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भाकृअनुप–सीफेट
ICAR-CIPHET

ANNUAL REPORT

भाकृअनुप–केन्द्रीय कटाई–उपरान्त अभियांत्रिकी एवं प्रौद्योगिकी संस्थान, लुधियाना–141004 (पंजाब)
ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana-141004 (Punjab)

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Annual Report 2020

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Preface

Nachiket Kotwaliwale
Director

Our Mandate is to Reduce Post-Harvest Losses of Agricultural Produce through Engineering & Processing Interventions

Post-harvest Engineering and Technology plays a vital role in the reduction of post-harvest loss of all agricultural and allied commodities, enhancing shelf-life of food products, ensuring value addition to agro produce, diversification and commercialization of agriculture, generation of employment, enhancing income of farmers and creating surplus for the export of agro and processed foods. Presently, India is producing in surplus but still faces substantial gap between demand and supply of certain commodities owing to huge post-harvest losses. Our studies have estimated that the post production losses in agro commodities is up to Rs 1,00,000 crores per annum. These losses occur due to inferior protocols and machinery for harvesting and on-farm handling, packaging, storage and transportation. Further, inadequate storage facilities, transport system, and awareness among farmers towards post-harvest management are some additional factors to contribute in the losses. These losses can be reduced by appropriate post-harvest management of agricultural, horticultural, fisheries and livestock produce to improve the farmers' income.

ICAR-CIPHET, Ludhiana is a premier national R&D institute in Post-Harvest Engineering and Technology. It is dedicated in the service of the country for increasing farmers' income, generating employment though entrepreneurship, value addition, developing post-harvest technologies, process protocols, novel machineries and products, and utilization of agro by-products. I am happy to place before you the Annual Report - 2020 of our institute to give you insights about the research, outreach programs and institute's significant achievements during last year. I feel proud to say that the institute, along with two All India Coordinated research projects (AICRPs) and one consortium research platforms (CRPs), is contributing significantly to the nation.

The Institute showed appreciable research outcomes in post-harvest machinery and equipment such as IoT-based modular smart device for monitoring of storage structure (one tonne) for pulses, solar-operated phase change material (PCM) based fruits and vegetables vending pushcart, sensors based smart solar dryer, pedal-operated seed removing tool for litchi, hot air maize cob dyer, system for compacting the dry fish hygienically into an earthen container, hand tool for easy removal of scales from fish skin, a portable smart ultraviolet-C disinfection system (UV*i*C), low-cost portable ozone-based fruits and vegetables washer-cum-purifier (Ozo-C), a prediction model based on near infra-red spectroscopy in combination with chemometrics for detection and quantification of khesari dal flour adulteration in *besan.*

The process technologies were standardized for high nutritional, convenient and functional products. Biological method has been developed using two lactobacillus bacterial strains for the precipitation of extracted proteins from de-oiled soy meal, Grass pea (*Khesari)* flour-based muffins have been developed with a very good acceptability, an enzymatic process have been developed for the extraction of ACE-inhibitory peptides from Rohu fish (*Labeo rohita*) by-products.

The national and international visibility of the Institute was facilitated due to participation in the programs like Agri. Business Incubator's Conclave, CII Agritech South: PJTSAU, Pusa Krishi Vigyan Mela, India International Food and Agri Week 2020 etc. Besides this, the Institute was actively involved in capacity building and organized more than 50 training programs and a total of 450 participants were trained for post-harvest management of agricultural and livestock produce through entrepreneurship development programs (EDP), farmers' trainings, and sensitization programmes. This has been achieved under heavy constraints of lock-down of majority of activities. During last year, institute has generated revenue of Rs. 54.82 Lakh through the sale of produce, training fee, food testing fee and technology licensing. Likewise, institute's Post-Harvest Machinery and Equipment Testing Centre (PHMETC) tested 11 machines from different parts of the country, earning a total revenue of Rs 14.11 Lakh.

