage studies. In third month, the quality of the product was analyzed for different properties like bulk density, expansion ratio, water activity, water absorption index, water solubility index and textural property (crispness) and browning index.

Table 26. Effect of Botanical "C" on *Tribolium castaneum* at different storage intervals

Treatment	3 MAS	6 MAS	9 MAS
Botanical 'C' 50 ppm (full capacity)	5.00	6.67	8.33
Botanical 'C' 50 ppm (3/4 capacity)	3.33	5.00	5.00
Botanical 'C' 50 ppm (half capacity)	0.00	1.67	3.33
Botanical 'C' 25 ppm (full capacity)	3.33	5.00	6.67
Botanical 'C' 25 ppm (3/4 capacity)	8.33	10.00	11.67
Botanical 'C' 25 ppm (half capacity)	11.67	13.33	16.67
Control (full capacity)	13.33	15.00	21.67
Control (3/4 capacity)	18.33	20.00	26.67
Control (half capacity)	20.00	23.33	30.00

Development of protocol for extruded RTE snack food from rice and banana (Tavanur centre)

The combinations of broken rice and banana were selected in the ratios of R_{60}:B_{40}, R_{70}:B_{30}, R_{80}:B_{20}, R_{90}:B_{10} with an increased amount of rice and decreased amount of banana powder. Initial trials were conducted on extrusion of rice and banana flour mixture at various proportions after conditioning the mixture to 16% moisture content. Extrusion trials were carried out in a single screw food extruder. Extrusion was carried out for these four different blends under different die zone temperatures of 170,

Development and evaluation of fly ash based organic pesticides for the management of pulse beetle (Udaipur centre)

Fly ash based organic pesticides were developed for effective and safe management of pulse beetle. Among the developed fly ash based insecticides, fly ash + neem seed kernel powder showed the maximum of 95.33 % mortality after 72h time intervals. The minimum mortality of 55.00 % was observed in cowpea grains treated with fly ash + curry leaf powder. The lowest number of eggs (0.40 eggs/seed, minimum adults (1.10) emergence), minimum weight loss of 1.4 % was recorded in fly

ash + neem seed kernel powder. The minimum of 62.40 % adult inhibitions were exhibited by fly ash alone at 10 g/kg seeds.

Horticulture sector

Development of turmeric slicer (Akola centre)

Cutting/slicing of turmeric rhizomes is necessary in order to achieve fast drying for preparation of turmeric powder. In order to solve the problem, power operated turmeric slicer (Capacity - 250 kg/h) was developed. The machine (fig. 82) cuts the turmeric rhizomes into slices of desired thickness from 2 to 5 mm. At optimum condition of rotor speed 400 rpm, slice thickness 2.5 mm and duration after harvest zero days *i.e.* fresh turmeric rhizomes, the slicing/cutting efficiency, percent damage and capacity were found to be 74.74%, 24.95% and 385 kg/h, respectively. Cost of processing was assessed to be Rs. 350/- per ton of turmeric. The machine is technically feasible and economically viable.

Fig. 82. Turmeric slicer

Microbial processing of fruit waste for the product development of animal feed (Bangalore centre)

The feed based on mango waste (fig. 83) was developed for poultry chicks / fish/ rabbit. Mango peel fermented by dual inoculation with *L. plantarum* and *S. boulardi* significantly enhanced the protein (7.88%), fat (4.18) and ash (5.74 %) content over an un-inoculated control (4.89%, 1.78% and 3.34% protein, fat and ash, respectively). Mango peel fermented with *S. boulardii* alone or in combination with *L. plantarum* was more efficient in fermenting mango peel waste. Further, mango seed meal supplemented with 1 % ammonium sulphate and fermented by yeast *S. boulardii* significantly enhanced protein (14.17%), fat (5.39%) and ash (5.90%) over an un-inoculated control (5.17%, 1.81% and 3.92%, respectively). The results revealed that mango peel supplemented with 1 % ammonium sulphate, 10 % soyabean and 10 % maize grits fermented by single inoculation with yeast *S. boulardii* enhanced highest protein (18.98%) followed by fermentation by dual inoculation with lactic acid bacteria and yeast (18.70%) over un-inoculated control (6.65%).

Fig. 83. Feed/powder from mango peel and seed

Development of mahua stamen removal machine (Bhubaneswar centre)

Power operated mahua stamen removal machine

Fig. 84. Mahua stamen remover

(fig. 84) has been developed which consists of a rasp bar mounted cylinder (150 mm dia, 250 mm length), oscillating sieve, 0.5 hp motor and 20 mm dia shaft, hood and frame. Stamen removal efficiency and whole flower recovery were found to be 97.1 and 88.47%, respectively at 11% (w.b) moisture content with 900 rpm and 9.5 mm concave clearance which was the optimum condition.

Development of process technology for preparation and storage of beverages from watermelon (Bhubaneswar centre)

Watermelon Juice was extracted manually and heated at 60°C for 15 minutes. Addition of 120 ppm sodium benzoate and 0.5 % citric increased the shelf life up to 6 months during bulk storage under refrigerated condition (8 to 10°C) which could be used for preparation of watermelon beverages

Fig. 85. Watermelon beverage with stabiliser

(fig. 85). To overcome the problem of cloudiness of the beverages during storage, addition of stabilizer like pectin and carboxy methyl cellulose (CMC) was standardized using response surface methodology (RSM). RTS with 15:1 brix to acid ratio, 20 % juice and 1 % pectin as stabilizer gave optimum result based on sensory attributes.

Development of on-line grading system based on internal and external qualities of mango using machine vision technology (Coimbatore centre)

Internal and external quality parameters of Bangalura var. (mango) were studied with off-season mango. The parameters such as volume, weight, surface area, pulp weight of individual fruit were measured as external quality factors. The images were captured with normal DSC and few image processing steps like Channel separation RGB to Gray Scale, Thresholding, Morphological Operation were carried out. Based on the studied quality parameters, mathematical models were developed to predict the external parameters using image processing. The positive results were obtained in Linear models, 2nd and 3rd order polynomial models to predict the external quality parameters like fruit volume, individual fruit weight using projected area

Table 27. Modeling results to predict the external quality parameters (weight and volume) of mango

S. No.	Parameters	Models	Coefficients	R^2	RMSE	χ^2
1	Weight	Linear model $f(x) = a*x + b$	a = 1.568 b = 60.64	0.885	2.18	5.16
		Polynomial (2nd order) $f(x) = a*x^2 + b*x + c$	a = -0.0382 b = 5.458 c = -37.48	0.911	2.048	4.753
		Polynomial (3rd order) $f(x) = a*x^3 + b*x^2 + c*x + d$	a = 0.0094 b = -1.466 c = 77.62 d = -1247	0.9192	1.835	4.195
2	True Volume	Linear model $f(x) = a*x + b$	a = 1.899 b = 40.69	0.8917	3.332	24.302
		Polynomial (2nd order) $f(x) = a*x^2 + b*x + c$	a = -0.0709 b = 9.113 c = -141.3	0.9461	2.417	11.766
		Polynomial (3rd order) $f(x) = a*x^3 + b*x^2 + c*x + d$	a = 0.0121 b = -1.909 c = 102 d = -1699	0.9505	1.601	9.946

calculated by image processing method. The results obtained from the fitted models are given in Table 27.

Shade free imaging chamber was developed with the dimension of 20" x 17" x20". The internal surface was made with light reflection coating. Top of the chamber, the camera was fixed with circular florescent lamp around the camera lens along with light focusing arrangement.

Each mango was serially numbered and images were captured using DSLR camera equipped with CMOS sensor at constant light intensity, fixed focal length and exposure. The external quality factors like weight, volume, surface area, geometric, arithmetic mean diameter, length (L), width (W) and thickness (T) were measured. The internal quality factors *viz.* firmness, TSS, external and internal colour values, pH and titrable acidity of corresponding mango fruits were recorded every day.

The captured color images were converted into gray scale image. Thresholding technique and morphological operations were done to separate the region of interest (ROI) from the background and to calculate the number of pixels inside the ROI, respectively. The object with known area was kept during image capturing as a reference in-order to convert the no. of pixel into area. The projected area (Pip) was calculated by converting the number of pixels into real time value (area) using this reference.

Three models *viz.* linear, quadratic and cubic were explored. Quadratic model was found to be best suitable to predict weight, volume, surface area, geometric and arithmetic mean diameter with higher accuracy (R2>0.95). At the same time length (L), width (W) and thickness (T) could not be predicted effectively (R^2<0.90) using projected area (Pip) computed by image processing. These findings would be more useful in machine vision especially in grading and sorting of mango fruits using image processing techniques. The fabrication of online grading machine is under progress.

Coconut de-shelling machine (Kasargod centre)

Coconut de-shelling machine has been designed with the objective to reduce both time and drudgery involved in the manual de-shelling process. Two concentrically rotating circular blade and a stationary shaft on which coconut is placed firmly are the major components of the de-shelling machine. Coconut to be processed is pressed towards the rotating blades by firmly placing on the stationary shaft. Shell gets detached from the kernel due to the impact force of the rotating blade. Fabrication/development of prototype is in progress (fig. 86).

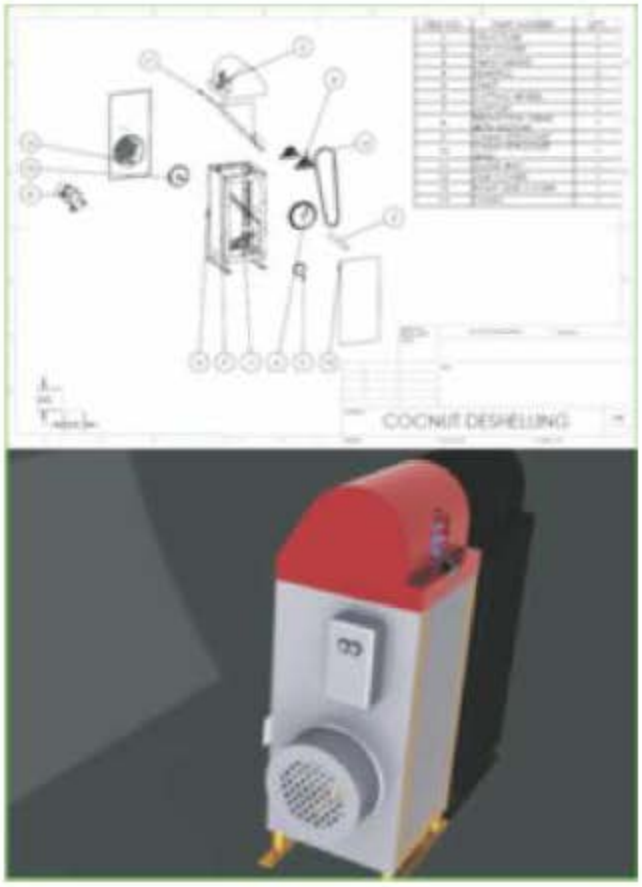


Fig. 86. Coconut de-shelling machine- engineering drawing and animation

Development of pilot level process and technology for the production of health foods from coconut milk residue and virgin coconut oil cake (Kasargod centre)

The process protocols for the production of health foods from coconut milk residue and Virgin cocomut oil cake have been standardized. The coconut milk residue and VCO cake were

incorporated with broken rice, maize and pearl millet at different proportions (0:100, 20:80 and 40:60) in the production of extrudates using co-rotating twin screw extruder (M/s Basic Technology Private Limited, Kolkatta, India). The expansion index, crunchiness and sensory evaluation of the developed extrudates were determined using standard methods. The sweet snacks was made by dipping the mixture of coconut milk residue (6.25%) and roasted broken rice powder (62.5%) in caramelized sugar syrup (31.25%) and molded into round ball shape and it was found acceptable by the consumers (fig. 87).

Fig. 87. Extrudates from coconut milk residue and virgin coconut oil cake

Development of packaging technology for fresh figs to enhance their shelf life (Raichur centre)

The new honeycomb structured packaging material was designed for packaging of fresh fig fruits. This concept was adopted and compared with the earlier best treatment (one kg CFB box) for the fresh fig fruit. Honey comb structured packaging material with inscribing circle diameter of 50 mm and 50 mm height was designed as per the physical dimensions of the fresh fig fruits. The craft paper of 90 and 120 GSM was selected for fabricating honey comb structured packaging material. Fresh fig fruits were procured from the local market and the trial experiments were carried out for assessing the transportation losses of fresh fig fruits using the designed honey comb structured packaging material in comparison with the one kg CFB box and 10 kg bulk packaging (fig. 88). The transportation trials are being conducted with newly designed honey comb structured packaging material.

Fig. 88. Packaging of fresh figs in honey comb structured packaging material

Development of process technology for starch production from tikhur rhizomes (*Curcuma angustifolia* L.), (Raichur centre)

Improved process technology for starch extraction from *tikhur* rhizomes was developed. Partial mechanization of the traditional technology of the tikhur starch extraction by tribal families resulted in increased yield of 3-4 % of starch, with reduction in processing time. About 1.5 to 1.75 quintals of rhizomes can be handled by two persons in a day. The performance of CTCRI starch extractor was evaluated for extraction of starch from *tikhur* rhizomes and optimum starch recovery of 8.28% was achieved with rhizomes of different sizes at rasper drum speed of 2000 rpm. The energy requirement in this speed was also found to be the lowest with the maximum capacity of 65kg/h. The calculated cost was found to be Rs. 18.50 per kg of starch powder. Enhanced production of *tikhur* starch coupled with better market prices has led to enhanced income of the groups involved in the business.

Technology for value addition of mushroom (Solan centre)

The mushroom was blanched with KMS (0.5%) + Citric acid (1%) and dried into cabinet dryer at 60°C at 10-11% moisture content and was grinded into powder. *Pleurotus* powder is added in different concentrations to the wheat flour for value addition and the products were screened on the basis of physico-chemical and sensory characteristics. On the basis of sensory analysis, combination of 90:10 was found to be the best among all the treatments for the preparation of bread. In T_1 (control) the energy value was 271.08 KJ/kg and on addition of mushroom, the maximum energy value achieved was 277.134 KJ/kg. Ten percent fortification was

found optimum for the preparation of mushroom fortified *chapatti*.

Mechanization of value chain of walnut (Srinagar centre)

Portable walnut dehuller (dimensions: front view: 1370 mm x 880 mm, side view: 1370 mm x 480 mm) was developed and evaluated (fig. 89). The capacity was recorded 188.38 kg/h with dehulling efficiency of 95.97% and fully dehulled walnut percentage (98.84%) and breakage of nuts (1.18%). Walnut dehuller was found to be the most effective when green walnuts were sprayed with ethephon (0.3%) as a pretreatment for hull dehiscence and were subjected to dehulling 4 days after spraying.

Fig. 89. Walnut dehuller under evaluation

MAP of edible wax coated passion fruit (Thrissur centre)

Passion fruit is highly perishable and loses its quality immediately after the second day of harvest. Wax applicator was designed and developed to extend the shelf life of passion fruit [(fig. 90(a)&(b)], which can apply a uniform and complete impervious coating to each fruit in a continuously moving stream of fruits. The major parts of the machine are feed hopper, tank, power source, rollers and brushes, collecting tray, wax supply system and main frame. Feed hopper of size 36 x 18 x 33 cm fixed with a slightly incline angle of 10°, which is based on sphericity and angle of repose of fruits. The tank of capacity 5l was fixed in the bottom of the mainframe and it was designed in such a way that the excess wax after the application can be collected. A single–phase electric motor was used to drive the main shaft. Three perforated rollers and brushes are used to transfer the excess wax sprayed over the fruits to the tank and 3 roller brushes to ensure uniform application of wax and to avoid bruising of fruits. A rectangular collecting tray collects the coated fruits. A centrifugal pump helps in transferring the wax from the tank to the spraying tube which is having a number of holes for spraying the wax.

The capacity of wax applicator was found to be 250 kg/h. The preliminary testing of wax applicator was conducted with passion fruit to evaluate its performance. On testing, the coating efficiency was less due to the insufficient conveying length to uniformly smear/coat the wax over the fruits. Hence to improve the efficiency, this length and the number of rollers were also increased suitably.

Fig. 90(a) First Model (b) Second Model

Development of cassava starch based adhesive formulations for corrugating and paper industries (Trivandrum centre)

Adhesive pastes based on native as well as modified cassava starch, as multipurpose adhesive have been developed and tested. The paste is moisture resistant and does not undergo syneresis and microbial contamination. It can be used for book binding, sticking labels on bottles, making envelops and paper pouches, sticking labels on fabrics, paper

boxes etc. A Ready-to-Mix two-part moisture resistant adhesive consisting of two components, which can be mixed together at the time of use has been developed. It is found suitable for binding hard materials.

Livestock sector

Development of processing technologies for foxtail millet incorporated meat products (Aligarh centre)

Process protocols were standardized for buffalo meat emulsion sausage nuggets, meat slices and kabab. The results revealed that slight increase in the quantity of meat resulted into significant change in the moisture content of the products. Further it is evident from the results that foxtail millet is the deciding factor for the ash content of the developed product. The range of fat content was between 5.00 and 5.52% in developed samples and pH of sausages freshly prepared samples was near 6.5. The fortification of sausages (meat 94.99 g, foxtail millet 6.48 g) was optimized using RSM; moisture 68.53%, fat 5.05%, ash 2.0% and pH 6.34.

Bio-preservation of meat using beneficial bacterial cultures (Chennai centre)

Cell free extract of *Lactobacillus bulgaricus* was prepared and its antibacterial activity was evaluated against *Escherichia coli and Staphylococcus*. The cell free extract *Lactobacillus bulgaricus* exhibited antibacterial activity against *Escherichia coli* and *Staphylococcus*, as evidenced by no growth of these organisms in their respective media. Pure culture of *Pediococcus* was propogated in MRS broth. Cell free supernatant of *Pediococcus* was prepared to assess the bio-preservation effect of *Pediococcus* on meat. The antibacterial activity of the prepared cell free supernatant of *Pediococcus* against *Staphylococcus* was demonstrated by Agar well diffusion method. A clear zone of inhibition was appreciable. The results of the study suggest that chicken carcasses sprayed with Pediocin alone or in combination with EDTA in comparison to that of control untreated chicken carcasses had higher pH throughout the study indicating a decline in autolysis and microbial load on the chicken carcasses, due to spraying of Pediocin alone or in combination with EDTA on chicken carcasses.

Novel technology for restructured pork ham (Khanapara centre)

Three batches of restructured pork ham with three different muscles and replacement of water with liquid whey to the extent of 25, 50 and 75% were prepared. Quality evaluation such as proximate analysis, microbiological quality, sensory and textural attributes of the freshly prepared samples were studied. Storage behavior of the restructured pork ham samples were studied up to 15 days at refrigeration temperature. Inclusion of up to 50% liquid whey to the brine formulation for wet cured ham as a substitute for water had no effect on juiciness, tenderness, flavor, and visual discoloration, as evaluated by the sensory panel. Liquid whey can be added successfully to restructured pork ham with a resultant product that is similar in appearance, taste, and storage stability to non whey added ham. It is evident on the basis of sensory panel evaluation that inclusion of liquid whey (up to 50%) to the brine formulation for wet cured ham as a substitute for water had no effect on juiciness, tenderness, flavor, and visual discoloration.

Processing of emulsion based pork products with porcine globin and plasma as fat replacers (Khanapara centre)

Pork sausage with 10% replacement of fat with porcine blood plasma was found to be highly acceptable by the sensory panel (fig. 91). The product had superior microbiological quality with nil *Coliform* and sulphide reducing *Clostridial* count. Textural property, appearance and colour attributes were found to be good. Pork sausage with porcine blood plasma significantly reduces the fat content of the sausage thereby making it more healthy product as compared to the sausage with 10% fat (control). The storage behavior of the sausage with different levels of porcine blood plasma was not found to be significantly different from the control and the

Fig. 91. Pork sausage with 10% plasma

product could be safely stored up to a period of 60 days.

Development of fish snacks using hybrid solar biomass powered dryer (Mangalore centre)

Technology for hygienically processed salt-dried fishery products was developed. The improved version of mechanical solar drier coupled with biomass heater not only helps to overcome the insect infestation but also avoids fungal and microbial problems. The masala coated anchovies dried using solar hybrid biomass dryer was observed to have extended shelf life even after 2 months of storage than uncoated sample.

Quality evaluation of shelf stable fermented pork sausages-modified salt and fat content (Mumbai centre)

The process protocol was developed and standardized for preparation of raw fermented pork sausages which can be stored upto two months at ambient temperature. *Pediococcus pentosaceus* @ 180mg/kg and Glucono delta Lactone @ 1% in meat emulsion are recommended as an acidulent during the preparation of fermented pork sausages having shelf-life of 60 days with acceptable microbial, physico-chemical, nutritional and sensory attributes of the products at ambient storage temperature. The process protocol is being adopted by food industry on commercial scale.

Jaggery sector

Organic jaggery cubes alternative to sugar and artificial sweeteners (Anakapalle centre)

The process protocols have been developed for production of organic jaggery cubes as an alternative to sugar (fig. 92). Jaggery cubes contain sucrose 74 to 85% as compared to 99% sucrose of sugar. Jaggery in the form of cubes in beverages and food to supplement important minerals along with sucrose, glucose and fructose, has certain advantage in terms of better shelf life, consumer preference, easy handling, distribution and export potential. The hardness of cubes was measured using textural analyzer and dispersibility of the compressed cubes in hot water was also measured. The value of water activity ranged from 0.316 to 0.363 for different treatments. The flow chart for making jaggery cubes is presented in fig. 93.

Fig. 92. Jaggery granules and cubes

Evaluation of shrink wrap, stretch wrap and modified atmosphere packaging for storage of jaggery cubes and blocks (Lucknow centre)

Jaggery was prepared from CoPant 84212 variety of sugarcane. Initial values of the jaggery quality parameters were determined as brix 13.5%, pol% 77.1, reducing sugar 5.6%, moisture content 7.1%, pH 6.4 and colour 193 at the normal room conditions. The initial readings corresponding to different environments *viz.* nitrogen, stretch wrap

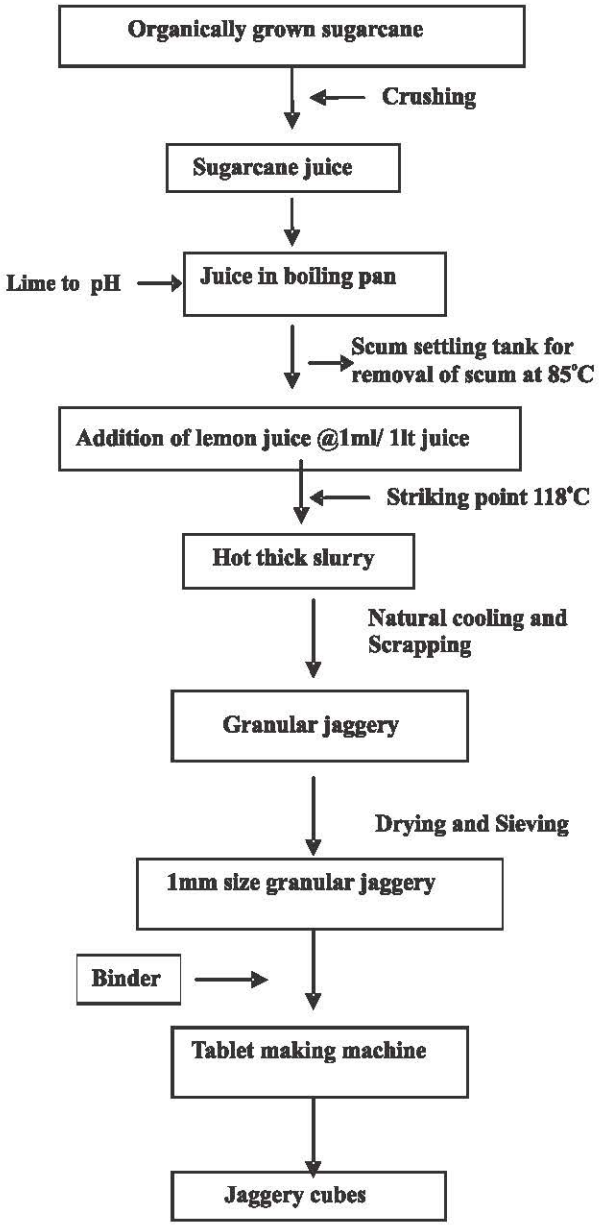


Fig. 93. Process flow chart for production of jaggery cubes

and shrink wrap were also determined, which were almost similar. Jaggery samples were packed in shrink wrap and stretch wrap and kept for storage for six months.