Institute technologies were showcased and demonstrated to various stakeholders during participation in business meet and exhibitions. Technology transfer and patents are the continuous efforts to enhance the visibility of Institute's research. In 2020, 10 technologies were licensed whereas 03 patents were filed and 06 were granted. The scholastic excellence of our scientists was shown in form of 40 research papers published in national and international peer reviewed journals and through various prestigious awards received during 2020. I also feel pleasure to share that under AICRP on PHET scheme, 47 post-harvest tools/equipments/process protocols and products were developed during 2020. A total of 48 technologies were transferred to the stakeholders under this scheme. Moreover, AICRP on PHET established 32 new agro-processing centres during the period. Under AICRP on PEASEM scheme, 20 technologies were developed whereas 2 technologies were transferred to the stakeholders.

Efforts were also made to enhance the usage of Hindi in routine office work and to implement important schemes like *Swachh Bharat Mission* and *Mera Gaon Mera Gaurav.* ICAR-CIPHET will continue to work on research and development related to Post-Harvest Engineering & Technological innovations and interventions. I believe that, our team will keep its untiring efforts to showcase its excellence in Post-Harvest Research and Development. I invite all to join the ICAR-CIPHET directly or indirectly for betterment of the country in the area of Post-Harvest Engineering and Technology.

(Nachiket Kotwaliwale)
Director

कार्यकारी सारांश

भा.कृ.अनु.प.–केन्द्रीय–कटाई उपरान्त अभियांत्रिकी एवं प्रोद्योगिकी संस्थान (आई.सी.ए.आर.–सेंट्रल इंस्टिट्यूट ऑफ पोस्ट–हार्वेस्ट इंजीनियरिंग एंड टेक्नोलॉजी, सिफेट), लुधियाना फसलोत्तर कृषि प्रसंस्करण एवं इससे जुड़े अभियांत्रिकी एवं प्रौद्योगिकी के शोध एवं प्रसार के क्षेत्र में एक अग्रणी एवं प्रमुख अनुसंधान सस्थान है। वर्ष 2020 में संस्थान ने कटाई के बाद के उपकरण और मशीनरी, कृषि संरचनाओं, उत्पादों और प्रक्रिया प्रोटोकॉल, खाद्य गुणवत्ता और सुरक्षा, प्रौद्योगिकी लाइसेंस के माध्यम से अनुसंधान निष्कर्षों का हस्तांतरण, प्रशिक्षण, क्षमता निर्माण और विस्तार गतिविधियाँ सहित फसलोत्तर इंजीनियरिंग और प्रौद्योगिकी के प्रमुख क्षेत्रों में महत्वपूर्ण प्रगति की है। । संस्थान ने स्वपोषित और बाह्य वित्त पोषित परियोजनाओं के माध्यम से बहुविषयक अनुसंधान को क्रियान्वित किया। वर्ष 2020 के दौरान कुछ महत्वपूर्ण उपलब्धियां नीचे प्रस्तुत की गई हैं:

भा.कृ.अनु.प.–सिफेट ने देश में चल रही कोविड–19 महामारी से लड़ने में मदद करने के लिए कुछ लघु मशीनें/प्रणालियाँ विकसित की हैं। एक पोर्टेबल स्मार्ट पराबैंगनी–सी कीटाणुशोधन प्रणाली (यूवीआईसी) विकसित की गई है जो व्यक्तिगत वस्तुओं और कार्यालय स्टेशनरी को कीटाणु रहित करने में सक्षम है। इसकी कार्यकारी कुल सतह क्षेत्र 25 x 25 सेमी^{2} है। प्रत्येक इकाई की कीमत मात्र 1500 रूपया है। घरेलू स्तर पर फलों और सब्जियों को कीटाणुरहित करने के लिए संस्थान ने एक कम लागत वाला पोर्टेबल ओजोन आधारित फल और सब्जियां वॉशर–कम–प्यूरिफायर (ओजो–सी) विकसित किया गया है। यह सिस्टम साइलेंट कोरोना डिस्चार्ज मेथड के सिद्धांत पर काम करता है। यह उपकरण भी किफायती है। प्रत्येक इकाई की कीमत सिर्फ 3500 रुपया है।