Refinement of juice extraction process with special reference to sugarcane cleaning and juice filtration for 100 kg jaggery/8 h (Lucknow centre)

A power operated cleaning cum washing machine has been developed. The unit consisted of mechanisms for sugarcane feeding through a chute, scraping, scrubbing, washing with re-circulatory forced water spray system, GI water tank and a compact power transmission system consisting of 1.0 hp motor, speed reduction unit and chain-sprocket arrangement. The machine successfully scraped the left out trashes, roots, and soil clods etc., and also washes the cane and delivers well cleaned sugarcane smoothly as a raw material for juice extraction purpose. Thus cleaned sugarcane stalks are fed into the crushing unit directly for crushing and juice extraction.

Reduction of sugarcane staling losses through post-harvest physico-chemical practices (Kolhapur centre)

Spraying of electrolyzed water and heaping found superior for minimizing the post-harvest deterioration of sugarcane even after 120 hours of harvest at high ambient temperature. Spraying of Sodium hypochlorite (electrolyzed water) and heaping found superior for minimizing the post-harvest deterioration of sugarcane even after 120 hours of harvest at high ambient temperature. The gross monetary returns was significantly highest (Rs.4,693.33) due to combination of post-harvest physico-chemical treatment of sodium hypochlorite @ 2000 ppm + heaping and 24 hours of staling period, followed by spraying of Benzalkonium chloride @ 2000 ppm + heaping and 24 hours of staling period (Rs. 4,654.00). Whereas, significantly lowest gross monetary returns (Rs.3,224.00) was observed due to combination of post-harvest physico-chemical treatment of heaping of sugarcane i.e., control at 120 hours of staling period.

Progress under Tribal Sub-Plan (TSP)

The basic objectives of the Tribal Sub Plan (TSP) is substantial reduction in poverty and unemployment, creation of productive assets in favour of Scheduled Tribes to sustain the growth likely to accrue through development efforts, human resource development of the Scheduled Tribes by providing adequate educational and health services,

and provision of physical and financial security against all types of exploitation and oppression. The major objective are to ensure the much needed flow of funds and benefits for the welfare and development of these two categories in proportion to their population

Programs namely training and demonstrations were undertaken in 13 districts by 14 centres of AICRP on PHT (Table 28).

Training and demonstrations have been given on various post-harvest technologies viz., processing and value addition of cereals, pulses, oilseeds, spices, horticultural crops and demonstration on various post-harvest machinery. Some topics covered so far are sand puffing and roasting of cereal grains like rice, maize and bengal gram, safe storage of food grains, processing and value addition of mushroom, pineapple, mahua, root crops, tamarind, aonla, betel leaves, extraction of pulp and juice, preparation of jam and chutney from fruits, dehydration of fruits, development of beverages from fruits, extraction of oil from wild apricot, preparation of pickles from green mango, chilli, carrot, beans and mixed vegetables, preparation of tomato sauce and puree, preparation of grapes squash, preparation of mixed fruit jam, processing and value addition of non-timber forest produce (NTFP), demonstration of post-harvest machinery, e.g. banana fibre extractor, dhal mill and millet pearler, etc. During the reported period (2014-15), totally 2694 individuals have been benefitted under TSP.

Assessment of harvest and post-harvest losses of major crops and commodities in India (MoFPI sponsored project)

Food saving means growing more food and hence it becomes paramount to study the extent of losses in agricultural crops and commodities at each stage starting from harvest till it reaches the consumers. The present study on assessing the harvest and post-harvest losses of 45 crops and livestock produces were taken-up. The data for estimating their losses were collected from 120 districts of India covering 14 agro-climatic zones and data of 107 districts covering harvesting, collection, sorting/grading, threshing, winnowing, drying, packaging and transportation as well as

Table 28: State-wise name of districts in which TSP is operational

State	District	AICRP on PHT Centre allocated
Andhra Pradesh	Prakasam, Guntur, Krishna	Bapatla
Chhattisgarh	Bastar, Kanker, Gariaband	Raipur
Gujarat	Gir-somnath	Junagadh
Himachal Pradesh	Chamba, Kinnaur	Solan
Jharkhand	Ranchi, Giridih, East Singhbhum, Latehar	Ranchi
Karnataka	Chamarajanagar Raichur, Yadgir, Koppal, Bellary	Bangalore Raichur
Madhya Pradesh	Satna	Jabalpur
Maharashtra	Akola, Washim, Buldhana	Akola
Odisha	Gajapati, Kandhamal, Koraput, Deogarh, Keonjhar, Mayurbhanj	Bhubaneswar
Rajasthan	Udaipur, Banswara, Chittoregarh	Udaipur
Tamil Nadu	Coimbatore	Coimbatore
Uttar Pradesh	Lakhimpur	Lucknow
West Bengal	West Medinipur	Kharagpur

storage loss at household, warehouse/cold stores, wholesaler, retailer and processing unit levels were analysed. The data were collected though enquiry and by observations visiting the fields by staff of AICRP centres. Stratified multistage random sampling method was used to select the respondents. It is evident from the results that there is significant reduction of overall losses for wheat, mustard, groundnut, mango, guava, mushroom, tapioca, arecanut, black pepper and coriander in comparision to the earlier estimates of 2005-07 by Nanda et al. The estimated losses however were significantly increased for maize, sorghum, chickpea, soybean, sunflower, citrus, sapota, cauliflower, cashew, marine fish, meat and poultry meat in comparison to 2005-07. For remaining commodities, the changes in loss were statistically non-significant at 5% level of significance. The economic value of harvest and post-harvest losses of major agricultural and livestock produce was also calculated based on production data of 2012-13 and wholesale prices of 2014 and compared with earlier results by shifting both prices at 2011-12 prices. The possible reasons for changing scenario of losses at different stages were also discussed. It is evident that improvements in infrastructural and transport facilities were found to be helpful on reducing the post-harvest losses. Development of cold chain and construction of cold store with the pace of production are essential for majority of perishables. The results were discussed among the committee of technical experts and peers and also with Minister of Food Processing Industries for final approval. The investments in post-harvest infrastructure particularly supply chain management and allocation to post-harvest R&D need to be enhanced. Besides, focus should be on HRD/training component pertaining to strategic post-harvest management practices including better handling, sorting, packing/packaging, storage and marketing practices, and also encourage primary and secondary processing through establishment of Crop Processing Training-cum-Incubation Centre in production catchments, so as to reduce the post-harvest losses and contribute towards food and nutritional security. The final report was printed and submitted to MoFPI.

Study on storge losses of food grains in FCI and CWC warehouse and to recommend norms for storage losses in efficient warehouse system (FCI sponsored project)

The project entitled "Study on determining storage losses in food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management" was undertaken by 20 centres of AICRP on PHT. The aim of study is to identify the extent of storage losses in food grains (wheat, paddy, rice and maize) in FCI and CWC warehouses; to identify the factors responsible for losses in storage; arriving at storage loss norms in different agro-climatic regions/ State with respect to various factors and the factors responsible for such losses, to suggest ways and means to reduce the extent of storage losses in different unit operations. The study covers 13 agro-climatic regions covering 21 states and one UT. The depots selected were 45 godown and 18 CAP storage. Commodities selected for storage study were wheat and rice in godown storage for 3 years and wheat and paddy under Cover and Plinth storage for one year. Maize was selected to be stored in godown for one year. Among these depots, rice is to be stored in 38 godowns; wheat in 33 godowns; maize in one godown; 17 depots for wheat under CAP and 4 depots for paddy under CAP. Stacking in almost all godowns and CAP has been completed and the data collection is in progress. The initial results were discussed and shared with FCI officials in the meetings held at IFS, Gurgoan; FCI, New Delhi and UAS Bangalore.

AICRP on Plasticulture Engineering and Technology

- Abohar centre studied the development of poly-house structure using Earth Air Heat Exchanger for mushroom cultivation in semi-arid region. A polyhouse was constructed to grow mushrooms. It was found suitable to create optimum microclimatic conditions for round the year mushroom production in semi-arid region.10-12 hrs use of earth air heat exchanger was found applicable to increase the temperature up to 12-14°C from 4-6°C during Dec-Jan in night hours, when temperature decreased down up to 3-4°C outside the structure. Thus button mushroom (*Agaricus bisporus*) can be cultivated during the chilling winter season of this region. Application of foggers (14 L/h) for 5 min (1.17 L) in morning and afternoon was found sufficient to create RH from 70-95% for 10-12 hrs. Oyster mushroom was successfully cultivated during Jun-Sep. It needs temperature between 25-35°C and RH 85-95% for proper growth and development. Application of air cooler (4-8 hrs during day time) and exhaust fan ventilation (10-12 hrs, during night) was found suitable to create these conditions for the oyster mushroom cultivation during summer. Earth Air Heat Exchanger was not applicable during summer season.

- Development and evaluation of multi tier multipurpose polyhouse for drying of produce and raising of crop nursery / small height crops by Gangtok centre. Drying chamber was evaluated in no load condition. Maximum temperature in the upper chamber was found to be increased by 72%, from the corresponding value of 38.42°C in the lower chamber. In full load conditions, temperature in the plenum chamber and the cultivation trays increased considerably during the day time and the maximum temperature of 65°C was reached in the drying chamber during October 3-7, 2014. Average temperature in the drying chamber was observed to be 54% higher than the average temperature under ambient conditions (26.82°C). Relative humidity in the plenum chamber and the cultivation trays decreased considerably during the day time and the minimum relative humidity of 8% was reached in the drying chamber during October 3-7, 2014. Average relative humidity in the drying chamber was observed to be 54% higher than the average temperature under ambient conditions (26.82°C). Drying of dalley (local chilly) was taken up in the drying chamber and the drying characteristics were compared with the same under local sun drying. Moisture reduction from 85% to 10% was achieved in the drying chamber during the fifth day, whereas, the removal of moisture was from 85% to 60% during the same period. The strawberry crop is in the cultivation tray and economic analysis would be conducted after harvest of the crop in December.

Fig. 94. Prototype of the polyhouse

One prototype (fig. 94) of the polyhouse (Length: 2m, width: 2m, south side height: 2m and north side height 2.5 m) was erected using MS square pipe (25X25X3 mm) frame with covering of 120 gsm silpaulin sheet. Observation of maximum and minimum temperature at 4 places in the polyhouse were taken and analysed. Design refinement with the introduction of black PE barrier and plenum chamber between the lower (cultivation chamber) and upper (drying chamber). No load evaluation of the drying

chamber was conducted for 4 days (August 30, August 31, September 13 and September 28, 2014). A Full load evaluation was made with drying of dalley in the drying chamber. The experiment took 5 days to be completed (October 3-7, 2014). Temperature and relative humidity were monitored using data loggers at six points in the drying chamber, six points in the plenum chamber, four points in the cultivation chamber and two points in ambient. Average values of temperature and relative humidity in the three chambers were compared with the ambient conditions. Lux values were taken on two hour basis and related to the observed temperature and relative humidity values. Strawberry was taken up in the lower chamber.

- Water use efficiency of tomato under drip irrigation and mulching studied by Gangtok centre. The Irrigation requirement of 128.97 mm (43.27 litres per plant) was estimated for the crop for application during the cropping season: February 5 to June 4. Per plant irrigation application rate of tomato using drip irrigation system was estimated to be 43.27 litres. The irrigation requirement was maximum (8.82 litres) during the 9th week after transplanting. Average discharge per dripper was found to be 1.24 lph at average pressure of 0.3 kg/cm^2. UC for drippers in a single lateral were found to be 95.73%. The corresponding value for drippers among different laterals was found to be 94.87%. The system may cost Rs. 10000 per 100 m^2 and seems to be suitable for profitable cultivation of tomato in low cost naturally ventilated polyhouses of Sikkim. Irrigation application depth was worked out to be 6 mm. It was applied to the root spread area in the drip irrigated plots and to the whole area in the plots without drip

a.	Type of soil	Sandy loam
b.	Percent Sand, silt and clay, %	62, 23 and 15
c.	Field capacity,%	23.7
d.	Wilting point,%	13.8
e.	Root zone depth, m	0.6
f.	Total available water, m	0.06
g.	Desired range of soil moisture depletion,%	50 to 60
h.	Depth of irrigation, m	0.006

irrigation. The details of plot are given below:

Volume of water applied (per plant) was calculated (Table 29) in different stages of growth considering the root spread area (assumed to be equal to the canopy).

During the period of crop growth (January 11 to May 11, 2013) irrigation application rate (Table 30) was found to be decreased by 50% and 62% by use of drip and drip with black poly mulch,

Table 29. Volume of water applied (per plant) in different stages of growth

Stage of growth	Average canopy dia (m)	Root spread area (sqm)	Volume of water application (litre per plant)
Drip, upto 15 DAT	0.20	0.03	0.2
Drip, 16 to 30 DAT	0.40	0.13	0.8
Drip, 31 to 45 DAT	0.45	0.16	1.0
Drip, 45 to 60 DAT	0.50	0.20	1.2
Drip, Beyond 60DAT	0.60	0.28	1.7
No Drip			2.2

respectively, compared to the corresponding irrigation application rate of 70 litres per plant in the flooding method. Localised application of water by drip irrigation and conservation of moisture by black poly mulch have resulted into reduced use of irrigation water in the plots with drip irrigation and mulch.

Plant height, canopy diameter and number of

Table 30. Rate of irrigation applied for different Combinations

Method	Rate of irrigation applied (litre per plant)
T1: Drip with no mulch	35.1
T2: Drip with black poly mulch	26.6
T3:No drip no mulch (control)	70.0
CD (0.05)	9.9

leaves were found to be highest for the plot with drip irrigation and mulch, among the treatments. Increase in plant growth parameters in plots with drip and mulch may be due to maintenance of optimum moisture level in the root zone by drip and mulch. The average figures of the two experiments conducted during 2013-14 and 2014-15 is presented in the Table 31.

From the mean data of two experiments conducted during 2013-14 and 2014-15, it was observed that the yield of tomato in plots with drip-without mulch and drip-with mulch were found to be increased by 18% and 23% respectively from the corresponding yield (1.3 kg per plant and 3.5 kg per sqm) in the control plots (Table 32). The yield of the first experiment (2013-14) was lower due to pest incidence (Fungus mould). IWUE was found to be increased by 1.3 times in plots with drip irrigation, and 2.2 times in plots with drip irrigation and mulch, compared to the IWUI in the control plots of 18 kg of produce per cum of irrigation water applied. It showed that irrigation applied for production of one kg of produce was 24.0 and 17.4 litres for plots with drip without mulch and drip with mulch, respectively, compared to the requirement of 56.5 litres in the control plots (without drip and mulch).

- Feasibility and Economic Evaluation of Heating and Cooling of Polyhouse using Earth Air Heat Exchange (fig. 95) by Barapani centre. Design and Installation of Heat Exchanger: It consists of eight 75 mm diameter and 6 m long MS pipes connected by elbows and nipples. Two pipes form one grid of 12 m length. After each grid a

Table 31. Plant height, canopy diameter and number of leaves for different Combinations

Treatment	Plant height (m)			Canopy diameter (m)			Number of leaves		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T1: Drip with no mulch	35.2	95.9	164.15	34.15	58.2	75.2	8.8	23.25	31.35
T2: Drip with black poly mulch	38.75	102.2	170.15	36.95	60.6	78.7	9.8	24.15	33.25
T3:No drip no mulch (control)	33.2	93.35	156.4	35.9	56.6	71	8.6	21.8	29.25

Table 32. Yield per plant and per sqm (g) and IWUI for different Combinations

Method	Yield per plant (g)	Yield per m^2 (g)	IWUI (kg of produce per cum of irrigation water applied)	Irrigation applied to produce 1 kg of tomato (litres)
T1: Drip with no mulch	1479	4101	42.2	24.0
T2: Drip with black poly mulch	1548	4292	58.4	17.4
T3:No drip no mulch (control)	1257	3485	18.0	56.5

butterfly valve has been placed to divert air from the rest of the grids to change the length of the path of air travel. The heat exchanger has been installed at a depth of 1.5 m. Scrap iron has been spread at the sides of the heat exchanger to increase heat transfer. Blower: This is backward curved centrifugal pump of diameter 300 mm

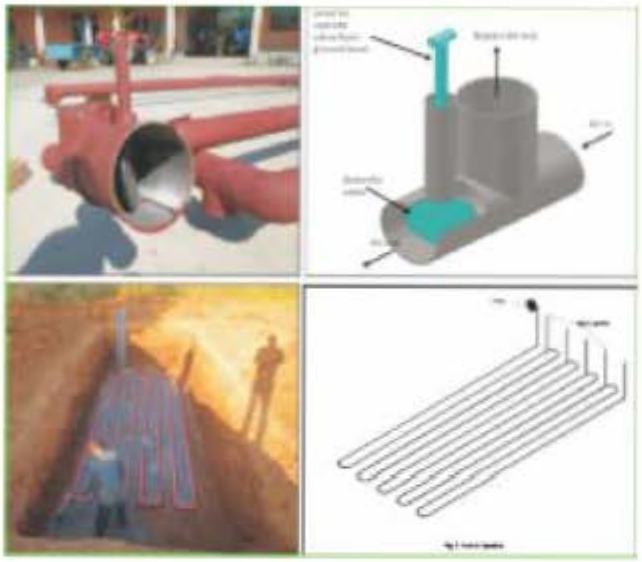


Fig. 95. Earth Air Heat Exchanger

and rotated by a three phase 740 watt 3000 rpm motor.

Ground area of the polyhouse is 8 m x 4 m. Height is 1.5 m at the side and 2.5 m at the centre (Capacity 64 cum). It is covered by 200 μ LDPE (fig. 96). Data recording: Temperature and humidity inside the polyhouse has been recorded continuously at an interval of 30 min by a data-logger.

- Periphyton production on different types of colored plastic strips in freshwater ponds for enhanced fish production by Bhubaneswar centre. Experiment-1: The experiment was conducted in triplicate with different colored plastics, such as Red, Blue, Black, Green and Transparent. After four months of observation, more periphyton growth in terms of volume was seen on red followed by green, blue, black and transparent plastic sheets under pond water. Number of genera established in the colonies was seen more on green followed by blue, red, transparent and black sheets. 48 different periphyton microalgae were observed on the plastic sheets. The more number of genera of green algae were found on the plastic sheets followed by diatoms, desmids and blue-green algae. It may be said that the color of the substrate is effective for the specific algae. No significant differences ($p<0.05$) were observed on the occurrence of the algae due to the color of the sheet within individual groups except for diatoms, where blue color sheet had significantly less than white sheet. Experiment-2: The experiment taking different colored plastic sheets (green, blue, black, white & red) and bamboo mats for periphyton growth on those in

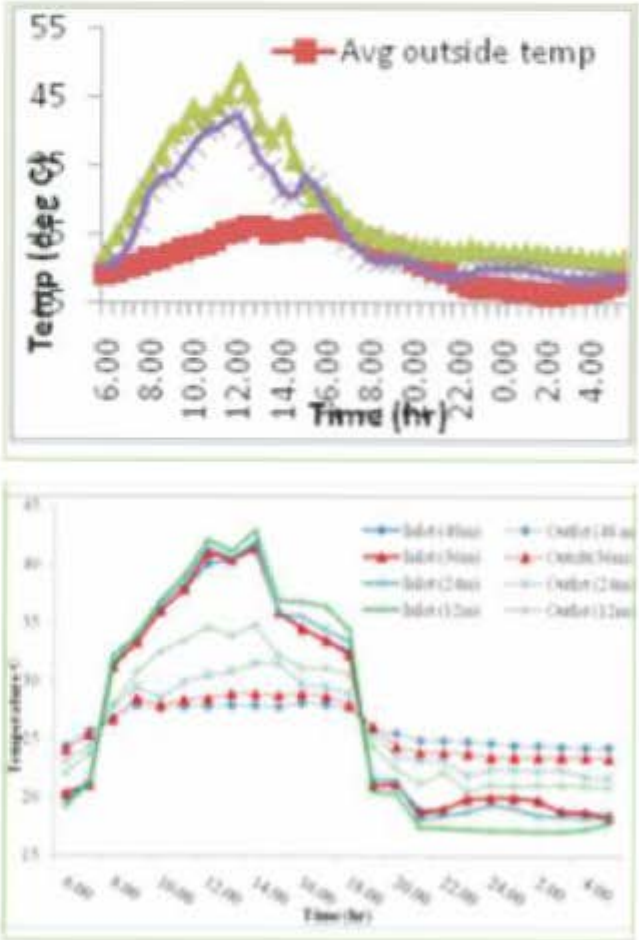


Fig 96. Difference in inlet and outlet temperature in different location of the heat exchanger

(Table 33) ponds (one stocked with fishes and the other without fish) was conducted. In bamboo mat and black colored plastic sheet the light didn't penetrate to the back side, so there was no periphyton growth on them (in the back side). Blue color had more amount of periphyton growth on it. The pond stocked with fish had quantitatively low amount of periphyton on it than the pond having no fish. 46.36 % less periphyton was observed on sheets in ponds with fish that means fish had eaten the plankton.

Table 33. Quantity of Periphyton (in ml) growth on different colored Plastic sheets

Colour of plastic sheet	Quantity of Periphyton (in ml) on sheets-Pond with fish	Quantity of Periphyton (in ml) on sheets-Pond with out fish
Red	4.5	6.5
Green	5.5	8.0
Blue	5.0	13.5
Black	4.5	7.0
White	4.5	12.0
Bamboo sheet	5.5	8.0

Experiment -3: Two ponds of 0.1 ha were selected for this experiment. One pond had of five different colour plastic sheets (fig. 97) for periphyton growth and another without plastic sheets. Each pond was stocked 50 kg of fish biomass (600-900 gm). These fish were reared for three months, supplementary feed was given in both the ponds with 2% fish biomass. There was no significant difference in water parameters of both the ponds. At the end of experiment, 79 kg fish biomass was harvested form pond with plastic sheet and 72 kg fish biomass from the pond without plastic sheets. The pond with plastic sheets had 9.72 % higher growth rate than pond without plastic sheet.

Fig. 97. Different coloured plastic sheets for periphyton growth

- Laboratory Jar Experiment for Periphyton Growth on Different Plastic Materials by Bhubaneswar centre. The water of each jar was fertilized by adding Urea (2.0 g) and SSP (3.0 g). The experiment was conducted in triplicate. Four types of plastic sheets were used for the experiment. Polyethylene (T-1, T-2, T-3), Polypropylene (T-4, T-5, T-6), FRP (T-7, T-8, T-9), and Acrylic (T-10, T-11, T-12) sheets were immersed in the water of the jars. The experiment was conducted for 45 days. The FRP sheets were seen with higher periphytic coatings than other sheets. Quantitatively the amount of periphyton from 33 x 26 cm area was for FRP - 5.59 ml, acrylic - 2.79 ml, polyethylene - 3.03 ml, and polypropylene - 2.79 ml. Polyethylene sheet had more types of genera (green algae) attached on to it and acrylic sheet had less type of genera. On all sheets, brown algae *i.e.*, Bacillariophyceae (Diatoms) had developed and species *Navicula* was the dominant type. The experiment was repeated for the second time for its accuracy of the result. And the result was same like previous experiment. The water parameters were analyzed in an interval of 15 days.

- Evaluation of Polyhouse covered fish pond for fish rearing under temperate climatic conditions of Kashmir valley by Srinagar centre. Four

numbers of ponds used for the study and stocked with uniformly graded fingerlings of common carp. Four treatments done in relation to the observations of Water temperature rise, Fish growth and Water quality parameter. The average temperature of P_1 pond was highest at 12.90°c followed by P_3, P_2 and P_4, respectively. The pH value of water in all ponds were found to be in range of 7-9.6 and average pH values were found in range 8.1-8.2. Dissolved oxygen (D.O) was found lower in P_1 but D.O found highest inP_3.The weight gain was found to be maximum in fingerlings stocked in P_1 followed by P_2, P_3& P_4 respectively. The results shown that the growth of fingerlings is better under polyhouse fish pond. The other parameters like weight gain in % and growth/day in %, body weight also showed the same trend while as specific growth rate was highest in P_1 followed by P_2, P_4 and P_3, respectively.