दालों के लिए भंडारण (एक टन) संरचना की निगरानी के लिए एक इंटरनेट ऑफ थिंग (IoT) आधारित स्मार्ट डिवाइस विकसित किया गया है। यह कैलोसोब्रुचस मैकुलैटस कीट के लार्वा और प्यूपा के विभिन्न चरणों की (100%) के लिए CO_2 की सांद्रता के आधार पर विकसित की गयी है। इसमें तीन सेंसर मॉड्यूल, एक नियंत्रण कक्ष, नियंत्रण वाल्व, एक कार्बन डाइऑक्साइड सिलेंडर और एक वितरण प्रणाली ($\pm 2\%$ CO_2) शामिल है। डेटा लॉगिंग एक वाई–फाई–कनेक्टेड डेटा–लॉगर द्वारा किया जाता है जो एक इंटरनेट प्रोटोकॉल पर स्टोरेज बिन के आंतरिक पर्यावरण डेटा को क्लाउड तक पहुंचाता है। विकसित प्रणाली का उपयोग थोक विक्रेताओं, खुदरा विक्रेताओं और घरेलू या सामुदायिक स्तर पर भंडारण एक डब्बा या डब्बों के समूह के साथ किया जा सकता है।

एक सौर–संचालित चरण परिवर्तन सामग्री (पीसीएम) आधारित फल और सब्जियों के लिए ठेला विकसित किया गया है। पीसीएम को फ्रीज करने के लिए पीवी आधारित सौर प्रणाली के साथ देला में इन–प्लेस चार्जिंग यूनिट (795 वाट) प्रदान की गई है। ठेला में नीचे की तरफ अतिरिक्त जगह के साथ दो क्विंटल उत्पादों को स्टॉक करने की क्षमता है। इसकी लागत लगभग 1 लाख रूपये हैं। सुखाने वाले कक्ष के पर्यावरण को नियंत्रित करने के लिए सेंसर आधारित स्मार्ट सोलर ड्रायर को प्रोग्राम किया गया है। एक लोड सेल सेंसर का उपयोग नमूने के वजन को मापने के लिए किया जाता है और तापमान सेंसर सुखाने के तापमान को नियंत्रित करता है। सेंसर के माध्यम से सुखाने वाले वातावरण के नियंत्रण के लिए एक एल्गोरिदम विकसित किया गया है और इसे और सिस्टम के साथ एकीकृत कर दिया गया है।

हरी मटर की फली से दाने निकालने की मशीन के संचालन को आसान बनाने और इसकी प्रभावकारिता को बढ़ाने के लिए एक मशीनीकृत गर्म पानी प्रीट्रीटमेंट यूनिट (80–90 लीटर क्षमताय खाद्य ग्रेड एसएस) विकसित किया गया है और इसे हरी मटर डिपोडर मशीन के साथ सिंक्रनाइज किया गया है। पीआईडी नियंत्रक (यूटीसी– 7204) और थर्मोकपल सेंसर का उपयोग प्रीट्रीटमेंट के लिए पानी के तापमान (70–85^{0}C) को नियंत्रित करने के लिए किया गया है।

छीले हुए लीची से गूदे को नुकसान पहुंचाए बिना बीज को निकालने के लिए एक यंत्रीकृत प्रणाली विकसित की गई है। इस प्रणाली में फीडिंग यूनिट, यू–आकार के फीड चौनलों का सेट, डी–स्टोनिंग टूल यूनिट,

विशेष रूप से डिजाइन किए गए फीड कप, बीज और गूदे को संग्रह करने वाले ट्रे शामिल हैं। यू–आकार के चौनल छिलके वाली लीची को फीड कप में व्यवस्थित रूप से रखने में प्रभावी होते हैं। नियंत्रित कंपन फीड कप में लंबवत अभिविन्यास में फीड करने के लिए यू आकार के चौनल में छीली हुई लीची को चिकनी गति प्रदान करते हैं।

दो छीले हुए लीची को एक साथ निकालने के लिए पैडल से चलने वाला बीज हटाने का उपकरण विकसित किया गया है। इसमें पैडल के दो सेट शामिल हैं, एक डी–स्टोनिंग के लिए और दूसरा डी–स्टोन्ड लीची पल्प को कलेक्शन ट्रे में छोड़ने के लिए। टूलसेट को दबाने के लिए पैडल का उपयोग हथेली से नीचे की ओर दबाने वाले टूलसेट की तुलना में अधिक सुविधाजनक है और संचालित करने में आसान है। उपकरण न्यूनतम क्षति (≤ 6–7%) के साथ एक मिनट में 6–8 छीले हुए लीची से बीज निकाल देता है।