- Studies on heating and cooling of agricultural Greenhouse using Earth Air Heat Exchanger (EAHE) by Ludhiana center. Heat exchanger is under operation and data being recorded with 6 inch size of motor pulley and the blower in speed 1440 rpm and found the final speed 3 m/s at outlet of EAHE. At this speed the air was blown up to half the length of the greenhouse. When the size of the pulley was reduced to 3.5 inch in 2400 rpm speed were found the final speed 4.7m/s and achieved full blown of the green house. Also observed that the difference between air temperature at the inlet and outlet was 3.2 ° C at 2440 rpm. When velocity is reducing the suction the rise of temperature.

- Junagadh centre studied the performance of plastic mulch (fig. 98) in Bt cotton. To evaluate plastic mulch (bio-degradable and silver black) as compared to wheat straw mulch and control under three different irrigation levels, the field experiment was laid out in strip plot design during 2011, 2012 and 2013. Crop and soil parameters were recorded during the

Fig. 98. Different colored Plastic Mulch in Bt Cotton

experiment. The irrigation was applied on the basis of ETc of 0.6, 0.8 and 1.0. Crop parameters like plant height (177.11 cm), plant canopy (25694.67 sq cm), monopodia/plant (4.19), sympodia/plant (27.01), number of balls/plant (74.06) and crop yield (4979.86 kg/ha) were found maximum under silver black plastic mulch with the irrigation level of ETc = 0.8. The crop parameters were found minimum under no mulch condition with the irrigation level of ETc = 0.6. The highest net return was obtained under silver black plastic (61833.20 Rs/ha) as compare to other mulching treatment. Total depth of water applied were 314.75 mm, 419.65 mm and 555.2 mm under the irrigation level of 0.6 ETc, 0.8 ETc and 1.0 ETc respectively. Maximum water use efficiency (13.49 kg/ha-mm) was found under silver black plastic mulch with 0.6 ETc irrigation level while it was minimum (6.05 kg/ha-mm) under no mulch condition with an irrigation level of 1.0 etc.

INSTITUTE ACTIVITIES

Extension activities of TOT Division

Trainings imparted

a) Farmers Training

- A training was organized on "Post-Harvest Management for Rural Catchment" for 7 farmers from Jamner, Jalgaon, Maharashtra and 5 farmers from Amalner, Jalgaon, Maharashtra during 05-09 May 2014.

- A five days training was organized for 21 farmers from Chandrapur, Maharashtra sponsored by

MACP, ATMA on "Post-Harvest Management" during 03-07 February 2015.

- A five days training was organized for 24 farmers from Chandrapur, Maharashtra, sponsored by MACP, ATMA on "Post-Harvest Management" during 17-21 February 2015.

b) Officers Training

- A capacity building training was organised (by Dr. S. K. Nanda and Dr. Indu Rawat) on 'Post-Harvest Management' during 07-11 April 2014 for 24 officers sponsored by MACP, VANAMATI, Nagpur.

- A capacity building training was organized on 'Post harvest technology of major crops and livestock produce of Odisha state' sponsored by Govt. of Odisha for 19 Agricultural Officers (1st batch) during 15-19 September 2014. The training programme was coordinated by Dr. S. K. Nanda, I/C Head (TOT) and co-coordinated by Dr. Indu Rawat, Scientist, TOT Division.

- A capacity building training was organized by Dr. S. K. Nanda and Dr. Tanbir Ahmad on 'Post harvest technology of major crops and livestock produce of Odisha state' sponsored by Govt. of

Odisha for 20 Agricultural Officers (2nd Batch) during 11-15 November 2014.

- A capacity building training was organized on 'Post-harvest technology of major crops and livestock produce of Odisha state' sponsored by

Govt. of Odisha for 20 Agricultural Officers (3rd Batch) during 25-29 November 2014.

- A capacity building training was organized on 'Post-harvest technology of major crops and livestock produce of Odisha state' sponsored by Govt. of Odisha for 20 Agricultural Officers (4th

Batch) during 08-12 December 2014. Theory and practicals on various ICAR-CIPHET developed technologies were organised for trainees. The trainees got exposure to food processing industry and agro processing through field visits to Nijjar Agro Industries, Amritsar and Agro-Processing Centre, Moga, Punjab. Besides, a visit for showcasing and demonstrating processing and farm machinery, PAU, Ludhiana, was also organised.

- A capacity building training was organized by Dr. S. K. Nanda, I/C Head (TOT) and Dr. Ranjeet Singh, Sr. Scientist, TOT Division on 'Post harvest technology of major crops and livestock

produce of Odisha state' sponsored by Govt. of Odisha for 20 Agricultural Officers (5th Batch) during 19-23 January 2015.

c) Students Training

- Transfer of Technology Division conducted 3 days training programme on "Post-Harvest Management of Fish" for 12 B.F.Sc. students from College of Fisheries, GADVASU, Ludhiana during 14-16 May 2014.
- Four months training was imparted to 3 B.Tech (Agril. Engg.) students of College of Agriculture Engineering and Technology, Anand Agricultural University, Godhra (Gujarat) on 'Quality evaluation of debittered kinnow juice and shrink wrap pacakaging of cabbage' w.e.f. 05.02.2014 to 31.05.2014.
- Three B.Tech (Agril. Engg.) students from Junagadh Agri. University, Junagadh, Gujarat

were imparted one month training w.e.f. June 01-June 30, 2014.

- A training was organised for 9 M.Tech. students from CAET, Junagarh during July 01-July 26, 2014 at ICAR-CIPHET Ludhiana.
- One month implant training was imparted to 13 students (12 B.Tech and 1 B.Sc) during July 01-July 31, 2014.
- ICAR-CIPHET imparted implant training to 12 B.Tech students from UAS Bangalore during Aug 2014.
- ICAR-CIPHET is imparting implant training to 2 B.Tech students from OUAT, Bhubaneshwar from Aug–Nov 2014.

d) Radio Programme

- One radio talk was delivered by Dr. S.K. Nanda, I/C Head (TOT) on ICAR-CIPHET developed technologies on FM Gold, Ludhiana. He focused on the role of post-harvest machineries and products developed in the ICAR-CIPHET and

the distinguishing features of each machine displayed for demonstrated at PAU *Kissan Mela* held at PAU, Ludhiana during 20-21 March 2015.

e) Participation in Exhibitions

- ICAR-CIPHET developed technologies were showcased in Innovation Exhibition at NIT Hamirpur, Himanchal Pradesh during 12-13 August 2014.
- ICAR-CIPHET attended 'Research and Extension Specialists Workshop for Rabi Crops'

organized by Directorate of Extension Education, Punjab Agricultural University, Ludhiana, Punjab held during August 12-13, 2014 held at Pal Auditorium, PAU Ludhiana.

- ICAR-CIPHET displayed its technologies and products in *Kisan Mela* held at PAU Ludhiana during 12-13 September 2014.
- ICAR-CIPHET developed technologies were demonstrated in *Kisan Mela*, PAU Ludhiana held at Regional Research Station of PAU, Rauni, Patiala on 16 September 2014.
- ICAR-CIPHET participated in *Kisan Mela*, PAU Ludhiana held at Regional Research Station of PAU, Bhatinda on 27 September 2014. During this exhibition, about 2000 farmers/ entrepreneurs visited the ICAR-CIPHET stall and appreciated the developed technologies and products.
- ICAR-CIPHET developed technologies were demonstrated in exhibition at NDRI, Karnal, Haryana during ICAR Institute-SAU-Development and Stakeholder Interface on 'Farmers and Industry Participation in Agricultural Growth" held on 18 October 2014.
- Selected proven technologies of ICAR-CIPHET were showcased and demonstrated in Food & Craft Mela held at PAU Ludhiana on 21 October 2014. Various technologies developed by the institute like barnyard millet based gluten based muffins, millet based extruded products etc. were displayed in this and attracted the

exhibitors.

- ICAR-CIPHET developed technologies were showcased and demonstrated in National Symposium on 'Agriculture Diversification for Sustainable Livelihood and Environmental Security' during 18-20 November 2014 at PAU Ludhiana.

- ICAR-CIPHET developed technologies were showcased and demonstrated in Agricultural Science Congress (ASC) India Expo during 03-06 February 2015 at NDRI Karnal.
- ICAR-CIPHET developed technologies were showcased and demonstrated in Eastern Zone Regional Agriculture Fair organized by ICAR-CPRI Shimla during 19-21 February 2015 at Central Potato Research Station, Patna, Bihar.
- Showcased and demonstrated ICAR-CIPHET developed technologies in Indian Agri Show Kisan Gyan Ganga during 26 – 28 February 2015 at Pragati Maidan, New Delhi.
- Showcased and demonstrated ICAR-CIPHET developed technologies in Pusa *Krishi Vigyan*

Mela organized by IARI, New Delhi during 10–12 March 2015.

- Showcased and demonstrated ICAR-CIPHET developed technologies in *Kisan Mela* held at PAU Ludhiana during 20-21 March 2015.

फूड इंडस्ट्री में पंजाब को मॉडल स्टेट बनाएंगे : हरसिमरत

किसानों को छोटी फूड प्रोसेसिंग मशीनें मुहैया करवाने पर जोर

f) Coverage in print media


मुंबई में फूड ग्रिड बनाएगा केंद्र : हरसिमरत


दिल्ली के किसान मेले में गुरप्रीत सोरगिल को इनोवेटिव फॉर्मर अवॉर्ड


सिफेट मनाएगा सिल्वर जुबली सेमिनार

तृप्तिकर। आईसीएआर-सिफेट ओर से 25 साल पूरे होने के उपलक्ष्य में सिल्वर जुबली सेलीब्रेशन मनाया जाएगा। नई दिल्ली में दो दिन आयोजित होने वाले इस सेमीनार में सिफेट द्वारा फार्मर आयोजित की जा रही गतिविधियां और अपने के कार्यक्रमों की रूपरेखा तैयार की जाएगी। दो दिवसीय सेमीनार का स्वतंत्रदिवस एमओएफपीआई की ओर से की जाएगी। इस संबंध में सिफेट की ओर से पीएयू में 19-20 दिसंबर को सेमीनार का आयोजन कर फूड प्रोसेसिंग के क्षेत्र में नए रिसर्च और नई संभावनाएं भी तलाशी जाएंगी। 19 दिसंबर को राधास्वामी सत्संग घर होशंगा रोड इलाके में भी इससे संबंधित सेमीनार का आयोजन किया जाएगा।

News items related to post-harvest technology

INSTITUTE ACTIVITIES

Commercialization/ Licensing of ICAR-CIPHET technologies during year 2014-15

Training and licensing of "Pearl millet based composite extrudates and pasta technology"

Pearl millet based composite extrudates and pasta technology is used to develop instant product having high caloric density, protein quality, high shelf life by using small low cost collet type food

extruder. Relatively low capital and operating costs allow the manufacturer to prepare the product at lowest possible cost so that they can effectively reach the low income segments of population. Dr. D.N. Yadav, Sr. Scientist and Ms. Monika Sharma, Scientist imparted the training regarding technical knowhow of the technology to a budding entrepreneur, Mr. Ashok Kumar from Jalandhar. Dr. Manju Bala, I/C ITMU, ICAR–CIPHET Ludhiana coordinated this activity. License of the mentioned technology was transferred to the entrepreneur on 01 May 2014 by Dr. R.K.Gupta, Director, ICAR-CIPHET.

Training and licensing of "Groundnut flavoured beverage, curd and paneer"

ICAR-CIPHET, Ludhiana has taken lead for the development of groundnut based dairy analogues such as flavored beverage, curd, paneer etc. Besides its nutritional values, groundnut beverages also protect from cardiac diseases and diabetes. Seven entrepreneurs viz. Mrs. Sarbjit Kaur from Jalandhar (Pb.), Mr. Dilbag Singh, Mr. Sat Pal Singla, Mr. Uttam Singh from Bathinda (Pb.), Mr. Inderjit Singh from Ludhiana, Mr. Suyash Shukla from Indore (M.P.) and S. Daljit Singh from Fatehabad (Haryana) took the training and license of this technology.

Licensing of "Process of manufacturing mix for ready to constitute makhana kheer"

Makhana which is mainly grown in eastern part of country is now spreading its horizon by creating demand in other parts of country as well. *Makhana kheer* has great potential for popularization and commercialization, but due to non-availability of standard and quick method, it is not so popular. A process for manufacture of ready to constitute *makhana kheer* mix (RCMK) with prolonged shelf life under suitable storage conditions has been developed which can be used to prepare *makhana kheer* almost instantly just by mixing one part of RCMK with desired parts of warm/hot/cold water. Entrepreneur from Baddi based M/s Ultra Bio Naturals and Hyderabad based firm M/s A1 Foods India Pvt. Ltd., Telangana approached ICAR-CIPHET for this technology. License of aforesaid technology was transferred to the firms on 06 June 2014 and 02 July 2014 respectively.

Licensing of "ICAR-CIPHET evaporatively cooled storage structure"

Fruits and vegetables being perishable in nature need immediate post harvest management to reduce field heat and enhance shelf life. Refrigerated storage, which is believed to be the best method for storing the fruits and vegetables in fresh form, is not only energy intensive but also involves huge capital investment. Besides it is not suitable for rural or on farm storage where the producer would like to store the commodities for only few days to accumulate sufficient quantities before carrying them to markets situated far off and in urban areas. Keeping in view the need for low cost alternative storage system, ICAR-CIPHET has developed evaporatively cooled structure which is lesser energy intensive and is able to maintain lower temperature in an enclosed chamber for storage of fruits and vegetables for a short duration. Dr. S.N. Jha, Head AS&EC Division provided design of this structure to Mr. M. Harikrishnan, Chief Executive of M/s Southern India Spices & Essences, Thiruvananthapuram, Kerala. BPD along with ITMU from ICAR-CIPHET helped the entrepreneur to get the licensing and training of this technology. Dr. S.N. Jha, I/C Director, ICAR-CIPHET handed over the MoA of this technology to the entrepreneur on 19 June 2014.

Training and licensing of "Minimal processing of vegetables"

Minimal processing of raw fruits and vegetables is important not only to keep the produce fresh but also to extend its shelf life to make distribution feasible within the region of consumption. The

minimally processed fruits and vegetables are the form of ready to eat or ready to cook kind which can be mixed salad, fruits slices, cubes, vegetable sticks can serve as convenience to consumers for ready food, especially with rapid changes in lifestyle. Dr. Rahul K. Anurag, Scientist imparted training on these technologies to Mr. M. Harikrishnan, Chief Executive of M/s Southern India Spices & Essences, Thiruvananthapuram, Kerala from 16-19 June 2014. Dr. D.M. Kadam, PI-BPD along with Dr. Manju Bala, I/C ITMU from ICAR-CIPHET helped the entrepreneur to get the licensing and training on this technology. Dr. S.N. Jha, I/C Director, CIPHET handed over the MoA to the entrepreneur on 19 June 2014.

Training on "Shrink wrap packaging of fruits and vegetables"

Individual shrink wrapping of produce in heat shrinkable or other plastic films is an extension of multi–unit packaging, such as plastic bags and tray over wraps for extending post-harvest life of fruits and vegetables. The individual shrink-wrap packaging extends the shelf-life by preventing the moisture loss, maintaining firmness and reducing the respiration rate. It also delays the physiological deterioration of fruits sometimes even better than the low temperature storage. Hence farmers/ entrepreneurs must know this technique to extend the shelf life and fetch high returns. BPD in association with Dr. Manju Bala, I/C ITMU organized 4 days training from 16-19 June 2014 and Dr. Rahul Anurag imparted the training to entrepreneur. The training was concluded by awarding the training certificate to the entrepreneur by Dr. S.N. Jha, I/C Director, ICAR-CIPHET, Ludhiana on 19 June 2014.

Licensing of "Process of separating a compound containing allylisothiocynate from mustard seed"

Mustard is one of the most important oilseeds in the country and it ranks number two after groundnut oil. In Ayurveda and other healing methods, the properties of mustard oil as antifungal, antibacterial and insecticidal have been highlighted. These properties are basically due to presence of

Allylisothiocyanate in the oil and ICAR–CIPHET, Ludhiana has developed technique for extraction of this component from mustard seed. Ludhiana based firm viz. M/s Parshuram Bio agrotech Pvt Ltd, approached the institute for this technology and Dr. Manju Bala, I/C ITMU facilitated the firm to get license of this technology. License of the mentioned technology was transferred by Dr. S.K. Nanda I/C Director, ICAR-CIPHET, Ludhiana on 26 June 2014.

Training and licensing of "Beetroot powder technology"

Beetroot is a nutritious vegetable and has been considered beneficial to the blood, heart and digestive system. It is rich in betaine which plays an important role in preventing toxic levels of homocysteine harmful to blood vessels. Beetroot is also rich source of carbohydrates, a good source of protein, dietary fibre and important vitamins. Powdering technology developed by the Institute would go long way to provide effective and easy solution to people of all age groups. Dr Mridula Devi, Senior Scientist at ICAR-CIPHET imparted

training regarding technical aspects of this technology during 25-26 July 2014. The MoA of this technology was given to Ms. Shelly Gandhi, a Delhi based young entrepreneur by Dr. R.K. Gupta Director, ICAR-CIPHET on 26 July 2014.

Licensing of "Potato peeler cum washer"

For the processing of potatoes in any form, removal of peel is an important unit operation. Hence, a power operated batch type potato peeler of capacity 400 kg/h with peeling efficiency of 95% was developed at ICAR-CIPHET, Ludhiana. The machine is driven with electric motor and is suitable

for small scale potato processing units. License of this technology was transferred to M/s Swift Machines Pvt. Ltd., Haryana on the occasion of Silver Jubilee Seminar on 19-20 December 2014.

Licensing of "Low fat meat emulsion and process for making the same"

Recent media attention to the global problem of obesity demonstrates a need for greater availability of foods with low fat and caloric content. Therefore,

there is a need to develop low fat meat emulsion and emulsion type meat products that have desirable flavor and texture like that of high fat meat emulsion and emulsion type meat products. ICAR–CIPHET, Ludhiana has developed the process for making low fat meat emulsion and emulsion type products with the replacement of unwanted added fat with advantageous plant origin gel that is well contributing to the flavor and texture in meat products. Ludhiana based company M/s Khanna Food Products, Ludhiana approached the institute for this technology. Dr. S.K. Nanda, I/C Director, CIPHET, Ludhiana handed over the MoA of this technology to entrepreneur on 20 February 2015.

Training and licensing of "Processing of aonla for manufacturing of value added products"

Aonla fruit is highly nutritive with great medicinal benefits. As aonla fruits are highly perishable in nature, its storage is very limited. Abohar centre of ICAR-CIPHET, Ludhiana

developed many products such as aonla candy, jam preserve, jelly, leather, mouth freshner etc. Mrs. Binder Pal Kaur approached ICAR-CIPHET for this technology. Mr. Vijay Singh Meena and Mr. Rajesh Kumar, Scientist and T-6 at HCP Division, Abohar imparted the training to the entrepreneur at Abohar Centre. Dr. Manju Bala, I/C ITMU coordinated the licensing and training of this technology. License of the mentioned technology was transferred to the entrepreneur on 26 March 2015 by Dr. R.K.Gupta, Director, ICAR-CIPHET.

ICAR-CIPHET technologies licensed during the year 2014-15

S. No.	Technology	Contracting Party	License Fee (Rs.)	Date of Signing Agreement	Type	Innovator
1.	Agreement for licensing of "Pearl millet based composite extrudates and pasta"	Mr. Ashok Kumar, S/o Mr. Gian Chand, VPO Ghurka, Teh. Phillaur, Distt. Jalandhar (Punjab)-144632	35000.00	01.05.2014	Licensing and training of non-IP protected technolgy	Dr. D.N. Yadav Ms. Monika Sharma
2.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mrs. Sarbjit Kaur, W/o Mr. Sukhjinder Singh, No. 60, Satnam Colony, Alipur Road, Mithapur, near Bhatti Cold Store, Jalandhar (Punjab)-144 006	15000.00	29.05.2014	Licensing and training of non-IP protected technolgy	Dr. D.N. Yadav
3.	Agreement for licensing of technology of "Process of manufacturing mix for ready to constitute makhana kheer (Patent application no. - 746/DEL/2008)"	M/s Ultra Bio Naturals 41, DIC (Baddi), Himanchal Pradesh	100000.00	06.06.2014	Licensing and training of IP protected technology	Dr. S.N. Jha
4.	Agreement for licensing of technology of "Minimal processing of vegetables"	M/s Southern India Spices & Essences, Kanjirampara, P.O. Thiruvananthapuram (Kerala) - 695 030	15000.00	19.06.2014	Licensing and training of non-IP protected technolgy	Dr. Rahul K. Anurag
5.	Agreement for licensing of technology of "Knowhow for construction of ICAR-CIPHET evaporatively cooled storage structure\ (5-7 tonne capacity)"	M/s Southern India Spices & Essences, Kanjirampara, P.O. Thiruvananthapuram (Kerala) - 695 030	25000.00	19.06.2014	Licensing and training of non-IP protected technolgy	Dr. S.N. Jha
6.	Agreement for licensing of technology on "A process of separating a compound containing allylisothiocynate from mustard seed (Patent No. – 250118)"	M/s Parshuram Bio-agrotech Pvt. Ltd., 4th floor Novelty Plaza, Bhai wala Chowk, Ludhiana	50000.00	26.06.2014	Licensing of IP protected technology	Dr. S.K.Tyagi

S. No.	Technology	Contracting Party	License Fee (Rs.)	Date of Signing Agreement	Type	Innovator
7.	Agreement for licensing of technology of "Process of manufacturing mix for ready to constitute makhana kheer (Patent application no.- 746/DEL/2008)"	M/s A1 Foods India Pvt. Ltd., 6-2-8/3, Shivrampally, Katedhan Village, Rajendranagar Mandal, RR District- 500 052, Telangana	50000.00	02.07.2014	Licensing of IP protected technology	Dr. S.N. Jha
8.	Agreement for licensing of technology of "Process for making beetroot shreds and powder"	Ms. Shelly Gandhi, A-11, Nizamuddin East, New Delhi - 110013	25000.00	26.07.2014	Licensing and training of non-IP protected technology	Dr. Mridula D.
9.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mr. Dilbag Singh, St. No. 13/10, Guru Gobind Singh Nagar, Opp. Antic Resort, Bathinda (Pb.) -151 001	15000.00	31.07.2014	Licensing and training of non-IP protected technology	Dr. D.N. Yadav
10.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mr. Sat Pal Singla, 39/2, Bharat Nagar, Bathinda (Pb.) -151 001	15000.00	31.07.2014	Licensing and training of non-IP protected technology	Dr. D.N. Yadav
11.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mr. Uttam Singh, # 19330, St. 5, Guru Teg Bahudur Nagar, Bibi Wala Road, Bathinda (Pb.) -151 001	15000.00	31.07.2014	Licensing and training of non-IP protected technology	Dr. D.N. Yadav
12.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mr. Inderjit Singh, S/o Late S. Daljit Singh, H. No. 5501, St. No. 6, Sahibzada Fateh Singh Nagar, New Shimlapuri, Ludhiana -141003	15000.00	14.10.14	Licensing and training of non-IP protected technology	Dr. D.N. Yadav
13.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	Mr. Suyash Shukla, S/o Mr. Sushil Kumar Shukla, 145, Sai Baba Nagar, 60 Feet Main Road, Dwarikapuri, Indore (M.P.)- 452 009	15000.00	25.11.2014	Licensing and training of non-IP protected technology	Dr. D.N. Yadav

S. No.	Technology	Contracting Party	License Fee (Rs.)	Date of Signing Agreement	Type	Innovator
14.	Agreement for transfer of KNOWHOW of "Potato peeler cum washer"	M/s Swift Machines Pvt. Ltd., 270, Mahesh Nagar, Ambala Cantt. (Haryana)	200000.00	19.12.2014	Licensing of non-IP protected technology	Dr. S.K. Tyagi
15.	Agreement for licensing of "Groundnut flavoured beverage, curd and paneer"	S. Daljit Singh, S/o S. Kirpa Singh, VPO Akkanwali, Tehsil Tohana, Distt. Fatehabad (Haryana) – 125 106	15000.00	11.02.15	Licensing and training of non-IP protected technology	Dr. D.N. Yadav
16.	Agreement for licensing of technology of "Low fat meat emulsion and process for making the same (Patent application no. - 2351/DEL/2013)	M/s Khanna Food Products, B-34-2450/1, Rajesh Nagar, Haibowal Kalan, Ludhiana -141 001	50000.00	20.02.15	Licensing of IP protected technology	Dr. Yogesh Kumar, Dr. K. Narsaiah and Dr. Tanbir Ahmad

EVENTS ORGANIZED

Visit of Hon'ble Union Cabinet Minister

Hon'ble Union Cabinet Minister for Food Processing Industries, Harsimrat Kaur Badal visited ICAR-CIPHET Ludhiana on 5 July 2014 to get apprised and review the progress achieved by the ICAR-CIPHET in 'Assessment of Post-harvest Losses of Major Crops and Livestock Produce in India', a project sponsored by the Ministry of Food Processing Industries, India. ICAR-CIPHET had already conducted the benchmark survey under the leadership of Dr S K Nanda, Former Project Coordinator of AICRP-PHT on quantitative post harvest losses in India and brought out its results during the last Plan. Dr R K Gupta, Director, ICAR-CIPHET explained the progress in this repeat study on the post harvest losses. Expressing her concern over the substantial post-harvest losses in the country, the Hon'ble Minister advised the institute to collaborate with PAU, Ludhiana; GADVASU, Ludhiana and Punjab State Government in popularizing the loss reduction technologies developed by ICAR-CIPHET, which may be emulated in other states. Dr Gupta also briefed the Hon'ble minister about the significant achievements of ICAR-CIPHET in recent years including litchi peeling machine, custard apple pulper, ground nut milk, etc., which were highly appreciated by her. The Hon'ble minister also visited the laboratories and the Agro Processing Centre of the institute and witnessed the pilot plant demonstration of milk production from ground nut, manufacturing of extruded products and cryogenic grinding system. Besides, an interaction programme with the entrepreneurs was organized. The products displayed by the entrepreneurs were soybean milk and tofu, groundnut milk, *amla* candy, fruits and vegetable based pickles, rose water, multi grain flour, etc. She applauded the efforts of the entrepreneurs and also the ICAR-CIPHET who gave them training and helped in establishing their ventures. She also instructed the concerned officials to provide appropriate platform to the entrepreneurs for marketing and popularizing their products.

Visit of Honorable Secretary, DARE & DG, ICAR

Dr. S. Ayyappan, Honorable Secretary, DARE & DG, ICAR and Dr. K. Alagusundaram, DDG (Engg.) visited ICAR-CIPHET on 14 November 2014. Potato Peeler cum Washer machine was inaugurated by him and he also encouraged the institute scientists. Dr. A. U. Muzaddadi, Sr. Scientist and Dr. Tanbir Ahmad, Scientist demonstrated Live Fish Transport Carrier system and Fish Descaling Machine (developed at ICAR-CIPHET) to Dr. S. Ayyappan in the presence of Dr. K. Alagusundaram,

DDG (Engg.), ICAR, Dr. R.K. Gupta, Director, ICAR-CIPHET and Dr. S.K. Nanda, I/C, HOD, TOT Division. The Director General expressed his

satisfaction over new developments in the institute and wished for the holistic progress of the institute and the sector in the coming years.

Visit of Honorable DDG (AE), ICAR, New Delhi

Dr. K Alagusundaram, DDG, Agricultural Engineering Division, ICAR visited ICAR-CIPHET on 29th October 2014 and interacted with the staff. On this occasion, Director showcased the institute video. ICAR-CIPHET Scientists introduced themselves with their field of work. Hon'ble Deputy Director General addressed the gathering with his thought-provoking speech and encouraged everybody to serve the society with full dedication. He also visited the laboratory of different Divisions, Units, APC and workshop.

- Dr. Gurbachan Singh, Hon'ble Chairman, ASRB visited ICAR-CIPHET, Ludhiana on 20 November 2014.
- Dr. Kevin D Gallagher, Ph.D & FAO Representative India, ad interim, Office of the Representative in India, New Delhi visited ICAR-CIPHET, Ludhiana on 22 December 2014 to discuss potential collaboration on studies pertaining to post-harvest losses. Dr. R.K. Gupta, Director ICAR-CIPHET welcomed Dr. Kevin to institute and presented before him the study about post harvest losses conducted by CIPHET. Dr Kevin appreciated the study and raised some issues regarding losses of food in Public Distribution System in India and wastage of food in India.
- 30 delegates from Kenya and Malawi along with two officials of MANAGE visited ICAR-CIPHET, Ludhiana on 10 September 2014 as part of their international training programme entitled *'New Dimensions in Agricultural Extension Management'* under US-India-Africa triangular International Training programme coordinated by MANAGE, Hyderabad.
- Dr. Abdel Gawad Saad, Visiting Scientist from Egypt, Cairo, completed the Post Doctoral Fellowship under the guidance of Dr. S.N. Jha, Head AS&EC Division at ICAR-CIPHET. Dr. Saad was recipient of Non-aligned and other Developing Countries Science & Technology Fellowship under DST Scheme of Research

Training Fellowship for Developing Country Scientists (RTF-DCS)' in the area of Post Harvest Engineering from April to August 2014.

- Prof. Bhesh Bhandari, Food Processing Technology and Engineering and his associate Dr. Sangeeta Prakash, University of Queensland Queensland, Australia visited ICAR-CIPHET, Ludhiana on February 18, 2015 for the research collaboration in the field of (i) Grain (Rice) breakage during drying/milling; (ii) Rice products development.

National Seminar

- ICAR-CIPHET, Ludhiana organized a National Seminar on "Present scenario and future

strategies for processing and value addition of agricultural commodities" during 19-20 December 2014 as an important activity in the Silver Jubilee Year of the institute. Seminar was sponsored by MoFPI, New Delhi to address the future expectations of stakeholders in food processing sector through research and development innovations. Dr Gurbachan Singh, Hon'ble Chairman, ASRB, New Delhi was the Chief Guest on the occasion. On this auspicious gathering, Dr. Gurbachan Singh said that after surplus production, India has become an exporter of many commodities and he also emphasized on the need of soil and water quality to produce good quality crops and its processing. Food saved is food processed, he added. Dr B.S. Dhillon, Vice-Chancellor, PAU, Ludhiana, Dr Anwar Alam, Ex-VC, SKUAST, Srinagar, Dr. Nawab Ali, Ex-DDG (Engg.), Dr. S.M. Ilyas, Ex-Director, ICAR-CIPHET and Project Director NIRD, Hyderabad graced the occasion as Guests of Honour. Dr K. Algusundaram, DDG (Agril. Engg.) chaired the Inaugural Session of the Seminar. Chief Guest, Dr Gurbachan Singh and other dignitaries released the 'Souvenir' of this Silver Jubilee Seminar, 'Silver Jubilee Lecture Series' and other publications. The design of 'Potato peeler-cum-washer', developed by ICAR-CIPHET, Ludhiana was also licensed to a leading company on this occasion. Dignitaries asked scientific communities to address the need of the hour and work towards seed and grain storage at farmer's level to get good quality seeds at cheaper rate. ICAR-CIPHET has to play lead role in post-harvest technology and management so that our producer can get more benefits. On this occasion, various SHGs, entrepreneurs and NGO also participated and displayed their value added products based on trainings received from the institute. Participants, researcher, entrepreneurs etc from different parts of the country attended the two days National Seminar.

Summer School on Modern Technologies and Approaches in Storage of Harvested and Processed Plant and Animal Food Products

ICAR sponsored 21 days Summer School on "Modern Technologies and Approaches in Storage of Harvested and Processed Plant and Animal Food Products" was organized at the Central Institute of Post-Harvest Engineering and Technology, Ludhiana from June 11 to July 01, 2014 successfully.

Twenty four participants across the country participated in the training programme. Summer school was blend of lectures, practicals, hands on experience, discussion, Skype lectures, participants presentation, visit to Adani and FCI storage facilities, Moga, Visit to N P Fresh Foods, Hambran, Visit to Field Fresh Pvt Ltd., Lodowal, Visit to GADVASU's College of Fisheries and College of Dairy Science and Technology, PHPTC and PAU's Food Science and Technology Division. During valedictory function, Dr. R K Gupta, Director ICAR-CIPHET Ludhiana, distributed the certificates to participants and urged them to utilize the knowledge learned in the school in their professional career.

Summer School on Food quality and safety: recent advances in evaluation techniques

ICAR sponsored 21 days Summer School on "Food quality and safety: recent advances in

evaluation techniques" was conducted during 05-25 August 2014 at ICAR-CIPHET, Ludhiana. Dr. Pranita Jaiswal and Dr Rahul Kumar Anurag were the Course Director and Co-Course Director respectively. A total of 61 participants had applied, out of them 24 participants were selected to attend the summer school. The school was blend of lectures, practicals, hands on experiences, discussions, skype lectures from eminent speakers, participant presentations. Visits were also arranged to state of art laboratories/food processing units having advanced quality evaluation facilities to expose the participants to the recent advancement in quality evaluation techniques. Visits were made to Punjab Biotechnology Incubator, Mohali; GADVASU, Ludhiana; Verka Milk processing plant and Field Fresh Pvt. Ltd., Lodowal. Participants congratulated the organizers for their cooperation and efforts during entire training programme. Dr. R.K. Gupta, Director, ICAR-CIPHET encouraged participants to work in collaboration. Dr B.S. Bisht, Director, BIAS Bhimtal, and former VC, G.B. Pant University of Ag. and Tech., Pantnagar and former Director, ICAR-CIPHET distributed the certificates to the trainees.

Entrepreneurship Development Programme on 'Nutritive functional flour and health foods'

ICAR-CIPHET, Ludhiana organized an Entrepreneurship Development Programme (EDP) for farmers, entrepreneurs and Self Help Groups on 'Nutritive functional flour and health foods' during 15-21 July 2014. This EDP was sponsored by

Agricultural Technology Management Agency, Palampur, Kangra (HP). The programme was coordinated by Dr. Mridula D., Sr. Scientist and Ms. Monika Sharma, Scientist of FG&OP Division. The programme was inaugurated by Dr. R.K. Gupta, Director, ICAR-CIPHET, Ludhiana. Speaking on the

occasion, the Chief Guest of the function, Dr. R.K. Gupta emphasized on the importance of health foods. The seven days EDP was designed to give participants a complete exposure to the basic concepts of value addition, processing and packaging, quality control, safety issues and regulatory standards of nutritive functional flour, quick cooking *dalia*, quick cooking multigrain *dalia*, high protein extrudates and functional pasta. It comprised of various lectures and practical sessions by experienced Scientists from ICAR-CIPHET. During the valedictory function, the farmers expressed their overwhelming response for the training received. Speaking on the occasion, Dr S.K. Tyagi, Principal Scientist & I/C Head, FG&OP Division motivated the participants for starting their own business based on the technologies learned at ICAR-CIPHET. While distributing the certificates, Dr. R.K. Gupta encouraged the participants to inform about the ICAR-CIPHET food processing technologies in their respective villages.

Institute Research Council (IRC) Meeting

The 23rd Institute Research Council Meeting was held during 20-21 June 2014 at ICAR-CIPHET, Ludhiana under the Chairmanship of Dr. R.K. Gupta, Director, ICAR-CIPHET. Dr. S.M. Ilyas, Project Director, NIRD, Hyderabad was the invited expert for the meeting. Dr. R.K. Vishwakarma, Sr. Scientist and Member Secretary, IRC welcomed the expert, Director, Project Coordinators, Head of Divisions and Scientists of both the campuses to the IRC meeting. Dr. R.K. Gupta, Director, ICAR-CIPHET

welcomed Dr. S.M. Ilyas and all Scientists in the meeting. Member Secretary presented the Action Taken Report on suggestion/recommendation of the last IRC held during 28-29 October 2013. After thorough deliberations and some modifications, ATR was accepted. Salient achievements of each division were thereafter presented by the respective Head of Divisions followed by presentations of 11 RPP-I, 19 RPP-II and 4 RPP-III.

Institute Management Committee Meeting

The 31st meeting of Institute Management Committee of ICAR-CIPHET was held on September 06, 2014 at ICAR-CIPHET, Ludhiana under the Chairmanship of Dr. R.K. Gupta, Director with the other members being Dr. S.K. Chattopadhyay, Head, MP Division, CIRCOT, Mumbai; Dr. Nachiket Kotawaliwale, Head (APPD), CIAE, Bhopal; Dr. Gautam Bose, Head, MP Division, (NIRJAFT), Kolkata; Dr. S.K. Jha, Pr.

Scientist (AS&PE), PHT Centre IARI, Pusa, New Delhi; Dr. P.R. Bhatnagar, PC (APA); Dr. S.N. Jha, Head, AS&EC; Dr. S.K. Nanda, In-Charge Head TOT; Dr. P.C. Sharma, Head, HCP and Sh. Manni Lal, AF&AO. The IMC members visited laboratories, other facilities of Institute and institute developed equipments viz. cryogenic grinder, basil pulper and makhana popping machine were shown to IMC members.

Coordination Committee Meeting (CCM) of AICRP on PET

11th Coordination Committee Meeting (CCM) of AICRP on Plasticulture Engineering and Technology (earlier Application of Plastics in Agriculture) was held during 20-21 November, 2014

at ICAR Research Complex for North Eastern Hill Region, Umiam (Barapani), Meghalaya under the Chairmanship of Hon'ble DDG (Engg.) Dr. K. Alagusundaram and Co-chairmanship of Dr. R.K. Gupta, Director, ICAR-CIPHET, Ludhiana and Dr. S.V. Ngachan, Director, ICAR RC for NEH, Barapani. Padma Shree Dr Brahma Singh, Ex-Director (Life Sciences), DRDO, and President, Indian Society of Protected Cultivation, New Delhi was the Chief Guest and Chairman, Expert Committee in the CCM. The important points emerged during the meeting are mentioned as: 6 projects were completed and the period of 11 projects were extended. The titles of two projects were revised/ changed. 38 new project proposals were submitted for approval. These projects were presented and after discussions, 28 new proposals were approved. 10 new proposals could not be accepted.

Workshop of ICAR-All India Coordinated Research Project on Post-Harvest Technology

30th Workshop of ICAR-All India Coordinated Research Project on Post-Harvest Technology was held during 6 to 9 January 2015 at UAS, Bangalore. Dr. K. Alagusundaram, DDG (Engineering) was the chairman of the workshop and Dr. Kanchan K. Singh, ADG (FF/PE) and Dr. R. K. Gupta, Director, CIPHET were the co-chairmen. Dr. S. N. Jha, I/C

PHT, presented major accomplishments of the scheme during 2012-14 and also discussed the way forward. Biennial progress reports (2012-2014) were presented by the respective AICRP on PHT Centres in technical sessions organized sector-wise, viz., Food Grains, Horticultural Crops, Jaggery and Livestock Produce sectors. Besides, two workshops on ICAR-MOFPI sponsored project and ICAR-FCI sponsored project were held on January 8, 2015. Some important recommendations emerging from the workshop are: pilot scale processing units with reduced costs to give improved quality products must be promoted among the farming community; AICRP centres should promote on-farm agro-processing and value addition technologies for enhancing socio-economic status of the farmers;

scientists should take such projects which maximise farmers' profits; research engineers (REs) should deliver the complete protocol for all the crops and commodities for increasing the processing level; engineering input must be increased in the design and development process

Silver Jubilee lecture series

As a part of Silver Jubilee celebration in the institute, four lectures were delivered by eminent persons in the field of Post harvest processing which have also been compiled as Silver Jubilee lecture series.

- Possible paradigm shifts in post-harvest engineering & technology R&D by Dr. S.M. Ilyas, Project Director, Distance Education, National Institute of Rural Development, Hyderabad on 20.06.2104.
- Modern food processing technologies - a survival kit for Indian agriculture by Dr. R.T. Patil, Former Director, ICAR-CIPHET; Chairman & ED, Benevole for PHT, Bhopal on 27.06.2014.
- Contemporary science, society and post harvest technology by Dr. B.S. Bisht, Former Vice-Chancellor, GBPUA&T Pantnagar, Former ADG, ICAR, New Delhi and Director, Birla Institute of Applied Sciences, Bhimtal on 25.08.2014.
- Augmenting food and nutritional security through post-harvest technology by Dr. Nawab Ali, Former DDG (Engg.), ICAR and Former OSD, ICAR-CIPHET, Ludhiana on 29.12.2014.

Meetings organized at ICAR-CIPHET

- Technology awareness meet was organized on the occasion of ICAR foundation day on 16 July 2014, with the farmers and students. 50 farmers from in and around Ludhiana and 40 students from Kundan Vidya Mandir, Civil Lines, Ludhiana participated in this programme.
- In association with ICAR-CIPHET, a Business Plan meet by NABARD was organized for its officers belonging to Agricultural Engineering Discipline at Ludhiana during 30–31 October 2014.
- A meeting on Future Perspective and Strategies for Post Harvest Technology Research with specific reference to ICAR-CIPHET, Ludhiana was held on 20 December 2014 at ICAR-CIPHET, Ludhiana. The eminent dignitaries/ officers viz. Dr. Anwar Alam; Dr. Gajendra Singh; Dr. Nawab Ali; Dr. S.M. Ilyas; Dr. R.T. Patil; Dr. B. Rangana; Dr. K. Alagusundaram, DDG (Agril. Engg.), Dr. Kanchan Kumar Singh, ADG (FE), ICAR, New Delhi, Dr. R.K. Gupta, Director, ICAR-CIPHET and Dr. K. Narsaiah, OIC PME Cell participated in the meeting.

World Food Day Celebration

World Food Day is celebrated on October 16 every year in the honour of the foundation day of the Food and Agriculture Organization of the United Nations in 1945. A different theme is adopted every year in order to highlight areas needed for action and provide a common focus. This year the theme was 'Family farming: feeding the world, caring for the earth'. In order to celebrate this occasion, FG&OP Division of the institute organized a food based quiz. The quiz was conducted by Ms. Monika Sharma and Dr. (Mrs) Swati Sethi, Scientists, FG&OP Division. Scientific, Technical and Administrative staff participated actively and gift hampers were distributed to the winners. The event was sponsored

by Parshuram Bio Agro Tech. Pvt. Ltd., Ludhiana.

Communal Harmony Campaign

ICAR-CIPHET observed Communal Harmony Campaign and the Fund Raising Week meant to

spread the message of communal harmony and national integration to the people of the country during 19-25 November 2014 and the Flag Day on 25 November 2014. This campaign was organized at Institute level by the committee constituted by the competent authority. On Flag Day, flags were distributed to the people and they were encouraged to donate generously.

National Science Day Celebration

ICAR-CIPHET celebrated National Science Day on 28th February 2015 with an aim to inculcate scientific temperament among school children. This Day is observed to mark the novel discovery of Raman Effect by the great Indian Physicist and Nobel Laureate, Sir Chandrasekhar Venkata Raman on 28th February 1928. Every year, Department of Science and Technology provides a theme for this Day and this year the theme was "Science for Nation Building". On this occasion, the institute organized a scientific quiz competition for the students of Pratap Public School, Ludhiana. Six teams of four students each, from class VIII participated in this contest. Dr. (Mrs.) Manju Bala, Sr. Scientist, FG&OP Division and convener of the programme informed the teams

about quiz rules. The quiz was coordinated by Mrs. Monika Kundu, Scientist, TOT Division and Dr. (Mrs.) Swati Sethi, Scientist FG&OP Division. After the quiz, the students interacted with the Scientists. Dr. K. Narsaiah, I/C Director enlightened the students about science and technology and encouraged the students to develop scientific temperament. The function was concluded with the distribution of prizes to the winners and Dr. Yogesh Kumar, Scientist, AS &EC Division presented the vote of thanks.

संस्थान में हिन्दी पखवाड़ा का आयोजन

प्रत्येक वर्ष की भांति इस वर्ष भी संस्थान में दिनांक 16 से 29 सितम्बर 2014 तक हिन्दी पखवाड़ा मनाया गया। डॉ. एस. के. नन्दा, प्रभारी, तकनीकी हस्ताक्षरण प्रभाग, की अध्यक्षता में समारोह का उद्घाटन मुख्य अतिथि आदरणीय निदेशक महोदय डा. आर. के. गुप्ता के करकमलों द्वारा किया गया। हिन्दी पखवाड़ा आयोजन समिति के सदस्यों डॉ. प्रनीता जायसवाल, वरिष्ठ वैज्ञानिक, श्रीमती मोनिका कुण्डू, वैज्ञानिक, डॉ. स्वाति सेठी, वैज्ञानिक एवं श्री यशपाल, तकनीकी सहायक ने समारोह के अन्तर्गत विभिन्न संयोजको के सहयोग से विभिन्न प्रतियोगिताऐं आयोजित की। दिनांक 30.09.2014 को हिन्दी पखवाड़ा का समापन समारोह आयोजित किया गया। इसमें मुख्य अतिथि इंजी. एच. एस. जोगी (सप–मुख्य अभियंता), पंजाब स्टेट पावर कॉरपोरेशन लिमिटेड लुधियाना

द्वारा विजेताओं को पुरस्कार वितरित किए गए। हिन्दी पखवाड़ा के अन्तर्गत आयोजित सभी प्रतियोगिताओं में संस्थान के सभी अधिकारियो एवं कर्मचारियों ने बढ़–चढ़कर हिस्सा लिया व समारोह को सुचारु रुप से सम्पन्न कराने में भागीदारी दी। पखवाड़े के दौरान आयोजित विभिन्न प्रतियोगिताएं एवं उनका परिणाम तालिका में वर्णित है:

तालिकाः हिंदी पखवाड़े के अंतर्गत आयोजित विभिन्न प्रतियोगिताएं एवं परिणाम

क्रम संख्या	प्रतियोगिता का नाम	विजेता प्रतियोगी	स्थान	संयोजक एवं सह–संयोजक	दिनांक
1	**हिन्दी कम्पयूटर टंकण प्रतियोगिता**	श्री हरभुपिंदर सिंह श्री इकबाल सिंह श्री विशाल कुमार	**प्रथम** **द्वितीय** **तृतीय**	डॉ. डी.एम. कदम, वरिष्ठ वैज्ञानिक श्री मन्नी लाल, सहा. वित्त एवं लेखा अधि.	15.09.2014
2	**हिन्दी अनुवाद प्रतियोगिता** (केवल तकनीकी वर्ग के लिए)	श्री राजीव शर्मा श्री यशपाल श्री विशाल कुमार	**प्रथम** **द्वितीय** **तृतीय**	डॉ. मृदुला देवी, वरिष्ठ वैज्ञानिक श्रीमती सूर्या, वैज्ञानिक	16.09.2014
3	**प्रार्थना पत्र प्रतियोगिता** (केवल चतुर्थ श्रेणी कर्मचारियों के लिए)	श्री शालिक ग्राम द्विवेदी श्रीमती वीरा बाली श्री.सुखवीर	**प्रथम** **द्वितीय** **तृतीय**	डॉ. तनवीर अहमद, वैज्ञानिक डॉ. स्वाति सेठी, वैज्ञानिक	17.09.2014
4	**हिन्दी नोटिंग एवं ड्राफ्टिंग प्रतियोगिता** (केवल प्रशासनिक वर्ग के कर्मचारियों के लिए)	श्री अजय कुमार टंडन श्री अवतार सिंह श्री कुवंर सिंह	**प्रथम** **द्वितीय** **तृतीय**	श्री राज कुमार, वरिष्ठ प्रशा. अधिकारी श्री बी.सी. कटोच, सहा. प्रशा. अधिकारी	18.09.2014
5	**निबन्ध प्रतियोगिता** राष्ट्र को एक सूत्र में बाँधने में हिन्दी का योगदान (सभी वर्गों के लिए)	श्रीमती लीना कुमारी कु. दीपिका श्रीमती मोनिका	**प्रथम** **द्वितीय** **तृतीय**	डॉ. संगीता बंसल, वरिष्ठ वैज्ञानिक श्रीमती मोनिका, वैज्ञानिक	19.09.2014
6	**कविता प्रतियोगिता** हास्य व्यंग्य (सभी वर्गों के लिए)	डा॰ संदीप मान श्री. बी. सी. कटोच श्री. विशाल कुमार	**प्रथम** **द्वितीय** **तृतीय**	डॉ. एस.के. नन्दा, प्रधान वैज्ञानिक डॉ. संदीप मान, वरिष्ठ वैज्ञानिक डॉ. राहुल कुमार अनुराग, वैज्ञानिक	20.09.2014
7	**एक दिवसीय (हस्तलिखित) पोस्टर पत्र प्रतियोगिता** : भारत में ग्रामीण विकास कार्यक्रम की उपलब्धियाँ (सभी वर्गों के लिए)	श्रीमती सूर्या तुषीर डा॰ इन्दु रावत डा॰ डी. एम. कदम	**प्रथम** **द्वितीय** **तृतीय**	डॉ. एस.के. त्यागी, प्रधान वैज्ञानिक डॉ. मंजू बाला, वरिष्ठ वैज्ञानिक	22.09.2014
8	**तत्काल भाषण प्रतियोगिता**	डा॰ मुकुन्द नारायण कु. दीपिका डा॰ इन्दु रावत	**प्रथम** **द्वितीय** **तृतीय**	डॉ. डी.एन. यादव, वरिष्ठ वैज्ञानिक डॉ. प्रनीता जायसवाल, वरिष्ठ वैज्ञानिक	23.09.2014
9	**विज्ञान संबंधित संगोष्ठी प्रतियोगिता** (सभी वर्गों के लिए)	डा॰ स्वाति सेठी डा॰ चन्दन सोलंकी डा॰ धृतिमान साहा	**प्रथम** **द्वितीय** **तृतीय**	डॉ. एस.एन. झा, परि. सम. (पी.एच.टी) डॉ. पी.आर भटनागर, परि. सम. (ए.पी.ए)	24.09.2014