संस्थान में गर्म हवा से मक्के के भुट्टे को सूखाने की 150 किलो क्षमता वाली मशीन बनायी गयी है और 1.815 x 0.912 x 2.80 (एल x डब्ल्यू x एच) आयाम वाले एक ड्रायर का परीक्षण किया गया है। ताजे कटे हुए मक्के के भुट्टे (छिलका के साथ) (नमीः 39.13 ± 2.09%) को मशीन में हाथ से डाला जाता है। वायुमंडलीय तापमान, 36.86 डिग्री सेल्सियस एवं सापेक्षिक आद्रता 51.37% पर 17–18% नमी तक सूखाने के लिए 60 डिग्री तापमान पर 24–27 घंटे तक रखा जाता है। ड्रायर की ताप उपयोग कारक (HUF) और थर्मल दक्षता क्रमशः 0.86–0.47 और 79.63 ± 1.54% है और बिजली की खपत 1.2 ± 0.3 kWh है।

सूखी मछली को मिट्टी के घड़े में स्वच्छ रूप से भरने के लिए एक प्रणाली विकसित की गई है। मिट्टी के बर्तन को एक धारक में रखा जाता है जो सूखी मछली के क्रमिक भरने के बाद संघनन को सक्षम करने के लिए केंद्रीय समर्थन के चारों ओर घूमता है। फीडिंग हॉपर को मिट्टी के कंटेनर में सूखी मछली की सही और नपी–तुली मात्रा में पहुंचाने के लिए डिजाइन किया गया है। घड़ों की बहुपरत भराव और सूखी मछली का संघनन हवा को हटा देता है और शिदोल तैयार करने के लिए आवश्यक आंशिक अवायवीय किण्वन की सुविधा प्रदान करता है।

भा.कृ.अनु.प.–सीफेट ने मछली की त्वचा से छिलके को आसानी से हटाने के लिए एक एर्गोनॉमिक रूप से डिजाइन किया हुआ, हल्का एवं आसानी से उपयोग करने वाला हस्त–चालित औजार विकसित किया है। यह पॉलीप्रोपाइलीन (पीपी) से बना है जिसके दोनों तरफ ब्रिसल्स लगे हुए हैं। इसके किनारों पर एवं बीच में अतिरिक्त ब्रिसल्स मछली की त्वचा से छिलके को आसानी से हटाने में मदद करता है। इसकी दक्षता 99.5% है।

बेसन में खेसारी दाल के पाउडर की मिलावट और इसकी मात्रा का पता लगाने के लिए केमोमेट्रिक्स के संयोजन से नियर इंफ्रा–रेड स्पेक्ट्रोस्कोपी पर आधारित एक भविष्यवाणी मॉडल विकसित किया गया है। मॉडिफाइड पार्शियल लीस्ट स्क्वायर (एमपीएलएस) रिग्रेशन का उपयोग एनआईआरएस भविष्यवाणी मॉडल के विकास के लिए किया गया है जिसमें निर्धारण का गुणांक (आरएसक्यू), आरएसक्यू (1–वीआर) का अनुमान, क्रॉस–सत्यापन (एसईसी) की मानक त्रुटियां और क्रॉस–सत्यापन (एसईसीवी) का मानक क्रमशः 0.999, 0.998, 0.922 और 1.422 है। क्रॉस सत्यापन और बाहरी सत्यापन के लिए भविष्यवाणी की मानक त्रुटि (एसईपी) क्रमशः 0.907 और 2.22 है। विकसित कैलिब्रेशन मॉडल को खेसारी के आटे के साथ मिलावटी बेसन के नमूनों की जांच के लिए प्रभावी ढंग से इस्तेमाल किया जा सकता है।