क्रम संख्या	प्रतियोगिता का नाम	विजेता प्रतियोगी	स्थान	संयोजक एवं सह–संयोजक	दिनांक
10	प्रश्नोत्तरी प्रतियोगिता	डा. तनवीर डा. योगेश कुमार श्रीमती लीना कुमारी डा. इन्दु रावत डा. प्रताप राय भटनागर श्री. मन्नी लाल डा. के. नरसईया श्री. एस. एस. वर्मा डा. सुरेश देवत्कल श्री. यशपाल श्री. अश्वनी कुमार डा. मुकुन्द नारायण	प्रथम द्वितीय तृतीय	डॉ. एच.एस. ओबराय, प्रधान वैज्ञानिक डॉ. चंदन सॉलकी, वैज्ञानिक श्री विशाल कुमार, तकनीकी सहायक	25.09.2014
11	लघु संगीत प्रतियोगिता (अन्ताक्षरी प्रतियोगिता) (सभी वर्गों के लिए)	डा. संगीता बंसल श्रीमती मोनिका शर्मा श्रीमती सूर्या कु. दीपिका श्रीमती लीना कुमारी डा. प्रनीता जयसवाल डा. योगेश कुमार डा. अरमान डा. स्वाति सेठी डा. धृतिमान साहा डा. चन्दन सोलंकी डा. राहुल सुभाष यादव	प्रथम द्वितीय तृतीय	डॉ. ए.यू. मूजाजद्दी, वरिष्ठ वैज्ञानिक डॉ. एस.के. नन्दा, प्रधान वैज्ञानिक	27.09.2014

संस्थान में हिन्दी कार्यशाला का आयोजन

सीफेट, लुधियाना में वर्ष 2014-15 में चार हिन्दी कार्यशालाऐं आयोजित करवाई गई, जिनका विवरण निम्नलिखित है:

30 मई 2014: डॉ. अनिल कुमार गुप्ता, प्रशासनिक अधिकारी (राजभाषा), न्यू इंडिया इंश्योरेंस कंपनी लिमिटेड, लुधियाना ने 'राजभाषा नीतिः नियम एवं अधिनियम' और 'सरकारी कार्यालयों में हिंदी में पत्राचार' विषयों पर मुख्य प्रस्तुति देकर संस्थान के सभी अधिकारियों एवं कर्मचारियों को लाभान्वित किया।

23 सितम्बर 2014: श्री भवेश खन्ना, प्रबंधक (राजभाषा), भारतीय स्टेट बैंक, प्रशासनिक कार्यालय, लुधियाना ने 'राजभाषा हिंदी' और 'अंग्रेजी से हिंदी में अनुवाद' विषयों पर मुख्य प्रस्तुति की।

27 दिसंबर 2014: डॉ. अनिल कुमार गुप्ता, प्रशासनिक अधिकारी (राजभाषा), न्यू इंडिया इंश्योरेंस कंपनी लिमिटेड, लुधियाना ने 'रचनात्मक हिंदी' और 'हिंदी में टंकण' विषयों पर प्रस्तुति एवं चर्चा की।

30 मार्च 2015: इस कार्यशाला में डॉ. मुकुंद नारायण, तकनीकी अधिकारी, सीफेट, लुधियाना ने 'तकनीकी कार्यों में हिंदी शब्दावली का प्रयोग' विषय पर संस्थान के सभी अधिकारियों एवं कर्मचारियों के समक्ष एक प्रस्तुति की।

"स्वच्छ भारत" अभियान

माननीय प्रधानमंत्री, भारत सरकार के आह्वान पर भारत वर्ष में "स्वच्छ भारत" अभियान को सफल बनाए जाने के प्रयासों के अन्तर्गत प्रत्येक वर्ष 100 घंटे यानी हर सप्ताह 2 घंटे श्रमदान करने के दृष्टिगत सीफेट लुधियाना एवं अबोहर में साफ-सफाई का कार्य किया गया। सीफेट लुधियाना में सफाई अभियान के दौरान परिसर में प्रयोगशाला, पुस्तकालय, कार्यालय तथा परिसर के आसपास की सफाई की गई। सफाई अभियान के दौरान प्लास्टिक, कचरे आदि को भी परिसर से हटाया गया। अभियान के दौरान पानी की टंकियों की सफाई की गई। सीफेट के सभी वैज्ञानिकों, प्रशासनिक और तकनीकी

कर्मचारियों ने इस अभियान में टीम बनाकर इस कार्य को पूरा किया। सीफेट लुधियाना में सफाई के कार्य को प्रत्येक दिन अलग अलग टीम द्वारा दोपहर 3.00 बजे से 5.00 बजे तक किया जाता है।

AWARDS & RECOGNITIONS

AWARDS AND RECOGNITIONS

- **ISO 9001:2008 Certificate award**

ICAR-CIPHET, Ludhiana was awarded ISO 9001:2008 certificate for operating Quality Management System on 17th February 2014 till 16th February 2017. In order to observe proper implementation of Quality Management System in compliance with ISO 9001:2008 at ICAR-CIPHET, annual surveillance audit was conducted by external agency 'BSCIC' on 25th February 2015. Based on Surveillance Report submitted by the Lead Auditor, ICAR-CIPHET has been recommended for continuation of ISO 9001:2008 for the year 2015-16.

- **Societal Innovation Award**

Dr. SN Jha and Dr. RK Vishwakarma of ICAR-CIPHET, Ludhiana have been jointly awarded Rs. 3.00 lakh (Rupees three lakh) for the development of *Makhana* seeds (*Euryale ferox*) roasting, popping and decorticating machine. The award was given on 25 February 2015 at PSG College, Coimbatore. The machine is an outcome of pioneering and untiring efforts and contribution of 25 years of Dr. Jha in different capacities at different places of his scientific endeavor. The machine has solved a long standing demand of *makhana* growers and performs both cumbersome roasting and popping operations. It eliminates the drudgery involved in manual methods and produces much better quality popped *makhana* than the manual method. In addition machine also decorticate raw kernel from the conditioned seeds which was not possible earlier and thus saves huge energy and long distance transportation cost. The machine is registered for patent, commercialized and has been installed at many places in India. This development has shown proven accrual benefits to society in general and poor *makhana* growers and processors in particular leading to their improved livelihood and food nutrition to humankinds.

- **Innovative Farmer Award**

ICAR-CIPHET nominated farmer got Innovative Farmer Award in Pusa Krishi Vigyan Mela 2015. IARI Innovative Farmer Award for 2014–15 was conferred upon Sh. Gurpreet Singh Shergill in Pusa *Krishi Vigyan Mela* organized by IARI, New Delhi during 10–12 March 2015. His innovations are 'Gladiolus bulb grader', 'Gladiolus bulb digger', 'Rose water and sharbat', and 'Vermi compost'. Based on his technologies, he has published various success stories in print media, and

has given various radio and television talks. He is honoured by Dr B S Hansra, ADG, ICAR at KVK, Patiala in 2002, Chief Minister's State award in 2011, award in 5th Indian Horticulture Congress at PAU, Ludhiana in 2012 and Sh Jagjivan Ram Innovative farmer award in 2012.

- **ICAR National fellow**

Dr. K. Narsaiah was awarded with ICAR National fellowship for working on research project entitled "Development of food biopolymer based micro and nano scale delivery systems for bioactive ingredients in functional foods" for a period of 5 years from 02/01/2015 with an overall budget of Rs.123.66 lakhs. The project aims to develop simple as well as advanced microencapsulation systems and processes which will synergistically further broaden and strengthen different methods of nanoencapsulation such as liposomes, nanoemulsions, cryotropic gelation, spray drying and spray cooling for encapsulation of food ingredients, nutraceuticals and biopreservatives. It also envisions to make ICAR-CIPHET a centre of excellence for encapsulation.

- **International fellowship**

Dr Tanbir Ahmad, Scientist, has been awarded prestigious ICAR- International Fellowship 2014-15 to pursue Ph. D. for three years at Universiti Putra Malaysia, Malaysia.

- **Society fellow**

ISAE Fellow 2014

Dr. R.K. Gupta was elected as ISAE fellow 2014 during 49th Annual Convention of ISAE at CAET, PAU, Ludhiana during Feb. 23-25, 2015 for his valuable contribution in the field of Agriculture Engineering.

- Dr. K. Narsaiah was awarded fellow of Society of Applied Biotechnology.

- **Other awards and recognitions**

Dr. R.K. Gupta is member, working group on post-harvest technology and value addtion, Haryana Kisan Ayog.

- Dr. R.K. Gupta is member Board of Management, NIFTEM, Kundli, Sonipat and PAU, Ludhiana.

- Dr. Ranjeet Singh, Sr. Scientist, TOT Division was awarded 'Certificate of Excellence' award during the 2nd Science and Technology Awards-2014 by EET CRS research wing for excellence in professional education and Industry in an award ceremony held at Bangalore. He received the award for his contributions in Active packaging technologies by using oxygen and ethylene scavengers for maintaining and extending shelf life of horticultural produce.

- Dr. Dattatreya M. Kadam received "Distinguished Service Certificate Award-2014" from Indian Society of Agricultural Engineers (ISAE) for outstanding contributions in the field of Agricultural Engineering during 49th Annual Convention of ISAE and Symposium on 'Engineering solutions for sustainable agriculture and food processing' held at PAU Ludhiana during 23-25 February 2015.

- Dr. Suresh Devatkal received Best Research Paper Award for the Oral Paper "Improving the quality and hygienic aspects of goat meat by using a refrigerated display cabinet for marketing of retail meat in street meat shops" in VI Conference of Indian Meat Science Association and National Symposium on 'Sustainable meat production for nutritional security and consumer well being: challanges and strategies' held at U.P Pt. Deen Dayal Upadhayaya Pashu Chikitsa Vigyan Vishwa Vidyalaya evam Go Anusandhan, Mathura, Uttar Pradesh on 28-30 November 2014.

- Dr Rahul Subash Yadav, Scientist (AS&EM), PC (PET) unit, ICAR-CIPHET, Ludhiana got best poster award for research paper entitled "Low tunnel cultivation of fruits and vegetables in different region of India" in National Seminar on "Hi-tech horticulture for enhancing productivity, quality and rural prosperity" held at ICAR-NRCSS, Ajmer (Rajasthan) during 19-20 January 2015 jointly

organized by Indian Society for Protected Cultivation, New Delhi and Indian Society of Seed Spices, Ajmer.

- Dr. Manju Bala received best poster award (3rd) for poster entitled "Distribution of fatty acids and their ratios in Indian Rapeseed-Mustard germplasm" in National Seminar on 'Strategic interventions to enhance oilseeds production in India' held at ICAR-DRMR, Bharatpur during 19-21 February 2015.

- Dr. Sandeep Mann got best poster award for the paper titled "Design & development of Taro peeling machine" from Indian Society of Agricultural Engineers (ISAE) during 49th Annual Convention of ISAE and Symposium on 'Engineering solutions for sustainable agriculture and food processing' held at PAU Ludhiana during 23-25 February 2015.

Success Story on "Groundnut flavoured beverage curd and paneer"

ICAR-CIPHET, Ludhiana has licensed the technology for groundnut flavoured beverage, curd and paneer to 18 entrepreneurs/farmers. A budding entrepreneur, Mr. Piyush Vyas from Junagadh, Gujarat learned about the technology from ICAR-

CIPHET website and approached the institute to know about this technology. Gujarat being one of the major groundnut producing states and because of surplus availability of raw material, he planned to adopt and commercialize this technology. He received training at the institute for preparing groundnut milk, *paneer* and curd. Initially he started a small plant of 200 litres/day capacity for production of groundnut milk. He faced difficulties in market for acceptability of new product. But he worked hard and put his marketing efforts while keeping in touch with the concerned Scientists from ICAR-CIPHET, Ludhiana to make the product/milk acceptable by the public. He also marketed the milk to different ice cream makers, chocolate makers etc. These manufacturers highly appreciated the product and demanded regular supply of groundnut milk for their products. As he had started with small scale manual plant and in order to meet the increased demand supply of groundnut milk and products, he initiated scaling up his production unit to 1000 litres/day capacity. In his new plant, he is also planning for production of other value added groundnut based products such as paneer, butter, concentrated protein powder, milk powder, butter milk and groundnut curd etc.

Another entrepreneur, Mr. Amarjeet Singh Kohli from Bathinda got licensing of this technology in January 2010, commenced production and is supplying groundnut milk, cream and *paneer* on demand basis.

Subsequently several entrepreneurs showed their interest in this technology by 2014 and altogether 18 entrepreneurs received licensing and training for this technology from ICAR-CIPHET, Ludhiana. Some of them are in process of establishing processing plants in their respective places.

CONFERENCES/ TRAININGS ATTENDED

PARTICIPATION IN INTERNATIONAL/ NATIONAL TRAINING PROGRAMME/SEMINARS/MEETINGS

Dr. R.K. Gupta, Director, ICAR-CIPHET, Dr. P.R. Bhatnagar, PC (APA), Dr. S.N. Jha, Head, AS&EC Division, & I/C PC (PHT) and Dr. P.C. Sharma, Head, HCP Division, ICAR-CIPHET, Abohar attended XXIII meeting of ICAR Regional Committee No.V held at PAU Ludhiana during 14-15 November 2014. One CIPHET publication (Technical Bulletin titled 'Occupational Health Hazards in Agro processing Industries and Control Measures') was released in the meeting by the Hon'ble DG, ICAR, Dr S. Ayyappan.

ICAR-CIPHET Scientists has participated in Training for Trainers programme during 23.3.2015 to 27.3.2015, organized by Ludhiana Unit of Food & Nutrition Board, Ministry of Women & Child Develoment, Govt. of India. In this programme Director ICAR-CIPHET, Ludhiana has delivered an extensive talk on Diet related chronic diseases: role of fruits, vegetables, fibre and antioxidants. Some other lecture-cum-discussion session were also conducted by the ICAR-CIPHET scientists on 'Inculcating healthy eating and life style in children', and 'Mass Media for nutrition education and mass awareness campaign' by Dr. Mridula D. and Dr. Indu Rawat respectively.

Anurag RK (2015). National Workshop on Packaging of Fresh and Processed Foods at Indian Institute of Packaging, New Delhi, Jan. 17, 2015.

Bala M (2014). National Seminar on Present Scenario and Future Strategies for Processing and Value Addition of Agricultural Commodities, ICAR-CIPHET, Ludhiana, Dec 19-20, 2014.

Bala M (2015). 49th Annual Convention of Indian Society of Agricultural Engineers and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb 23-25, 2015.

Bansal S (2015). 3rd International Conference on Impacting Food Value Chain and Leveraging Innovation, NIFTEM, Kundli, Haryana during 26-28 February 2015.

Bansal S (2015). Workshop on Sample Preparation for Food and Environmental Samples, Punjab Biotechnology Incubator, SAS Nagar (Mohali), Aug 23, 2014.

Bhatnagar PR (2014). Attended and presented keynote address in National Seminar on Natural Resource Management & Environmental Concerns at GBPUA&T, Pantnagar during 16- 18 May 2014, pp. 43.

Goswami D (2014). Winter School on 'Recent trends in value addition of subtropical fruits for nutritional security and secondary agriculture', CISH, Lucknow, Nov 5-25, 2014.

Gupta RK (2014) Attended 2nd meeting of Working Group on Post Harvest Technology and Value Addition of Haryana Kisan Ayog Office, Panchkula during April 21-23, 2014.

Gupta RK (2014) Attended Interactive Conference of Vice-Chancellors and Directors at NASC Complex, New Delhi during April 27-29, 2014.

Gupta RK (2014) Conducted Research Plan examination for the Ph.D student at Deptt. of Food & Chemical Engineering, SLIET, Sangrur on May 5, 2014.

Gupta RK (2014) Attended International Workshop on Food and Nutritional Security Assurance through Efficient Resource and Technology Management at NIRD, Hyderabad during May 19-20, 2014.

Gupta RK (2014) Attended one day conference at IFS Gurgaon to review progress of FCI sponsored project on Storage Losses in Food Grains on May 23, 2014.

Gupta RK (2014) Attended meeting of establishment of food testing laboratories with the support of grant-in-aid from MoFPI and status of accreditation of the laboratories from NABL at NASC complex, New Delhi on May 28, 2014.

Gupta RK (2014) Attended NAAS Foundation day lecture delivered by Bharat Ratna CNR Rao at NASC Complex, New Delhi on June 5, 2014.

Gupta RK (2014) Attended NAIP workshop on Impact of Capacity Building Programmes at NASC Complex, New Delhi during Jun 6-7, 2014.

Gupta RK (2014) Attended 3rd Working Group meeting on "Post Harvest Technology and Value Addition" (WG &VA) of Haryana Kisan Ayog at HAU, Hisar during Jun 9-10, 2014.

Gupta RK (2014) Attended XXIII meeting of ICAR Regional Committee No. I at CSWCRTI, Dehradun during June 18-19, 2014.

Gupta RK (2014) Attended 6th TSC meeting at NASC Complex, New Delhi on June 26, 2014.

Gupta RK (2014) Attended the Board of Management of NIFTEM meeting at NIFTEM, Kundli, Sonepat on Jun 27, 2014.

Gupta RK (2014) Attended NAAS Silver Jubilee Symposium & delivered presentation on "Status of mechanization and future needs of post-production operations on small farms" at CIAE, Bhopal during 17.07.2014 - 19.07.2014.

Gupta RK (2014) Attended 86th Foundation Day and Award Ceremony-2014 of ICAR and participated in Vice-chancellors'-Directors' Conference during July 28-30, 2014 at NASC complex, New Delhi.

Gupta RK (2014) Participated and presented lead paper in All India Seminar on Appropriate Technologies on farm mechanization for marginal & small farmers held at Kolkata during Aug 07-10, 2014.

Gupta RK (2014) Attended EDP on Leadership Development Programme at NAARM, Hyderabad during Aug 18-24, 2014.

Gupta RK (2014) Attended meeting on the issues of 'Losses being incurred for perishable produce due to shortage of cold chain capacity and the plan of action to contain the losses' called by PM Office during 29.08.2014 to 02.092.14.

Gupta RK (2014) Attended Special Convocation of the Post Graduate School during the visit of Director General, FAO at NASC Complex, New Delhi during 07.09.2014 – 08.09.2014.

Gupta RK (2014) Attended Ist Meeting of the Task Force on Cold Chain at MOFPI on 15.09.2014.

Gupta RK (2014) Attended Valedictory Function as Chief Guest of Summer School on Engineering Interventions in Processing and Value addition of milk and milk and milk products at NDRI, Karnal on 23.09.2014.

Gupta RK (2014) Acted as External Examiner for Ph.D Qualifying Viva-Voce Examination at Division of Agricultural Engineering, IARI, Pusa, New Delhi on 29.09.2014.

Gupta RK (2014) Attended BOS meeting for Dept. of Post Harvest Processing, RAK Institute of Agriculture, AMU, Aligarh on 13.10.2014.

Gupta RK (2014) Acted as External Examiner for M. Tech. Thesis examination at AMU, Aligarh on 13.10.2014.

Gupta RK (2014) Attended SMD-wise meeting of Engineering Division on Vision 2050 and Institute based research projects and other official works at SMD, New Delhi during Oct 27-29, 2014.

Gupta RK (2014) Attended Technical Session on Post-Harvest Technology as Chairman in the National Seminar on "Emerging Problems on Potato" at CPRI, Shimla & presented an invited paper during Nov. 01-02, 2014.

Gupta RK (2014) Acted as External Examiner to examine the research plan for the Ph.D. work and M. Tech. Thesis at SLIET, Longowal, Distt. Sangrur (Punjab) on 10.11.2014.

Gupta RK (2014) Participated in CCM, organized by PC, AICRP on Plasticulture Engineering & Technology at ICAR-Research Complex for NEH Region, Umiam, Barapani during Nov 20-21, 2014.

Gupta RK (2014) Attended NRDC Meeting on 26.11.2014 at NRDC, New Delhi.

Gupta RK (2014) Attended ASRB Meet at ASRB Office, Pusa, New Delhi on 27.11.2014

Gupta RK (2014) Attended Meeting related to review of the establishment of Food Testing Laboratories at Krishi Bhawan, New Delhi on Dec 9, 2014.

Gupta RK (2014) Attended 19th meeting of Board of Management of NIFTEM held on 06.12.2014 at NIFTEM, Kundli, Sonepat.

Gupta RK (2014) Attended Working Group meeting on Post Harvest Technology and Value Addition for Haryana organized by Haryana Kisan Ayog on Dec. 11-12, 2014 at Panchkula.

Gupta RK (2014) Attended meeting on report of the Task Force on 'Cold Chain Projects' chaired by Principal Secretary to Prime Minister at PM Office, New Delhi on Dec 13, 2014.

Gupta RK (2015) Participated in Annual Workshop of AICRP on PHT held during Jan. 6-9, 2015 at UAS, Bangalore.

Gupta RK (2015) Attended meeting on CRPs on Health Food and Secondary Agriculture on Jan. 19, 2015 at SMD, New Delhi.

Gupta RK (2015) Participated in Workshop on "Assessment of harvest and post-harvest losses of major crops and commodities in India" at IIT, Chennai on Jan 23, 2015.

Gupta RK (2015) delivered a talk on 'Anaaj di sambhal te prasanskaran' on All India Radio, Jallandhar on 16.03.2015.

Gupta RK (2015) Attended meeting as expert in the area of Post Harvest Technology in U.P. Council of Agricultural Research, Lucknow on March 20, 2015.

Gupta RK (2015) Attended one day workshop on Model mechanized Farm with Food Processing Training Cum Incubation on 23.03.2015 KAB-II, New Delhi.

Gupta RK (2015) Attended ASRB Meet at ASRB Office & BIS Meeting at BIS Office on 24.03.2015 at New Delhi.

Gupta RK (2015) Attended meeting of BIS "Ready-to-Eat Foods and Specialized Products Sectional Committee, FAD 24 on Mar 24-25, 2015 at BIS Office, New Delhi.

Gupta RK (2015) Attended 270th meeting of the Board of Management of the Punjab Agricultural University held at Punjab Civil Secretariat-II, Chandigarh on 30.03.2015.

Jaiswal P (2014). National Seminar on Present Scenario and Future Strategies for Processing and Value Addition of Agricultural Commodities, ICAR-CIPHET, Ludhiana, Dec. 19-20, 2014.

Jaiswal P (2015). 49th Annual Convention of Indian Society of Agricultural Engineers (ISAE) and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Jha SN (2014). National Seminar on Pre-/Post-harvest Losses & Value Addition in Vegetables, Indian Institute of Vegetable Research (IIVR) Varanasi, July 12 -13, 2014.

Jha SN (2014). National Seminar on Present Scenario and Future Strategies for Processing and Value Addition of Agricultural Commodities, ICAR-CIPHET Ludhiana, Dec. 19-20, 2014.

Kadam DM (2015). 49th Annual Convention of Indian Society of Agricultural Engineers (ISAE) and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Kudos ASK (2014). XXV Group meet of All India Coordinated Research Network on Underutilized Crops, NBPGR regional station, Shimla, May 12-13, 2014.

Kumar ATV (2014). Professional attachment training at Indian Institute of Technology, New Delhi, 14 Nov 2014 – 13 Feb, 2015.

Kumari L (2015). 49th ISAE Convention and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Kumari L (2015). International Conference on Impacting food value chain and leveraging Innovation (IFVCLI), NIFTEM, Sonepat, Feb. 26-28, 2015.

Kumari L (2015). Sensitization workshop on Societal Fellowship Scheme of DST, Govt. of India, for women empowerment, Punjab University, Chandigarh, Feb. 4, 2015.

Kundu M (2015). Sensitization Workshop on Societal Fellowship Scheme of DST, Government of India for Women Empowerment, Punjab university, Chandigarh, Feb. 4, 2015.

Mann S (2014). National Seminar on Present Scenario and Future Strategies for Processing and Value Addition of Agricultural Commodities, ICAR-CIPHET, Ludhiana, Dec. 19-20, 2014.

Mann S (2015). 49th ISAE Convention and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Mann S (2015). National Seminar on Hi-Tech Horticulture for Enhancing Productivity, Quality and Rural Prosperity, National Research Centre on Seed Spices, Ajmer, Jan. 19-20, 2015.

Mridula D (2014). One day training and awareness workshop on J-Gate@CeRA, at NAAS, Pusa, New Delhi, Sep. 29, 2014.

Mukund Narayana, Yadav RS and Bhatnagar PR (2015). Gravity-fed micro irrigation system in conjuction with *ldpe* lined pond for hilly region. Paper presented in 17th Indian Agriculture science and farmers' congress on Agri-innovations for enhancing Production and rural Employment held at bioved Krishi Prodyogiki Gram, Moharab, Sringverpur, Allahabad (UP) during February 21-22, 2015, pp 83.

Muzaddadi AU (2014). ICAR-CIPHET Silver Jubilee Year Seminar on Present Status and Future Strategies for Processing and Value Addition of Agricultural Commodities during Dec. 19-20, 2014.

Muzaddadi AU (2014). Refresher Course on Agricultural Research Management for directly recruited Senior/Principal Scientists at NAARM, Hyderabad during July 14-26, 2014.

Muzaddadi AU (2014). Research and Extension Specialists' Workshop for Rabi Crops organized by Directorate of Extension Education, Punjab Agricultural University, Ludhiana, Punjab on August 12-13, 2014 at Pal Auditorium, PAU.

Narsaiah K (2014). National Conference on Pre-/Post-Harvest Losses & Value Addition in Vegetables, Indian Institute of Vegetable Research (IIVR), Varanasi during July 12-13, 2014.

Narsaiah K (2014). Workshop on Probiotics in India: Challenges and Prospects, NDRI Karnal, Dec. 9, 2014.

Narsaiah K (2015). 49th ISAE Convention and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Rawat Indu (2014). 21 days Winter School on Drudgery Reduction Technologies for Women to Enhance Productivity and Safety in Agriculture at MPUAT, Udaipur during Nov. 12- Dec. 02, 2014.

Saha D (2014). Professional attachment training at Agricultural Engineering College and Research Institute, TNAU, Coimbatore, May 12 – Aug 12, 2014.

Sethi S (2014). Professional attachment training at Defense Food Research Laboratory, Mysore, May 2- Aug 1, 2014.

Sharma M (2014). XXIII Indian Convention of Food Scientists & Technologists on Fostering Innovative Research and Entrepreneurship (FIRE) for Indian Foods, NIFTEM Campus, Kundli, Haryana, Dec. 13-14, 2014.

Solanki C (2014). Professional attachment training at Agricultural Engineering College and Research Institute, TNAU, Coimbatore, May 12 – Aug 12, 2014.

Tushir S (2015). Sensitization Workshop on Societal Fellowship Scheme of DST, Government of India for Women Empowerment, Punjab University, Chandigarh, Feb. 4, 2015.

Vishwakarma RK (2014). National Seminar on Present Scenario and Future Strategies for Processing and Value Addition of Agricultural Commodities, ICAR-CIPHET, Ludhiana, Dec. 19-20, 2014.

Vishwakarma RK (2015). 49th ISAE Convention and Symposium on Engineering Solutions for Sustainable Agriculture and Food Processing, PAU, Ludhiana, Feb. 23-25, 2015.

Yadav DN (2014). ICAR-CIPHET Silver Jubilee Seminar on "Present Status and Future Strategies for Processing and Value Addition of Agricultural Commodities" held at ICAR-CIPHET Ludhiana during Dec. 19-20, 2014.

Yadav DN (2014). XXIII IcFOST held at NIFTEM, Kundli during Dec. 13-14, 2014.

Yadav RS, Bhatnagar PR and Mukund Narayan (2015). Low tunnel cultivation of fruits and vegetables in different region of India. Participated in a National Seminar on Hi-tech Horticulture for Enhancing Productivity, Quality and Rural Prosperity held at NRCSS, Tabiji, Ajmer (Rajsthan) during Jan. 19-20, 2015.

Yogesh K (2014). 10 days short training course "Molecular Characterization of Bio-molecules using Label Free Biosensor and Nanotechnology Approaches for Rapid, Real Time Diagnosis of Pathogens" organized by the biophysics and electron microscopy section, Faculty of Animal Biochemistry, IVRI, Izatnagar from November 17-26, 2014.

PROFESSIONAL ATTACHMENT TRAINING

As part of the ICAR-FOCARS Programme, ICAR-CIPHET has assigned all its newly joined scientists for three months professional attachment training. Considering the scientist's academic background and Institutes prospect, ICAR-CIPHET has deputed its new scientists to Central Research/Academic Institutes or State Agricultural University for professional training. The knowledge earned during the course of training programmes would lay a strong foundation in our scientific fraternity in the field of post harvest processing.

- **Dr. Swati Sethi** did her training work at Defence Food Research Laboratory, Mysore *w.e.f.* May 2nd to August 1st 2014. At Fruits and Vegetables Technology Division, DFRL, Mysore she had been trained on "High Pressure Processing" under the supervision of Dr. O. P. Chauhan. High pressure processing of food emulsions was learned during the training. The new skills and practical knowledge earned during training period will be effectively utilized in future assignments in the area of food processing, using non-thermal processing technologies with better understanding.

- **Er. Chandan Solanki** received the training from Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore *w.e.f.* May 12th 2014 to August 12th 2014. The training was on "Evaluation of Engineering Properties" under the supervision of Dr. N. Varadharaju, Professor and Head, PHTC, TNAU, Coimbatore. Practical experience in evaluation of engineering properties of minor millets was gained.

- **Er. Dhritiman Saha** has undergone the training at Department of Food and Agricultural Process Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore *w.e.f.* 12th May 2014 to 12th August 2014. Er. Dhritiman was trained on "Rapid detection of formalin in milk by Fourier Transform Near Infrared Spectroscopy" under the supervision of Prof. K. Thangavel. The training helped in imparting practical experience in FT-NIR spectroscopy through detection of formalin (used as preservative) in milk as an example. The knowledge earned during the course of training programme may lay a good foundation in the areas of non destructive food safety evaluation.

- **Er. Sakharam Jagan Kale** has done training at Agricultural and Food Engineering Department, IIT Kharagpur *w.e.f.* May 12, 2014 to August 26, 2014. He worked on "Analysis and Design of Saw-tooth and Quonset shaped Greenhouse Structures for different regions of India" under the supervision of Prof. K. N. Tiwari. During training period, he visited protected cultivation structures at PFDC project at IIT Kharagpur, Centre of Excellence, Bhubaneswar and Aerotech Engineering Works, North 24 Paragans, West Bengal. He also studied the structural aspects of greenhouses owned by farmers. Er. Sakharam carried out theoretical analysis of load distribution on greenhouse structural components and determined their appropriate dimensions using STAAD Pro software.

The knowledge earned during this training may lay a strong foundation in him to carry forward this important aspect of structural analysis in the field of agricultural structures and post-harvest management.

- **Prerna Nath Kale** has undergone the training at Fruit and Vegetable Technology Division, Defence Food Research laboratory, Mysore *w.e.f.* May 12, 2014 to August 26, 2014. She worked on "Effect of high pressure and thermal treatment on coriander paste and changes during refrigerated storage" under the mentorship of Dr. O. P. Chauhan, Scientist D, Fruits and Vegetables Technology Division. The training was successful in imparting practical experience and knowledge on handling High Pressure Processing Unit and also other lab scale instruments of specific importance such as vacuum assisted microwave drier, osmotic dehydration processes, rheometer, deep freezer, different types of driers (tray drier, freeze drier, solar drier) etc. This hand on training of three months programme has provided ample knowledge for professional and personal growth.

- **Er. Manoj Kumar Mahawar** has undergone the training at Department of Food and Agricultural Process Engineering, Agricultural Engineering College and Research Institute (AEC&RI) TNAU, Coimbatore *w.e.f.* May 12th 2014 to August 12th 2014. He worked on "Rheological properties of mango peel powder of Banglora and Neelam variety: effect of concentration and particle size" under the supervision of Dr. V. Thirupathi. The training was successful in imparting practical experience in handling a Rheometer unit and also other lab scale instruments of specific importance such as tray drier, texture analyzer, hot air oven, hunter colour lab meter etc. Also, data obtained during rheological examining via Rheometer were analyzed using model analysis viz. Rheological models (Herschel–Bulkley, Power law and Casson models).

- **Er. Kirti Ramesh Jalgaonkar** has done training at Department of Food and Agricultural Process Engineering, Agricultural Engineering College and Research Institute (AEC&RI) TNAU, Coimbatore *w.e.f.* May 12, 2014 to August 12, 2014. She worked on "Effect of ethylene exposure and different storage condition on respiration rate and ripening behavior of mango (cv. Neelum)" under the supervision of Dr. T. Pandiarajan. The training was successful in imparting practical experience and knowledge on handling of ethylene gas analyzer, oxygen and carbon dioxide headspace gas analyzer, and other lab instruments. The three month attachment training has provided ample knowledge for professional and personal growth.

- **Er. Rahul Subhash Yadav** has done training at Department of Agriculture and Food Engineering, Indian Institute of Technology, Kharagpur. w.e.f. May 12, 2014 to August 12, 2014. He has been trained on "Design of food grain storage structure" under the supervision of Dr. P. S. Rao. The training was successful in imparting experience in designing of food grain storage structures. During this training, he visited CWC and studied the operation & maintenance of different warehousing structures. The knowledge earned during the course of training programme may lay a

strong foundation in scientific fraternity to carry forward the designing aspects related to food grain storage structure in the field of Agriculture structures and environmental management engineering.

- **Er. Arun Kumar T V** received the training from the Department of Biochemical Engineering and Biotechnology, IIT Delhi *w.e.f.* Nov. 14, 2014 to Feb. 13, 2015. He was trained on "Basics of Ultrafiltration" under the supervision of Prof. G. P. Agarwal. The training was successful in imparting practical experience in handling a basic ultrafiltration module "Stirred Cell" and also a lab scale nanofiltration unit. This training will help him to carry forward this increasingly adoptive non-thermal process method in the field of agricultural process engineering.

- **Dr. Arvind Kumar Jaiswal** has undergone the training at Food Preservation and Sensory Evaluation Division, Defence Food Research Laboratory (DFRL), Mysore *w.e.f.* Nov. 17, 2014 to Feb. 16, 2015. He has been trained on "Fortification of cereal proteins to improve its quality" under the supervision of Sri P E Patki, Scientist, F and Head. The training was successful in imparting practical experience in chromatographic separation and identification of essential amino acids and supplementation of cereals with quality proteins to improve the quality of cereals which are deficient in lysine and other essential amino acids. Overall, the work experience during this training programme would strengthen the knowledge base and will aid in future research endeavors.

PUBLICATIONS

RESEARCH PAPERS

Babu R, Singh K, Jawandha SK, Alam MS, Jindal SK, Khurana DS and Narsaiah K (2014). Effect of pre-harvest spray of putrescine on shelf life and quality of tomato during storage. International Journal of Advanced Research 2(10): 861-865.

Bansal S, Mangal M, Sharma SK, Yadav DN and Gupta RK (2014). Optimization of fermentation conditions for probiotic soy yoghurt using response surface methodology. Journal of Food Processing and Preservation DOI: 10.1111/jfpp.12415.

Barman P, Muzaddadi AU, Goswami UC and Mandal SC (2014). A modified method for preparation of *sukati mas* (a traditional fish powder of north-east India) from *muwa* (*Amblypharyngodon mola*). Fishery Technology 51: 117-124.

Bhushan B, Kumar S and Pal A (2014). Production and partial characterization of extracellular xylanase from acidophilic Aspergillus flavus MTCC 9390 grown in SSF mode. Research J. Biotechnol 9(5): 97-105.

Bhushan B, Pal A, Kumar S and Jain V (2015). Biochemical characterization and kinetic comparison of encapsulated haze removing acidophilic xylanase with partially purified free xylanase isolated from Aspergillus flavus MTCC 9390. Journal of Food Science and Technology 52: 191-200.

Bhushan B, Pal A, Narwal R, Meena VS, Sharma PC and Singh J (2015). Combinatorial approaches for controlling pericarp browning in litchi (*Litchi chinensis*) fruit. Journal of Food Science and Technology DOI 10.1007/s13197-015-1712-8.

Bhushan B, Pal A, Rajesh, Kumar S and Singh A (2015). Evaluation of post-germinative lipid peroxidation and enzymatic antioxidant potential in lead absorbing oat (*Avena sativa*) seedlings. Journal of Environmental Biology 36: 279-288.

Bhushan B, Singh A, Yadav OP, Gaikwad K, Kumar S, and Rai RD (2014). Induced defence responses of contrasting bread wheat genotypes under differential salt stress imposition. Indian J. Biochem. Biophy 52(1-2): 75-85.

Boggala RB, Singh K, Jawandha SK, Jindal SK, Alam MS, Khurana DS, Chawla N and Narsaiah K (2014). Effect of post-harvest application of 1-methyl cyclopropene on storage behaviour of fresh tomatoes (*Solanum lycopersicum L.*). Journal of Food Processing and Preservation DOI: 10.1111/jfpp.12350.

Bordoloi R, Muzaddadi AU and Ganguly S (2014). Sanitary condition of Battala Fish Market at Agartala, Tripura and its Public Health Significance. International Journal of Current Microbiology and Applied Sciences 3(3): 176-181.

Devatkal S, Anurag RK, Jaganath B and Rao S (2014). Microstructure, microbial profile and quality characteristics of high-pressure-treated chicken nuggets. Food Science and Technology International DOI: 10.1177/1082013214546957.

Dulta JS, Kashyap P, Karale AR, Singh SP and Meena VS (2014). Variability and correlation studies for pomological characteristics in guava clones. Annals of Horticulture 7(1): 58-61

Gawad SA, Jaiswal P and Jha SN (2014). Nondestructive quality evaluation of tomato using VIS-NIR Spectroscopy. International Journal of Advance Research 2(12): 632-639.

Grewal MK, Jaiswal P and Jha SN (2014). Detection of poultry meat specific bacteria using FTIR spectroscopy and chemometrics. Journal of Food Science and Technology DOI 10.1007/s13197-014-1457-9.

Jaiswal A, Bajaj R, Mann B and Lata K (2014). Iron (II)-chelating activity of buffalo α_s-casein hydrolysed by corolase PP, alcalase and flavourzyme. Journal of Food Science and Technology DOI 10.1007/s13197-014-1626-x

Jaiswal P, Jha S N, Narsaiah, K and Bhardwaj R. (2014). Rapid prediction of microbial load on intact mango surface using spectroscopy. Journal of Agricultural Engineering 51(2): 19-28.

Jaiswal P, Jha SN, Borah A, Gautam A, Grewal MK and Jindal G (2015). Detection and quantification of soymilk in cow-buffalo milk using attenuated total reflectance fourier transform infra-red spectroscopy (ATR-FTIR). Food Chemistry 168: 41–47

Jaiswal P, Prasanna R, Dureja P and Singh PK (2014). Evaluating the biocidal spectrum of rice field cyanobacterium *Nostoc* sp. Egyptian Journal of Biology 16: 87-94.

Jha S N, Jaiswal P, Grewal M K, Gupta M and Bharadwaj R. (2015). Detection of adulterants and contaminants in liquid foods – A Review. Critical Reviews in Food Science and Nutrition DOI 10.1080/10408398.2013.798257.

Jha SN, Jaiswal P, Borah A, Gautam A and Srivastava N (2014). Detection and quantification of urea in milk using attenuated total reflectance -Fourier transform infrared spectroscopy. Food Bioprocess Technology DOI 10.107/s11947-014-14455y.

Karki I, Sharma P and Rastogi SK (2014). Assessment of work environmental and physiological cost of nurses working in shift pattern in hospitals of Uttarakhand. International Journal of Basic and Applied Agricultural Research 12 (1): 135-139.

Kumar S, Kumar R, Nambi VE and Gupta RK (2014). Post-harvest changes in antioxidant capacity, enzymatic activity and microbial profile of strawberry fruits treated with enzymatic and divalent ions. Food and Bioprocess Technology: An Int. Journal 7: 2060-2070.

Kumar S, Yadav P, Jain V and Malhotra SP (2014). Isozymes of antioxidative enzymes during ripening and storage of ber (*Ziziphus mauritiana* Lamk.). J. Food Sci. Technol 51(2): 329-334.

Lata K, Jaiswal A and Ray A (2015). A Study on Quality Changes in Stored Bottle Gourd *(Lagenaria siceraria)* juice. Research & Reviews: Journal of Food Science and Technology 4(1): 21–27.

Lata K, Jaiswal A, Naik L and Sharma R (2015). Gold Nanoparticles: Preparation, Characterization, and its Stability in Buffer. Nanotrends: A Journal of Nanotechnology and its Applications 17(1): 1–10.

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MISCELLANEOUS

(RESEARCH PROJECTS/ COMMITTEES/PERSONNEL)

LIST OF ON-GOING RESEARCH PROJECTS

INHOUSE & COLLAOBRATIVE PROJECTS

Sr. No.	Project Name	Project Leader & Associates	Period of Association		Project period
			From	To	
1.	Development of a PCR based diagnostic process for the detection of potential aflatoxin producing molds during post harvest handling in rice.	Dr. Manisha Mangal (PI) Dr. Sangita Bansal (Co-PI) (PI) Dr. H.S. Oberoi (Co-PI) Ms. Surya (Co-PI)	01.09.2011 01.09.2011 07.08.2013 01.09.2011 01.11.2013	07.08.2013 07.08.2013 31.08.2014 30.10.2013 31.08.2014	09/2011 08/2014
2.	Development of animal handling and automated cooling systems for dairy farms.	Dr. K. Narsaiah (PI) Dr. Yogesh Kumar (Co -PI) Ms. Leena Kumari (Co-PI) Dr. Sandeep Mann (Co-PI) Dr. Mukesh Bhakat (CCPI), NDRI, Karnal Dr. T.K. Mohanty (CCCo-PI), NDRI, Karnal	01.01.2013 01.01.2013 01.01.2013 01.11.2013 01.01.2013 01.01.2013	Till date Till date Till date Till date Till date Till date	01/2013 12/2015
3.	Development of nano-particle embedded biodegradable food packaging biopolymer.	Dr. D.M. Kadam (PI) Dr. P. Jaiswal (Co -PI) Dr. S.K. Nanda (Co-PI)	01.01.2013 01.01.2013 01.01.2013	Till date Till date Till date	01/2013 06/2015
4.	Development of nano-biocomposite based construction material for storage of food grains.	Dr. D.M. Kadam (PI)	01.01.2013	31.10.2013	01/2013 10/2013
5.	Development of hybrid cold storage structure for onion and tomato.	Er. Manpreet Kaur (PI) Ms. Leena Kumari (Co-PI) Dr. R.K Vishwakarma (PI)	01.03.2013 01.03.2013 01.10.2013	24.07.2013 Till date Till date	03/2013 09/2015

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
6.	Shelf life extension of strawberry and plum fruits using active packaging in high barrier metal laminates.	Dr. Rahul Kumar (PI) Dr. Pranita Jaiswal (Co-PI)	01.04.2013 01.04.2013	31.12.2014 31.12.2014	04/2013 12/2014
7.	Development of RFID based quality tracing system.	Ms. Leena Kumari (PI) Dr. K. Narsaiah (Co-PI) Dr. Rahul Kumar (Co-PI)	01.01.2013 01.01.2013 01.01.2013	31.03.2015 31.03.2015 31.03.2015	01/2013 03/2015
8.	Technology for production of protein concentrate /isolate from commercial peanut cake.	Dr. D.N. Yadav (PI) Dr. R.K. Gupta (Co-PI) Dr. Mridula D (Co-PI) Dr. Manisha Mangal (Co-PI)	01.01.2013 01.01.2013 01.01.2013 01.01.2013	31.12.2014 30.06.2014 31.12.2014 07.08.2013	01/2013 12/2014
9.	Primary processing and value addition of pseudocereals.	Dr. Aleksha Kudos (PI) Dr. Mridula D. (Co-PI) Dr. R.K. Gupta (Co-PI)	01.01.2013 01.01.2013 01.01.2013	31.12.2014 31.12.2014 31.12.2014	01/2013 12/2014
10.	Development of process technology for browning inhibition, novel product development and by product utilization of pear	Dr. Ramesh Kumar (PI) Dr. Sunil Kumar (Co-PI) Dr. P.C. Sharma (Co -PI)	01.01.2013 01.01.2013 01.01.2013	Till date Till date Till date	01/2013 12/2015
11.	Development of process protocol for de-bittering of kinnow juice.	Dr. Sunil Kumar (PI) Dr. Ramesh Kumar (Co-PI) Dr. P.C. Sharma (Co-PI)	01.01.2013 01.01.2013 01.01.2013	Till date Till date Till date	01/2013 06/2015
12.	Design and development of bael pulper	Dr. Nilesh Gaikwad (PI) Dr. Rahul Kumar (Co-PI) (PI) Dr. D. R. Rai (Co-PI)	01.01.2013 01.01.2013 03.08.2013 01.01.2013	03.08.2013 03.08.2013 30.06.2014 20.04.2013	01/2013 06/2014
13.	Development of national database on post-harvest technologies.	Dr. Indu Rawat (PI) Dr. Tanbir Ahmad (Co -PI) Dr. S.K. Nanda, (Co-PI) Dr. D. R. Rai (Co-PI)	01.01.2013 01.01.2013 01.01.2013 01.01.2013	31.12.2014 31.12.2014 31.12.2014 20.04.2013	01/2013 12/2014

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
14.	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)	01.10.2013 01.10.2013 01.10.2013	Till date Till date Till date	10/2013 09/2016
15.	Development of fat replacer and hydrocolloid from pearl millet and barley.	Ms. Monika Sharma (PI) Dr. D.N.Yadav (Co -PI) Dr. A.K Singh (Co-PI), NDRI, Karnal	01.10.2013 01.10.2013 01.10.2013	Till date Till date Till date	10/2013 09/2016
16.	Development of vegetable mixed - wadi making system	Dr. Sandeep Mann (PI) Ms. Deepika Goswami (Co-PI)	01.10.2013 01.10.2013	Till date 22.01.2015	10/2013 03/2016
17.	Design and development of oat dehuller.	Dr. Aleksha Kudos (PI) Dr. Anil Dixit (Co -PI)	01.10.2013 01.10.2013	30.06.2014 30.06.2014	10/2013 06/2014
18.	Shelf life enhancement and quality improvement by controlling pericarp browning of litchi fruits using enzyme technology.	Dr. Bharat Bhushan (PI) Dr. P.C. Sharma (Co -PI)	01.10.2013 01.10.2013	30.06.2014 30.06.2014	10/2013 06/2014
19	Development of carrier system for live table carps rohu (*Labeo rohita* Hamilton) and silver carp (*Hypophthelmicthys molitrix* Valenciennes)	Dr. A.U. Muzaddadi (PI) Dr. Tanbir Ahmed (Co -PI) Ms. Monika Kundu (Co-PI)	01.10.2013 01.10.2013 01.10.2013	31.12.2014 31.12.2014 31.12.2014	10/2013 12/2014
20.	Design and development of wonder Bag for wheat storage	Dr. Sandeep Mann (PI) Dr. H.S. Oberoi (Co-PI)	01.07.2014 01.07.2014	Till date 15.11.2014	07/2014 06/2016