चने के आटे (बेसन) से मेटानिल येलो रंग की मिलावट का पता लगाने के लिए एक एफटीआईआर–आधारित गैर–विनाशकारी विधि विकसित की गई है। शुद्ध बेसन, शुद्ध मेटानिल येलो और मिलावटी नमूनों का एफटीआईआर स्पेक्ट्रा 400–4000 सेमी–1 की तरंग संख्या रेंज में क्षीण कुल प्रतिबिंब (एटीआर) मोड में प्राप्त किया जाता है। आंशिक न्यूनतम वर्ग प्रतिगमन (पीएलएसआर) मॉडल को अंशांकन और सत्यापन के लिए क्रमशः 0.9889 और 0.9424 के मान के साथ विकसित किया गया है।

रोहू मछली (लेबीओ रोहिता) के उप–उत्पादों (सिर, शल्क, फिन्स, एवं वायु थैली) से उच्च रक्त–चाप रोधी (एनजीओ–टेनसिन कन्वर्टिंग एंजाइम, ACE – अवरोधक) पेप्टाइड्स के निष्कर्षण के लिए एक एंजाइमेटिक प्रक्रिया विकसित की गई है। मछली के

उप–उत्पादों में मौजूद प्रोटीन को हाइड्रोलाइज करने के लिए एल्केलेज (बेसिलस लइकेनीफॉर्मिस से प्रोटीएज) का उपयोग किया गया और जैवसक्रिय पेप्टाइड को पाने के लिए प्रसंस्करण के विभिन्न मापदंडों की अनुकूलित मानक को ढूंढा गया। पेप्टाइड्स निकालने के लिए अनुकूलतम तापमान 52.1 डिग्री सेल्सियस और हाइड्रोलायसिस समय 129 मिनट पर 55% ACE रोधी जैवसक्रियता पायी गयी। इसका आणविक भार 3 kDa है।

अरहर की पिसाई से हर साल भूसी, चुन्नी और तोड़े के रूप में उप–उत्पादों की पर्याप्त मात्रा का उत्पादन होता है। इस उप–उत्पाद से फेनोलिक यौगिकों को निकालने के लिए एक प्रक्रिया विकसित की गई है। भूसी के अर्क की कुल फिनोल सामग्री 88.51 – 405.07 मिलीग्राम GAE/g की सीमा में पाई जाती है। फेनोलिक यौगिकों के निष्कर्षण के लिए अनुकूलित स्थितियां हैं: 45°C पर 40% इथेनॉल सांद्रता 4 घंटे का निष्कर्षण समय।

भैंस की त्वचा से कोलेजन हाइड्रोलिसेट्स की उपज और गुणवत्ता में सुधार के लिए एक एंजाइमेटिक (पपैन और ब्रोमेलैन) प्रक्रिया विकसित की गई है। जब भैंस की त्वचा के नमूनों को 0–50 इकाइयों के बीच 40 डिग्री सेल्सियस पर 3 घंटे के लिए पपैन एंजाइम के साथ ऊष्मायन किया जाता है तो एसडीएस–पेज एंजाइम की 30 इकाइयों में त्वचा प्रोटीन की अधिकतम गिरावट दर्शाता है। कोलेजन हाइड्रोलिसेट्स का आणविक भार वितरण 30 से 65 kDa है। 30 यूनिट और 50 यूनिट पैपेन और ब्रोमेलैन पर प्राप्त कोलेजन हाइड्रोलाइजेट फ्रैक्शंस ने उच्च एंटीऑक्सीडेंट क्षमता दिखाई है।

तेल रहित सोया मील से निकाले गए प्रोटीन के अवक्षेपण के लिए दो लैक्टोबैसिलस जीवाणु उपभेदों का उपयोग करके एक जैविक विधि विकसित की गई है। जैविक रूप से अवक्षेपित सोया प्रोटीन आइसोलेट्स (बीपीएसपीआई) को तेल रहित सोया मील से तैयार किया गया है। शुद्धता, उपज, प्रोबायोटिक गिनती, हल्कापन, सफेदी सूचकांक, और हाइड्रोलिसिस की डिग्री बीपीएसपीआई में काफी (पी $\leq$ 0.05) अधिक है। बीपीएसपीआई में कार्यात्मक गुण (घुलनशीलता, झाग क्षमता, जल बंधन क्षमता और फैलाव) अधिक होते हैं। परिणामों से पता चलता है कि बीपीएसपीआई के पास पारंपरिक रूप से तैयार एसिड अवक्षेपित सोया प्रोटीन आइसोलेट्स (एपीएसपीआई) की तुलना में बेहतर गुण हैं।