Sr. No.	Project Name	Project Leader & Associates	Period of Association		Project period
			From	To	
21.	Development of nutritious convenience foods using extrusion processing technique for 'at risk' population	Dr. Mridula D. (PI) Ms. Deepika Goswami (Co-PI) Ms. Surya (Co-PI)	01.07.2014 01.07.2014 01.07.2014	Till date 22.01.2015 Till date	07/2014 06/2016
22.	Development of a process for extraction and utilization of D-limonene and low methoxyl pectin from citrus fruit residue	Dr. Sunil Kumar (PI) Dr. Ramesh Kumar (Co-PI)	01.04.2014 01.04.2014	Till date Till date	04/2014 03/2016
23	Impact Assessment of Technologies from CIPHET and AICRP on PHT and APA	Dr. Anil Dixit (PI) Dr. S.K. Nanda (Co-PI) Dr. Indu Rawat (Co-PI) Dr. Ranjeet Singh (Co-PI)	01.06.2014 01.06.2014 01.06.2014 01.06.2014	Till date Till date Till date Till date	06/2014 05/2017

EXTERNALLY FUNDED PROJECTS

S. No.	Project Name	Project Leader & Associates	Period of association From	To	Project period
1.	Improvement the microbial safety and nutritional quality of fresh meat using a low cost refrigerated cabinet for retail marketing of meat in street meat shops.	Dr. Suresh Devatkal (PI) Dr. Rahul Kumar Anurag (Co-PI)	13.05.2013 06.09.2013	31.12.2014 31.12.2014	13.05 2013 31.12.2014
2.	Development of spectroscopic methods for detection and quantification of adulterants and contaminants in fruit juices and milk under National Funds for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA).	Dr. S.N. Jha (PI) Dr. Pranita Jaiswal (Co-PI) Er. Manpreet Kaur Grewal (Co-PI)	01.06.2012 01.06.2012 01.06.2012	Till date Till date 24.07.2013	01.06.2012 31.05.2015
3	Assessment of quantitative harvest and post-harvest losses of major crops/commodities in India.	Dr. S.K. Nanda, Project Coordinator, AICRP on PHT, CIPHET, Ludhiana (PI) Dr. R.K. Gupta, Project Coordinator, AICRP on PHT, CIPHET, Ludhiana (PI) Dr. S.N. Jha, I/C PC (PHT) (PI) Dr. R.K. Vishwakarma, CIPHET, Ludhiana (Co-PI) Dr. A.K. Dixit, Sr. Scientist (Co - PI) Dr. S.K. Aleksha Kudos, Scientist (SS) (Co-PI)	01.02.2012 14.11.2013 24.05.2014 01.02.2012 14.11.2013 14.11.2013	13.11.2013 23.05.2014 31.03.2015 31.03.2015 31.03.2015 31.03.2015	01.02.2012 31.03.2015

S. No.	Project Name	Project Leader & Associates	Period of association From	To	Project period
		Dr. Tauqueer Ahmed (CCPI) Pr. Scientist Sample Survey Division, ICAR-IASRI, New Delhi. Dr. Anil Rai (CC Co-PI) Head, Division of Bioinformatics ICAR-IASRI, New Delhi. Dr. Prachi Mishra (CC Co-PI) Senior Scientist, Sample Survey Division ICAR-IASRI, New Delhi. CCPI from AICRP on PHT Centres: All Research Engineers/PI			
4.	"Business Planning and Development (BPD) Unit at CIPHET, Ludhiana" Under the NAIP	Dr. D.M. Kadam (Co-PI & PI) Er. Prasoon Verma (PI) Dr. K. Narsaiah (Co-PI) Dr. P. Barnwal (Co-PI) Dr. Nilesh Gaikwad (Co-PI)	22.05.2013 22.05.2013 22.05.2013 22.05.2013 22.05.2013	30.06.2014 08.08.2013 30.06.2014 10.09.2013 03.08.2013	22.05.2013 30.06.2014
5.	Technology for enhancing oil recovery and production of edible grade de-oiled meal from sunflower and groundnut and their diversified uses.	Dr. R.K. Gupta (PI) Dr. M.R. Manikantan (Co-PI) Dr. Mridula D (Co-PI)	08.07. 2013 08.07. 2013 08.07. 2013	Till date 18.07.2013 Till date	08.07.2013 07.07.2016
6.	Development of molecular tools for detection of adulteration of medicinal oilseeds and spices for value addition and processing.	Dr. Sangita Bansal (PI) Dr. Anupan Mangal (Co-PI) Dr. Sanjeev Kumar (Co-PI)	08.10.2013 08.10.2013 08.10.2013	Till date Till date Till date	08.10.2013 07.10.2016

S. No.	Project Name	Project Leader & Associates	Period of association From	To	Project period
7.	Study on determining storage losses in food grains in FCI and CWC warehouses and to recommend norms for storage losses in efficient warehouse management.	Dr. S.N. Jha, I/C PC (PHT) PI Dr. R.K. Gupta, PC, PHT & Director (PI) Dr. S.K. Nanda, PC, PHT (PI) Dr. S.K. Aleksha Kudos, Scientist (SS) (Co-PI) Dr. A.K. Dixit, Sr. Scientist (Co-PI) Research Engineers/PI of Cooperative Centre (20 Nos. CCPI)	24.05.2014 14.11.2013 01.07.2013 14.11.2013 14.11.2013	Till date 23.05.2014 13.11.2013 Till date Till date	01.07.2013 30.06.2017
8.	Development of nano-biocomposite based construction material for storage of food grains.	Dr. D.M. Kadam (PI) Dr. Manju Bala (Co-PI)	01.11.2013 01.11.2013	Till date Till date	01.11.2013 31.10.2017
9.	Studies and refinement of live-fish carrier system for mass transportation of table fish, brooders, fingerlings and aquarium fisher.	Dr. A.U. Muzaddadi (PI) Dr. S.K. Nanda (Co-PI) Ms. Monika (Co-PI)	08.08.2014 08.08.2014 08.08.2014	Till date Till date Till date	08.08.2014 07.08.2015

RESEARCH ADVISORY COMMITTEE

Research Advisory Committee of ICAR-CIPHET, Ludhiana for the period of three years w.e.f. 22.01.2015 to 21.01.2018

S. No.	Name and Address	Designation	Contact Details
1.	**Dr. B. S. Bisht** Former ADG, ICAR & Director Birla Institute of Applied Sciences Bhimtal, Nainital Uttarakhand-263 136	Chairman	Ph: 05942 - 247032/247921/247095 Mob: 094109-05454 Fax: 05942-247095 Email: director@birlainstitute.co.in
2.	**Dr. B. Ranganna** Professor Emeritus University of Agricultural Sciences J-Block, GKVK Campus Bangalore-560 065, Karnataka	Member	Ph. 080 - 23330153 (O) Ext. 346 Fax: 080 - 23330277 Mob: 097400-10564, 094498-66931 Email: rangannab@gmail.com
3.	**Prof. Susanta Kumar Das** Professor Agricultural & Food Engineering IIT, Kharagpur-721 302, West Bengal	Member	Ph: 91-03222-283112/113 Mob. 094340-68741, 094753-49779 Fax. 91-03222-278224 Email: skd@agfe.iitkgp.ernet.in susantaiitkgp@gmail.com
4.	**Dr. Pitam Chandra** Professor & Head Department of Food Engineering NIFTEM, Kundli Sonepat-131 028, Haryana	Member	Ph: 91-130-2281099 Email: pc1952@gmail.com
5.	**Dr. Ashok Kumar** ADR (Food Science, Nutrition and Engineering) Punjab Agricultural University Ludhiana –141 004 (Punjab)	Member	Mob: 98728-76077 Email: akdevgan@pau.edu
6.	**Dr. Sanjod Kumar Mendiratta** Head Livestock Products Technology Division IVRI, Izatnagar-243 122, U.P.	Member	Mob: 094124-45311 Email: mendiratta_65@yahoo.co.in
7	**Dr. R. K. Gupta** Director ICAR - CIPHET, PO: PAU Campus Ludhiana-141 004 (Punjab)	Member	Ph. 0161-2308669, 2313102 Fax: 0161-2308670 Mob: 098728-59024 Email : rkguptaciphet@gmail.com : ciphet.director@gmail.com
8	**Dr. Kanchan K. Singh** (Ex-Officio) Assistant Director General (FE/PE) Indian Council of Agricultural Research Room No.-405, Krishi Anusandhan Bhawan II, Pusa, New Delhi -110012	Member	Ph. 011-25840158 Mob: 095829-63548 Email: kksingh03@yahoo.co.uk
9.	**Dr. D. M. Kadam** Senior Scientist, AS&EC Division, ICAR-CIPHET, PO: PAU Campus Ludhiana-141 004, Punjab	Member Secretary	Ph. 0161-2313123 Fax: 0161-2308670 Mob: 94175-96894 Email: kadam1k@yahoo.com

INSTITUTE MANAGEMENT COMMITTEE

Institute Management Committee of ICAR-CIPHET, Ludhiana for the period of three years w.e.f. 27.08.2013 to 26.08.2016

S. No.	IMC Members	Contact Details
1.	Dr. R.K. Gupta Director, ICAR-CIPHET Chairman-IMC	PA to Director : 061-2308669, 2313103 Mob. 098728-59024 Fax : 0161-2308670 Email : rkguptaciphet@gmail.com ciphet.director@gmail.com
2.	Assistant Director General (PE) Division of Agricultural Engineering Indian Council of Agricultural Research Krishi Anusandhan Bhawan-II, Pusa New Delhi-110 012	Telefax : 011-25846492 Fax: 011-25842660
3.	The Director of Agriculture Department of Agriculture, Punjab Kheti Bhawan, Phase-6 Near Dara Film Studio Mohali, Chandigarh -160055	Tel: 0172-2970602 Mob: 98140 38659 Fax : 0172-2970609 Email: dr.mssandhupakki@gmail.com PA's Email: agril67@gmail.com
4.	Dr. S.P. Sharma The Director of Research Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya (CSKHPKV) NH 20, Palampur-176 062 Himanchal Pradesh	Tel: 01894-230406 (O) 01894-231051 (R) Mob: 094184-78969 Fax: 01894-230406, 230511
5.	Director (Horticulture) Govt. of Gujarat Directorate of Horticulture First Floor, Krishi Bhawan Sector 10 A, Gandhi Nagar-382 010 Gujarat	Tel: 079-23256104 079-23256013/23256227 Fax: 079-23256113 Email: dir_bag@gujarat.gov.in
6.	Sh. Jagdish Chander The Finance & Accounts Officer Directorate of Wheat Research Karnal-132 001 (Haryana)	Tel : 0184-2266762 Mob: 090509-05843 Fax : 0184-2267390 Email: pao.dwr@gmail.com
7.	Sh. Abhijit Shantaram Rokade Shukrawar Peth, House No. 5 Taluka-Junnar, Distt. Pune-410 502 Maharashtra	Mob:094230-11236, 096045-61769 Email: grapessywines_beverages@yahoo.com

S. No.	IMC Members	Contact Details
8.	Dr. S.K. Chattopadhyay Head, MP Division Central Institute for Research on Cotton Technology (CIRCOT) Adenwala Road, Matunga (East) Mumbai -400 019	PA to Director: 022-24146002 Mob: 09850083130 Fax : 022-24157239, 24130835 Email: drskchattopadhyay@gmail.com
9.	Dr. Gautam Basu Head, MP Division National Institute of Research on Jute & Allied Fibre Technology (NIRJAFT) 12, Regent Park Kolkata-700 040 (West Bengal)	PA to Director: 033-24711807 Phone No. 033-24212115-17, Ext. 215, 265 Mob: 094330-03241 Fax : 033-24712583 Email: gbose91@yahoo.com
10.	Dr. Nachiket Kotawaliwale Head (APPD) Central Institute of Agricultural Engineering Nabi Bagh, Berasia Road Bhopal-462 038	EPBAX : 0755-2521000-1 PA to Director : 0755-2737191 Tel: 0755-251110 Fax : 0755-2734016 Email : nachiket@ciae.res.in
11.	Dr. S. K. Jha Principal Scientist (AS&PE) PHT Centre Indian Agricultural Research Institute Pusa, New Delhi-110012	PA to Director : 011-25843375 011-25842367 Mob. 098684-27205 Fax : 011-25846420 Email: skj_ageg@iari.res.in
12.	Sh. Sharanjit Singh S/o Sh. Sukhdeep Singh H. No. 109, Narula Colony Near Budha Dal Public School Lower Mall Road, Patiala-147021 Punjab	Mob: 98550-55517 Mob: 98554-70007 (R)

PERSONALIA

JOINING:

- Dr. Swati Sethi joined ICAR-CIPHET as Scientist (FST) on 1st April 2014. She has been posted in Food Grains and Oilseeds Processing Division. She did her B.Sc. (H) in Food Technology in 2007 from University of Delhi and M.Sc. (Food Technology) in 2009 from G.B. Pant University of Agriculture and Technology, Pantnagar. She has completed her Ph.D. with major in Food Technology and minor in Process and Food Engineering from G.B. Pant University of Agriculture and Technology, Pantnagar in 2012. She has also served as Lecturer (Food Technology) in University of Delhi.

- Er. Chandan Solanki joined ICAR-CIPHET as Scientist (APE) on 9th April 2014. He has been posted in Food Grains and Oilseeds Processing Division. He did his B. Tech. (Dairy Technology) from College of Dairy Technology, I.G.A.U. Raipur, Chhattisgarh in the year 2009 and M. Tech. (Dairy Engineering) from ICAR-NDRI, Karnal in the year 2011. Before joining ICAR-CIPHET, he has worked as a Technical Assistant in Dairy Technology Section at ICAR-NDRI, SRS, Bangalore for two and half year.

- Er. Dhritiman Saha joined ICAR-CIPHET as Scientist (APE) on 9th April 2014. He has been posted in Food Grains and Oilseeds Processing Division. He did his B.Tech in Agricultural Engineering from Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (West Bengal) in the year 2008 and M. Tech from Indian Institute of Technology, Kharagpur in the discipline of Dairy & Food Engineering during 2008-10. Prior to joining ARS, he was employed as Factory Advisory Officer in Tea Board of India.

- Er. Rahul Subhash Yadav joined ICAR-CIPHET on 9th April 2014 as Scientist (AS&EM) in AICRP on PET (earlier APA) unit and associated with Agricultural Structures and Environmental Control Division for research work. He did his B.Tech. in Agricultural Engineering from Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra in 2010 and M.Tech in 2012 from Indian Agricultural Research Institute, New Delhi in the discipline of Agricultural Engineering.

- Er. Sakharam Jagan Kale joined ICAR as Scientist (AS&EM) on 1st January 2014 and got posted at ICAR-CIPHET Ludhiana on 9th April 2014. He is presently working in Horticultural Crop Processing Division, ICAR-CIPHET, Abohar, Punjab. He has completed his B.Tech. (Agricultural Engineering) from MPKV Rahuri, Maharashtra, M.Tech (Agricultural Processing and Structures) and Ph.D degree from Department of Food Science and Post Harvest Technology, ICAR-IARI, New Delhi.

- Dr. Prerna Nath Kale joined as Scientist (FST) in ICAR on 1st January 2014 and got posting at ICAR-CIPHET Ludhiana on April 9, 2014. She

is currently posted at ICAR-CIPHET, Abohar, Punjab. She completed her graduation, B.A.Sc. (Hons.) Food Technology from Bhaskaracharya College of Applied Sciences, University of Delhi, M.Sc. Food Science and Technology from Acharya N. G. Ranga Agricultural University, Hyderabad and Ph.D from Division of Food Science and Post Harvest Technology, ICAR-IARI, New Delhi.

- Er. Manoj Kumar Mahawar joined as Scientist (APE) in ICAR on 1st January 2014 and got posted at ICAR-CIPHET Ludhiana on 9th April 2014. He is presently working in Division of Horticultural Crop Processing, ICAR-CIPHET, Abohar, Punjab. He has completed his B.Tech. (Agricultural Engineering) from UAS Raichur, Karnataka, M.Tech (Food Biotechnology Engineering) from GBPUA&T, Pantnagar and Ph.D (Agricultural Structures and Process Engineering) from ICAR-IARI, New Delhi.

- Er. Kirti Ramesh Jalgaonkar joined ICAR as Scientist (APE) on 1st January 2014 and got posted at ICAR-CIPHET Ludhiana on 9th April 2014. She is presently working in Horticultural Crop Processing Division, ICAR-CIPHET, Abohar, Punjab. She has completed her B.Tech. (Agricultural Engineering) from Dr. BSKKV, Dapoli, Maharashtra and M.Sc. (Post Harvest Engineering and Technology) and Ph.D degree from Department of Food Science and Post Harvest Technology, ICAR-IARI, New Delhi.

- Er. Arun Kumar T. V. joined ICAR-CIPHET as Scientist (APE) on 10th October 2014. He has been posted in Food Grains and Oilseeds Processing Division. He did his B.Tech. in Agricultural Engineering from University of Agricultural Sciences, Bangalore in the year 2007 and M. Tech. from Tamil Nadu Agricultural University, Coimbatore in the discipline of Food and Agricultural Process Engineering during 2008-10.

- Dr. Arvind Jaiswal joined ICAR-CIPHET as Scientist (FST) on 13th October 2014. He is posted in Transfer of Technology Division. He did B.Sc. from Faizabad University, M.Sc. (Food Technology) from Centre of Food Technology, University of Allahabad, Uttar Pradesh and Ph.D. (Dairy Chemistry) from National Dairy Research Institute, Karnal, Haryana. He worked on 'Process development for the production of bioactive active peptides (antioxidant, antihypertensive and mineral binding) form buffalo milk α_s-casein using different commercially available proteolytic enzymes' during Ph.D. programme.

PROMOTION

- Sh. Gurdeep Singh, Sr. Tech. Asstt (Lab. Technician) got promoted to Technical Officer from 1.01.2014.
- Sh. Vishal Kumar, Tech. Asstt. (Lab. Technician) got promoted to Sr. Technical Assistant from 22.07.2014.
- Sh. Jaswinder Singh, Sr. Technician (Machinist) got promoted to Technical Assistant from10.3.2014.

- Sh. Jagtar Singh , Sr. Technician (Electrician) got promoted to Technical Assistant from 23.3.2014
- Sh. Pradip Kumar, Sr. Technician (Field Farm) got promoted to Technical Assistant from 23.9.2014.
- Sh. Beant Singh, Technical Assistant (Driver) got promoted to Senior Technical Assistant (Driver) from 4.3.2014.

TRANSFER

- Dr. Jitendra Kumar, Sr. Scientist has been transferred from CIPHET, Abohar to NCIPM, New Delhi on 02.05.2014.
- Sh. Neeraj Kumar Tahiliani, F&AO has been transferred from CIPHET, Ludhiana to Indian Institute of Soil Science, Bhopal, on 21.07.2014.
- Dr. H.S. Oberoi, Pr. Scientist has been transferred from CIPHET, Ludhiana to IIHR, Bangluru on 15.11.2014 as Head, PHT.
- Sh. Ajay Kumar Tandon, LDC has been transferred from CIPHET, Ludhiana to DRMR Bharatpur, Rajasthan on11.11.2014 on selection as JFO.
- Dr. P.R. Bhatnagar PC(APA) has been transferred from CIPHET, Ludhiana to IISWC, Regional Centre, VASAD, District Anand, Gujrat on 8.12.2014 on selection as Head of regional centre.

HIGHER EDUCATION

- Ms. Deepika Goswami, Scientist, FG&OP Division has joined the Ph.D. Degree program in Food Science and Technology Department at PAU, Ludhiana in January 2015.
- Dr. Tanbir Ahmad, Scientist, TOT Division has joined the Ph.D. Degree program at Universiti Putra Malaysia, Malaysia in February 2015.

PERSONNEL

Name	Designation
ICAR-CIPHET, Ludhiana Campus **Scientific Staff**	
Dr. R.K. Gupta	Director
Dr. S.K. Nanda	Pr. Scientist, I/C TOT & I/C PC(PET)
Dr. S.N. Jha	Pr. Scientist & I/C PC (PHT)
Dr. S.K. Tyagi	Pr. Scientist (Chemical Engg.)
Dr. K. Narsaiah	Pr. Scientist (APE)
Dr. Mridula Devi	Sr. Scientist (F&N)
Dr. Suresh K. Devatkal	Sr. Scientist (LPT)
Dr. Anil Kumar Dixit	Sr. Scientist (Agril. Economics)
Dr. Deep Narayan Yadav	Sr. Scientist (Food Science & Tech.)
Dr. Pranita Jaiswal	Sr. Scientist (Microbiology-Plant Sci)
Dr. D. M. Kadam	Sr. Scientist (APE)
Dr. Sangita Bansal	Sr. Scientist (Biotechnology Plant-Sci)
Dr. R. K. Vishwakarma	Sr. Scientist (AS&EM)
Dr. Manju Bala	Sr. Scientist (Plant Bio-chemistry)
Dr. Sandeep Mann	Sr. Scientist (AS&EM)
Dr. Armaan Ullah Muzaddadi	Sr. Scientist (Fish Processing Technology)
Dr. S.K. Aleksha Kudos	Scientist (SS) (APE)
Er. Manpreet Kaur Grewal**	Scientist (APE)
Dr. Yogesh Kumar	Scientist (LPT)
Dr. Tanbir Ahmad	Scientist (LPT)
Ms. Deepika Goswami	Scientist (FST)
Ms. Monika Sharma	Scientist (FST)
Dr. Indu Rawat	Scientist (FRM)
Dr. Rahul Kumar	Scientist (FST)
Ms. Leena Kumari	Scientist (Electronics & Instrumentation)
Ms. Monika	Scientist (Electronics & Instrumentation)
Ms. Surya	Scientist, (Agricultural Microbiology)
Dr. Swati Sethi	Scientist (FST)
Er. Yadav Rahul Subhash	Scientist (AS&EM)
Er. Chandan Solanki	Scientist (APE)
Er. Dhritiman Saha	Scientist (APE)
Dr. Ranjit Singh	Sr. Scientist (APE)
Er. Arun Kumar T.V	Scientist (APE)
Dr. Arvind Kumar Jaiswal	Scientist (FST)

Name	Designation
Administrative Staff	
Mr. Raj Kumar	SAO
Mr. Manni Lal	AF&AO
Mr. B.C. Katoch	AAO
Mr. Kunwar Singh	Assistant
Mr. Avtar Singh	Assistant
Mr. Tarsem Singh Purba	Assistant
Ms. Jasvir Kaur	Assistant
Mr. Gurdial Singh	UDC
Mr. Harbhupinder Singh	UDC
Mr. Iqbal Singh	UDC
Mr. Ashwani Kumar	UDC
Ms. Sunita Rana	LDC
Mr. Ram Khelawan Yadav	LDC
Mr. Sohan Lal	LDC
Mr. Rajinder Kumar	LDC
Mr. Sughar Singh Verma	Private Secretary
Technical Staff	
Dr. Mukund Narayan	Technical Officer (Agril. Engg.)
Mr. Gurdeep Singh	Technical Officer (Lab. Tech.)
Mr. Hardev Singh Sekhon	Sr. Technical Assistant (Driver)
Mr. Beant Singh	Sr. Technical Assistant (Driver)
Mr. Chaman Lal	Technical Assistant (Lab. Asstt.)
Mr. Lakhwinder Singh	Technical Assistant (Fitter)
Mr. Bhajan Singh	Technical Assistant (Fitter)
Mr. Jaswant Singh	Technical Assistant (Welder)
Ms. Sonia Rani	Technical Assistant (DEO)
Mr. Vishal Kumar	Sr. Technical Assistant (DEO)
Mr. Rajiv Sharma	Technical Assistant (Lab. Technician)
Mr. Jaswinder Singh	Technical Assistant (Machinist)
Mr. Jagtar Singh	Technical Assistant (Electrician)
Mr. Pradip Kumar	Technical Assistant (Field Asstt.)
Mr. Yashpal Singh	Sr. Technician (Field Asstt.)
Mr. Satwinder Singh	Sr. Technician (Lab. Technician)
Mr. Sarup Singh	Technician (Lab. Technician)
Supporting	
Mr. Sukhbir	Skilled Support Staff
Ms. Viran Bali	Skilled Support Staff
Mr. Shalikgram Dwivedi	Skilled Support Staff

Name	Designation
ICAR-CIPHET, Abohar Campus	
Scientific Staff	
Dr. Pritam Chand Sharma	Head, HCP Division, Abohar
Dr. Ramesh Kumar	Sr. Scientist (Hort.)
Dr. Sunil Kumar	Sr. Scientist (Bio-Chem. Plant. Sci.)
Er. Eyarkai Nambi, V. **	Scientist (APE)
Mr. Vijay Singh Meena	Scientist (Hort.)
Dr. Bharat Bhushan	Scientist (Biochem. Plant. Sci)
Ms. Prerna Nath	Scientist (FST)
Er. Manoj Kumar Mahawar	Scientist (APE)
Er. Sakharam Jagan Kale	Scientist (AS&EM)
Er. Kirti Ramesh Jalgaonkar	Scientist (APE)
Administrative Staff	
Mr. Pawan Kumar	AAO
Mr. Mohan Lal	Assistant
Mr. Sanjay Kumar Gaur	LDC
Technical Staff	
Mr. V.K. Saharan	Chief Technical Officer
Mr. Prithvi Raj	Sr. Technical Officer (Filed Form.)
Mr. Rajesh Kumar	Sr. Technical Officer (Filed Form.)
Mr. Ganpat Ram	Technical Assistant (Driver)
Mr. Devinder Kumar	Technical Assistant (Fitter)
Mr. Dalu Ram	Technical Assistant (Fitter)
Mr. Pawan Kumar	Technical Assistant (Electrician)
Mr. Hardeep Singh	Technical Assistant (Turner)
Mr. V.K. Saharan	Chief Technical Officer
Mr. Prithvi Raj	Sr. Technical Officer (Filed Form.)
Supporting Staff	
Mr. Surinder Kumar	Skilled Support Staff

**Study Leave

APPENDIX

Appendix - I

RESULTS - FRAMEWORK DOCUMENT (RFD)

(2013 – 2014)

SECTION 1:

Vision, Mission, Objectives and Functions

Vision

Higher profitability of agricultural production systems through efficient post harvest engineering and technological interventions

Mission

Creating prosperity through minimization of post harvest losses and increase in value addition to produce and by-products from crops, horticulture, livestock and fisheries sector.

Objectives

1. To design, develop and evaluate post-harvest processing equipment, tools and gadgets
2. To develop process protocols and value added products
3. To organize human resource development and capacity building programmes

Functions

- To undertake basic, applied and adaptive engineering and technology research in post production sector of produce of plant origin, livestock and aquaculture produce including agricultural and environmental control, quality and safety.
- To act as national institute for research, education/teaching and training in post harvest engineering and technology
- To act as national repository of information on processes, equipment, products and technologies on post harvest engineering and technology
- To transfer technology and provide advisory and consultancy services and promote entrepreneurship
- To develop and strengthen linkages with the private and public sector in the mandated areas

SECTION 2:
Inter se Priorities among key Objectives, Success indicators and Targets

S.No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent	Very Good	Good	Fair	Poor
							100%	90%	80%	70%	60%
1.	To design, develop and evaluate post-harvest processing equipment, tools and gadgets	28	Design & development of post harvest processing equipment, tools and gadgets	Equipment designed and developed	Number	18	5	4	3	2	1
			Testing and evaluation of post harvest processing equipment, tools and gadgets	Final validated design of machine	Number	10	6	5	4	3	2
2.	To develop process protocols and value added products	24	Process protocols	Development of process protocol	Number	11	13	12	10	8	7
			Value added products	Development of value added products	Number	13	12	10	8	7	6
3.	To organize human resource development and capacity building programmes	37	Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	35	28	25	20	18	15
				Patents filed	Number	02	5	4	3	2	1
4.	Efficient functioning of the RFD system	03	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date	02	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013
			Timely submission of results of RFD (2012-13)	On-time submission	Date	01	01/05/2013	02/05/2013	05/05/2013	06/05/2013	07/05/2013
5.	Administrative reforms	04	Implement ISO 9001 as per the approved action plan	% Implementation	%	02	100	95	90	85	80
			Prepare an action plan for innovation	On time submission	Date	02	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013
6.	Improving internal efficiency / responsiveness / service delivery of Ministry / Department	04	Implementation of Sevottam	Independent Audit of Implementation of ——	%	02	100	95	90	85	80
				Independent Audit of implementation of public grievance redressal system	%	02	100	95	90	85	80

SECTION 3:
Trend Values of the Success Indicators

S.No.	Objectives	Actions	Success Indicators	Unit	Actual Value for FY 11/12	Actual Value for FY 12/13	Target Value for FY 13/14	Projected Value for FY 14/15	Projected Value for FY 15/16
1.	To design, develop and evaluate post harvest processing equipment, tools and gadgets	Design & development of post harvest processing equipment, tools and gadgets	Equipment designed and developed	Number	11	5	4	5	6
		Testing and evaluation of post harvest processing equipment, tools and gadgets	Final validated design of machine	Number	16	3	5	6	7
2.	To develop process protocols and value added products	Process protocols	Development of process protocol	Number	15	8	12	14	15
		Value added products	Development of value added products	Number	14	10	10	12	13
3.	To organize human resource development and capacity building programmes	Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	26	28	25	28	30
			Patents filed	Number	8	6	4	5	6
4.	Efficient functioning of the RFD system	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date			16/05/ 2013		
		Timely submission of results of RFD (2012-13)	On-time submission	Date			02/05/ 2013		
5.	Administrative reforms	Implement ISO 9001 as per the approved action plan	% Implementation	%			95		
		Prepare an action plan for innovation	On time submission	Date			10/08/ 2013		
6.	Improving internal efficiency / responsiveness/ service delivery of Ministry / Department	Implementation of Sevottam	Independent Audit of implementation of Citizen's Charter	%			95		
			Independent Audit of implementation of public grievance redressal system	%			95		

SECTION 4: Acronyms

S.No	Acronym	Description
1.	CIPHET	Central Institute of Post-harvest Engineering and Technology
2.	FLDs	Field Level Demonstrations
3.	R&D	Research and Development
4.	SAUs	State Agriculture Universities
5.	NGO	Non Government Organization
6.	MOFPI	Ministry of Food Processing Industries
7.	CSIR	Council of Scientific and Industrial Research
8.	GDP	Gross Domestic Product
9.	KVK	Krishi Vigyan Kendra
10.	FLD	Front Line Demonstration

SECTION 4: Description and Definition of Success Indicators and Proposed Measurement Methodology

S.No.	Success indicator	Description	Definition	Measurement	General Comments
1.	Equipment designed and developed	Success indicators cover number of equipment, tools and gadgets developed.	Development of post-harvest engineering and technology related equipment, tools and gadgets.	Number of equipment, Tools and gadgets developed	NIL
2.	Final validated design of machine	Post harvest processing equipment, will be evaluated including refinement of developed/ existing equipment, tools and gadgets.	Evaluation and refinement of developed/existing post harvest processing equipment, tools and gadgets.	Performance, efficiency and accuracy along with low cost and energy efficiency.	NIL
3.	Development of process protocol	Development of protocols for value added products.	Process protocol for value added products	Number of protocols developed	NIL
4.	Development of value added products	Development of value added products using developed protocols.	Manufacture of products from commodities and co-products	Number of value added products	NIL
5.	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Training conducted for farmers and upcoming entrepreneurs, private and government officials, R&D and extension personnel. Licensing and training on CIPHET developed technologies.	Trainings, FLDs, exhibitions for transfer of technology and commercialization along with human resource development.	Number of training, FLDs, & exhibitions conducted/ participated. Numbers of technologies licensed.	NIL
6.	Patents filed	Patenting innovative technology and process/ products.	A license to use exclusive rights to a process/design	Number of patents filed.	NIL

SECTION 5:
Specific Performance Requirements from other Departments

Location Type	State	Organisation Type	Organisation Name	Relevant Success Indicator	What is your requirement from this organisation	Justification for this requirement	Please quantify your requirement from this Organisation	What happens if your requirement is not met.
State Govt.	All states	Other	Other	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Sponsorship for conducting trainings and sponsored candidates	For dissemination of developed technologies to the end users.	Number of trainings and candidates	Dissemination of developed technologies to the end users will be affected.

SECTION 6:
Outcome / Impact of activities of organization /ministry

S. No.	Out Come/Impact of Organisation	Jointly responsible for influencing this outcome / impact with the following department (s) / ministry(ies)	Success Indicator (s)	Unit	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
1	Reduction in postharvest losses and increase in value addition of agricultural produce	SAUs, CSIR, MOFPI, Entrepreneurs, Food Processing Industry	Increase in number of food pro cessing units over previous year (%)	%	1.1	1.1	1.2	1.3	1.4
			Contribution of food processing to GDP of Agriculture	%	12	12	12.5	13	13.5
2	Human resource development	SAUs, KVKs, Manufacturers, Entrepreneurs	Skilled manpower developed	Number	350	412	430	500	560

Annual (April 1, 2013 to March 31, 2014) Performance Evaluation Report of RFD of RSCs i.e. Institutions for the year 2013-2014
Name of the Division: Agricultural Engineering
Name of the Institution: ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana
RFD Nodal Officer: Dr. D. M. Kadam

S. No.	Objectives	Weight	Actions	Success Indicators	Unit	Weight	Target / Criteria Value					Achievements	Performance		Performance (Against 90% -raw score)
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60 %		Raw score	Weighted score	
1	To design, develop and evaluate post harvest processing equipment, tools and gadgets	28	Design & development of post harvest processing equipment, tools and gadgets	Equipment designed and developed	Number	18	5	4	3	2	1	6	100	18	150
			Testing and evaluation of post harvest processing equipment, tools and gadgets	Final validated design of machine	Number	10	6	5	4	3	2	6	100	10	120
2	To develop process protocols and value added products	24	Process protocols	Development of process protocol	Number	11	13	12	10	8	7	14	100	11	116.6
			Value added products	Development of value added products	Number	13	12	10	8	7	6	10	90	11.7	100
3	To organize human resource development and capacity building programmes	37	Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	35	28	25	20	18	15	36	100	35	144
				Patents filed	Number	02	5	4	3	2	1	3	80	1.6	75
4	Efficient functioning of the RFD system	03	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date	02	15/05/2013	16/05/2013	17/05/2013	20/05/2013	21/05/2013	17/05/2013	80	1.6	90
			Timely submission of results of RFD (2013-14)	On-time submission	Date	01	01/05/2014	02/05/2014	05/05/2014	06/05/2014	07/05/2014	19/04/2014	100	1	110

5	Administrative reforms	04	Implement ISO 9001 as per the approved action plan	% Implementation	%	02	100	95	90	85	80	100	**100**	**2**	**110**
			Prepare an action plan for innovation	On time submission	Date	02	30/07/2013	10/08/2013	20/08/2013	30/08/2013	10/09/2013	30/07/2013	**100**	**2**	**110**
6	Improving internal efficiency / responsiveness / service delivery of Ministry / Department	04	Implementation of Sevottam	Independent Audit of Implementation ----	%	02	100	95	90	85	80	**100**		**0**	**105**
				Independent Audit of implementation of public grievance redressal system	%	02	100	95	90	85	80	**100**		**0**	**105**
													Composite Score =	**93.9%**	
													Rating	**Very Good**	

Annual Achievements of RFD 2013-14 of ICAR-CIPHET, Ludhiana

Actions	Success Indicators	Unit	Targets achieved	Brief details of targets achieved
Design & development of post harvest processing equipment, tools and gadgets	Equipment designed and developed	Number	06	1) Canning line 2) Inclined draper type separator for separation of Berseem and Chicory Seeds 3) Adoption/modification of coarse cereal dehuller for dehulling of Sesame 4) Mechanized system for popping and decortications of makhana seeds 5) Groundnut kernel testa remover 6) Bael/ Woodapple Pulper machine
Testing and evaluation of post harvest processing equipment, tools and gadgets	Final validated design of machine	Number	06	1) Inclined draper type separator for separation of Berseem and Chicory Seeds 2) Sesame dehuller 3) Pineapple peeler-corer device 4) Pedal operated grader for dried apricot 5) Evaluation of compact fruit grader for oblong and round fruit 6) Hand operated cocoa pod breaker
Process protocols	Development of process protocol	Number	14 1) 2) 3)	1) Optimization and validation of potential antimicrobial and antioxidative natural extracts for meat packaging 2) Controlled release of pediocin, encapsulated in hybrid capsules 3) Process for separation of oligosaccharides 4) Process protocol for removal of impurities (husk, testa etc) from commercial ground nut cake 5) Calcium fortified rice 6) Process protocol for amplification of genes; a) omt-1 gene and b) nor-1 gene involved in aflatoxin biosynthesis 7) Process protocol for amplification of genes; a) apa gene and b) aflr gene involved in aflatoxin biosynthesis 8) Process protocol for development of Probiotic Peanut Yoghurt 9) Process protocol for development of Barnyard millet based muffins 10) Process protocol for development of High fibre extruded product 11) Process protocol for protein concentrate / isolate from commercial groundnut cake 12) Process protocol for enhancing the shelf -life of pomegranate arils and strawberry using enzymes and bio-chemicals 13) Process protocol for development of Protein rich flour from Sesame and sunflower 14) Process optimization for encapsulation of bacteriocins
Value added products	Development of value added products	Number	10	1) Instant corn based kheer mix 2) Corn based Nutritious Energy bar 3) Probiotic Peanut Yoghurt 4) Barnyard millet based muffins 5) Coarse cereal based nutritious extrudates 6) Protein rich extruded product using de-oiled ground nut cake 7) Vegetable blended pasta 8) Nutritionally rich functional flour

				9) Three putative probiotic bacteria were isolated and their 16S rDNA sequences have been registered with NCBI as per the details given below: GenBank Accession no. — Organism name — Strain name KC433734 — *Streptococcus infantarius* — bbe1 KC433735 — *Streptococcus infantarius* — bbe2 KC662611 — *Enterococcum faecium* — bbe3
Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	36	1) **Technology Licensed:** CIPHET licensed the Beetr oot powder technology to Mr. Preetinder Singh from Chandigarh on April 15, 2013. 2) **Technology Licensed:** Mechanized system for popping and decortications of makhana seeds was licensed (non exclusive) to M/s Jwala Engineering and Consultancy Services, Ambala for commercialization. 3) **News clippings**: News clippings were published in leading national and local newspapers. . . **Training:** Training on 'Sorting, grading, minimal processing and packaging of fresh fruits and vegetables' was imparted to Entrepreneur from 23 -25th September, 2013. 5) **International Training:** Dr. Michel Bakar DIOP, Asst. Prof. Gaston Berger University (UGB), Saint -Louis, Senegal has successfully completed one month Training on "Processing and Dehydration of Onion using Tray and Green House Dryers" from September 17 th to October 18 th, 2013 at CIPHET, Ludhiana under "C. V. Raman International Fellowship for African Researcher 2012 -13" sponsored by DST/FICCI, New Delhi. Dr. Dattatreya M. Kadam, Senior Scientist was the Host Scientist for Dr. Michel Bakar DIOP. 6) **ATMA training:** Training on Post - Harvest Technologies for Rural Catchment for 20 farmers from Namakkal sponsored by ATMA, Namakkal, Tamilnadu was conducted during 10th-14th October, 2013. 7) **Entrepreneurs trainings:** Paid training on "Onion Dehydration & Onion Flakes processing" was attended by 3 farmers/ entrepreneurs from 3rd to 5th October, 2013 8) **Entrepreneurs trainings:** Paid training on "Novel process for production of Green Chilli Powder & puree" was attended by 2 farmers/ entrepreneurs from 7th to 9th October, 2013.
Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	36	9) **Training attended:** NAIP sponsored Nation training workshop on "Scientific Report Writing and Presentation" was attended by K. Narsaiah from October 17 -22, 2013 at NAARM Hyderabad. 10) **Technology Licensed:** Agreement for licensing and transf er of "CIPHET Cryogenic spice grinding system" to M/s Spectra Cryogenic Systems Pvt. Ltd. H -326(E), Road No. 6, IPIA, Kota, Rajasthan. 11) **Exhibition:** BDP- CIPHET has exhibited technologies during Two -day Kisan Mela at PAU, Ludhiana. 12) **Exhibition:** BPD CIPHET has showcase CIPHET developed technologies at international platform "Food 360 International conference -cum- Exhibition" on Agribusiness and Food Processing jointly organized by FICCI and Govt. of Andhra Pradesh at Hyderabad International Convention Centre, Hyderabad from 6th to 7th Nov 2013. 13) **Paid Training Organized:** Three days training on 'Microencapsulation Methods for Food and Biotechnological Application" was organized during 20 -22 November 2013. 14) **Technology Licensed:** Agreement for licensing and technology transfer of "Pearl millet based extrudates and vegetable blended composite pasta' to Mr. Siddharth Aggarwal, Ludhiana on December 3, 2013. 15) **Technology Licensed:** Agreement for licensing and technology transfer of " Ginger Processing Technology (Dried Ginger F lakes, Osmo-Sweetened flakes, Powder and Paste) to Mr. Rakesh Thapa, Block Inspector, Co -operative Societies, Block Sangrah, Sirmaur, HP on December 27, 2013.

				16) **Technology Licensed:** Agreement for licensing and technology transfer of " Ginger Processing Techn ology (Dried Ginger Flakes, Osmo -Sweetened flakes, Powder and Paste) to Mr. Mohan Singh, Member, The Sirmaur Ginger Seed Development Farmer Co - operative Society, Sirmaur, HP on December 27, 2013. 17) **Technology Licensed:** Agreement for licensing and technology transfer of " Ginger Processing Technology (Dried Ginger Flakes, Osmo -Sweetened flakes, Powder and Paste) to Mr. Baldev Singh, Secretary, The Sirmaur Ginger Seed Development Farmer Co - operative Society, Sirmaur, HP on December 27, 2013. 18) **Training:** Three da ys training on "Pearl millet based extrudates and vegetable blended composite pasta' was imparted to Mr. Siddharth Aggarwal, Ludhiana. 19) **Training:** Hands on Training imparted to Mr. Rakesh Thapa, Block Inspector, Co - operative Societies, Block Sangrah, Sirma ur, HP and Mr. Mohan Singh, Member, and Mr. Baldev Singh, Secretary, The Sirmaur Ginger Seed Development Farmer Co -operative Society, Sirmaur, HP on "Ginger Processing Technology (Dried Ginger Flakes, Osmo - Sweetened flakes, Powder and Paste) and Garlic Pr ocessing" during December 23 - 27, 2013.
Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	36	20) **Workshop and demonstration:** Launch workshop and demonstration of makhana popping machine was conducted at RCM Darbhanga, Bihar on 3.12.2013 21) **Demonstration:** Demonstration of makhana popping machine and ready to c onstitute makhana kheer mix was organised on 4.12.2013 in Rahika block of Madhubani District of Bihar 22) **Demonstration**: Makhana popping machine and ready to constitute makhana kheer mix was demonstrated in Kishan Mela in Katihar, Bihar during December 24 -25, 2013. 23) **Exhibition:** Business Planning and Development (BPD), CIPHET has showcased CIPHET developed technologies at KISAN -2013 at Pune Maharashtra during December 13 -17, 2013. 24) **Training:** Training on 'Handling and processing of turmeric' was conducted at C IPHET for the 30 farmers from Maharashtra during January 13 -16, 2014 sponsored by ATMA, Wadgaon, Chandrapur, Maharashtra. 25) **Incubation:** BPD CIPHET, Ludhiana has provided incubation facility on " Amla processing line" to incubatee. This facility was inaugura ted by Dr. Bangali Baboo Ex ND NAIP and Dr. K.K Singh ADG (PE) ICAR on 28 th January 2014 on the occasion of National seminar (In Hindi) on Food Processing and management: Scope of self employment for entrepreneurs at CIPHET, Ludhiana from 28 to 29 January 2014. 26) **Technologies demonstrated:** BPD CIPHET, Ludhiana has demonstrated CIPHET developed Technologies and given presentation to Kisan Club Members (About 150), Punjab Agriculture University, Ludhiana on 2 nd Jan 2014. 27) **Technologies demonstrated:** BPD Unit of CIPHET Ludhiana demonstrated and created awareness about CIPHET developed technologies in 12 th Rural Technology and Crafts Exhibition Organized by National Institute of Rural Development (NIRD) at Hyderabad from 14th -19th February, 2014. 28) **Incubatee:** Mr. Jagtar Singh was enrolled at BPD CIPHET, Ludhiana as incubatee from January 15 – February 15 for Amla processing. 29) **Technologies demonstrated:** CIPHET organized ICAR pavilion comprising CIPHET, CSSRI, CIRB and IISR and also participated in "Progressive Pun jab Agricultural Summit" held at Mohali, Chandigarh from16-19th February, 2014. 30) **Training:** A training on "Post -Harvest Management" for 26 officers from Vanameti, Nagpur (Maharashtra) sponsored by ATMA during 17 -21 Feb 2014. 31) **Training:** A Training on Post - Harvest Technologies for Rural Catchment for farmers from Gondia sponsored by ATMA, Gondia, Maharashtra (24 th-27th Feb., 2014) for 26 farmers.

				31) **Presentation on Technologies:** Dr. D. M. Kadam, Senior Scientist and PI, BPD has gave presentation on "CIPHET Dev eloped Technologies on Post -Harvest Engineering and
Transfer of technology, capacity building	Trainings, FLDs, Exhibitions & Licensing of improved postharvest technologies	Number	36	32) **Presentation on Technologies:** Dr. D. M. Kadam, Senior Scientist and PI, BPD has gave presentation on "CIPHET Dev eloped Technologies on Post -Harvest Engineering and Technology" to the 25 food processing incubator professionals from 5 African countries i.e. Cameroon, Uganda, Mali, Angola and Kenya on 27 February 2014. 33) **Training:** A training program on 'Soybean processin g for milk and tofu' was conducted during Feb 3-5, 2014 for two participants from district Ludhiana and Sangrur. 34) **Technologies demonstrated:** Demonstrated and showcased post harvest technologies of CIPHET at Krishi Vasant, from 9 -13 Feb, 2014 at Nagpur. 35) **Technologies demonstrated:** PAU Kisan Mela, 2014 KISAN Mela -Punjab Agricultural University (PAU), Ludhiana 14 -15 March2014. 36) **Presentation on Technologies:** BPD Unit, CIPHET attended the Entrepreneurship Development Programme on the topic: "Role of Post -Harvest Technology" at DIC office Ludhiana on March 10, 2014.
	Patents filed	Number	**03**	1) Patent on Mechanized system for popping and decortications of makhana seeds (Patent application no. – 674/DEL/2013) was filed. 2) Process for preparation of alcoholic beve rage with nutraceutical properties from Kinnow peels. (Patent No: 1049/DEL/2013) was filed. 3) Low fat meat emulsion and process for making the same. (Patent No: 2351/DEL/2013) was filed.
Efficient functioning of the RFD system	Timely submission of draft RFD (2013-14) for approval	On-time submission	Date	**17/05/2013**
	Timely submission of results of RFD (2013-14)	On-time submission	Date	**19/04/2014**
Administrative reforms	Implement ISO 9001	% Implementation	**%**	**100%, ISO 9001: 2008 Certification:** CIPHET has o btain ISO 9001: 2008 Certification for the scope "Research and Development, Training and Extension on Post -harvest Engineering and Technology" from 17 February 2014.
	Prepare an action plan for innovation	On time submission	Date	**30/07/2013**
Improving internal efficiency / responsiveness / service delivery of Ministry /	Implementation of Sevottam	Independent Audit of Implementation of Citizen's Charter	%	**100%**
		Independent Audit of implementation of public grievance redressal system	%	**100%**

Celebrating 25 years of establishment

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

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