खेसारी (ग्रास मटर) आटा आधारित मफिन विकसित किया गया है जिसकी औसत समग्र स्वीकार्यता स्कोर (8.30 ± 0.50) संदर्भ नमूने (8.67 ± 0.6) के करीब है । इसी तरह, काले चने पर आधारित मफिन विकसित किए गए हैं जिनकी परिष्कृत गेहूं के आटे में 60% काले चने का बेसन समावेश स्तर पर संवेदी स्वीकार्यता है। अरहर आधारित प्रोटीन युक्त पास्ता कोल्ड एक्सट्रूजन तकनीक का उपयोग करके विकसित किया गया है। अरहर के आटे और सूजी (60:40) के साथ पास्ता के नमूने एक अच्छा संवेदी समग्र स्वीकार्यता स्कोर (7) दिखाते हैं। एक ट्विन एक्सट्रूडर मशीन का उपयोग करके उच्च एंथोसायनिन और पॉलीफेनोलिक सामग्री वाले पिगमेंटेड अनाज एक्सट्रूडेट्स को काले चावल, लाल चावल (ज्योति संस्करण), और पिगमेंटेड मक्का से विकसित किया गया है।

अन्य उत्पादों में रोहू मछली (लेबीओ रोहिता) के उप–उत्पादों (सिर, शल्क, फिन्स, और वायु थैली) से एंटी–हाइपरटेंसिव पेप्टाइड (55% एसीई अवरोध) को प्रोटीऐज एंजाइम का उपयोग करके विकसित किया गया है। कम वसा–उच्च फाइबर वाले मांस उत्पादों को खाद्य उद्योग के उप–उत्पादों का उपयोग करके विकसित किया गया है। कम वसा वाले उत्पाद 4% फाइबर स्तर पर उच्च संवेदी स्वीकार्यता दिखाते हैं। कोलेजन हाइड्रोलाइजेट (सीएच) को एंजाइम का उपयोग करके भैंस की त्वचा से तैयार किया गया है, जिसमें उच्च एंटीऑक्सीडेंट और कार्यात्मक गुणों के साथ कम आणविक भार पेप्टाइड्स होते हैं। सोया प्रोटीन आइसोलेट्स (बीपीएसपीआई) को माइक्रोबियल–असिस्टेड विधि का उपयोग करके डी–ऑयल सोया मील से तैयार किया गया है।

एआईसीआरपी–पोस्ट–हार्वेस्ट इंजीनियरिंग एंड टेक्नोलॉजी (पीएचईटी) ने विभिन्न मशीनें, उत्पाद और प्रक्रिया प्रोटोकॉल विकसित किए हैं, जैसे गीली लाल मिर्च के बीज निकालने वाला, बिना बाइंडर का उपयोग किए गन्ने की खोई से ब्रिकेट, डाइइलेक्ट्रिक गुणों के आधार पर केले को ग्रेड करने के लिए एक पोर्टेबल गैर–विनाशकारी उपकरण, कृषि उत्पादों में एफ्लाटॉक्सिन बी1 का तेजी से पता लगाने के ऑन–साइट लेटरल फ्लो डिवाइस, एचएयू सोलर पीवी मॉड्यूल असिस्टेड गन्ने का रस निष्कर्षण मशीन, नारियल को दूध का पाउडर, मोबाइल पोर्क कटिंग एवं डिस्प्ले–कम–सेलिंग यूनिट, केले के पत्तों का उपयोग करके मांस और मांस

उत्पादों की पैकेजिंग और ढोने के लिए पर्यावरण के अनुकूल पैकेजिंग सामग्री, ऑयल, फलों और सब्जियों के लिए स्ट्रीट वेंडिंग कार्ट, मसालों की कम तापमान पर पीसने की प्रक्रिया, पाउडर बनाने के लिए संशोधित एलो पॉलीसेकेराइड जेल का फोमिंग प्री–ट्रीटमेंट, वैक्यूम पैन, बाजरा डीहलर।

एआईसीआरपी पीईएएसईएम के उपलब्धियों में कृषि संरचनाओं और पर्यावरण प्रबंधन में प्लास्टिक इंजीनियरिंग ग्रीनहाउस के लिए सेंसर आधारित प्रकाश तीव्रता मीटर का विकास, शहरी और परिनगरीय आबादी के लिए रूफटॉप/टेरेस सब्जी पोषण उद्यान मॉडल का विकास पुनर्चक्रण, कृषि जल उत्पादकता में सुधार के लिए सेंसर नेटवर्क आधारित सिंचाई प्रणाली, कम लागत वाला पानी उठाने वाला उपकरण, मिनी ट्रैक्टर संचालित प्लास्टिक मल्च बिछाने की मशीन, मछली और पौधों के बायोमास उत्पादन के लिए आर्थिक रूप से व्यवहार्य और किसान के अनुकूल एक्वापोनिक सिस्टम, भेड़ या बकरी के बच्चों के बेहतर पालन के लिए पोर्टेबल प्लास्टिक संलग्नक गर्म और शुष्क क्षेत्र में पॉलीहाउस के अंदर चयनित सब्जियों की खेती में अधिकतम ऊर्ध्वाधर स्थान उपयोग के लिए रणनीतियां, चरण परिवर्तन सामग्री आधारित असेंबल प्रकार के फल पकने का कक्ष, कोंकण क्षेत्र में सब्जी उत्पादन के लिए लागत प्रभावी मिट्टी रहित खेती प्रणाली आदि।

संस्थान ने 2020 में लगभग चौवन लाख बयासी हजार (54.82 लाख) रुपये का राजस्व उत्पन्न किया। संस्थान के वैज्ञानिकों को कटाई उपरांत प्रौद्योगिकी के क्षेत्र में अनुसंधान और विकास में उनके योगदान के सम्मान में कई मौखिक/पोस्टर प्रस्तुतिकरण पुरस्कार सहित अन्य पुरस्कार और सम्मान मिला। संस्थान के वैज्ञानिक भारतीय खाद्य संरक्षा एवं मानक प्राधिकरण (FSSAI) सहित विभिन्न समितियों और पैनलों के सदस्य हैं। वर्ष 2020 के दौरान दस प्रौद्योगिकियों को लाइसेंस दिया गया जिसमें वडी बनाने की मशीन, हाथ की सफाई के लिए नो–टच स्वचालित डिस्पेंसर, पोर्टेबल स्मार्ट पराबैंगनी–सी कीटाणुशोधन प्रणाली (यूवीआईसी), ओजोन आधारित फल और सब्जी वॉशर–कम–प्यूरिफायर (ओजो–सी), मखाना खीर मिश्रण बनाना, गुलाब की पंखुड़ी से जैम तैयार करने की प्रक्रिया, वसा रहित स्वादयुक्त मखाना बनाने की प्रक्रिया, माइक्रोकैप्सूल के उत्पादन के लिए उपकरण, कच्चे मखाने के बीज को प्राथमिक भूनने के लिए यंत्रीकृत प्रणाली और उसकी प्रक्रिया, और अल्कोहल युक्त पेय तैयार करने की प्रक्रिया, किन्नू के छिलकों के न्यूट्रास्युटिकल गुण तैयार शामिल हैं। प्रौद्योगिकी लाइसेंसिंग से वर्ष 2020 में 4,75,000 रुपये का राजस्व प्राप्त हुआ। इस वर्ष के दौरान छह पेटेंट दिए गए और तीन नए दायर किए गए। हमारे पोस्ट–हार्वेस्ट मशीनरी एंड इक्विपमेंट टेस्टिंग सेंटर ने देश के विभिन्न हिस्सों से 11 मशीनों का परीक्षण किया, जिससे लगभग चौदह लाख ग्यारह हजार रुपये (14.11 लाख रुपये) की कुल कमाई हुई। रिपोर्ट की गई अवधि के दौरान, कुल 450 प्रतिभागियों को उद्यमिता विकास कार्यक्रमों (ईडीपी), किसानों के प्रशिक्षण और संवेदीकरण कार्यक्रमों के माध्यम से कृषि और पशुधन उपज के कटाई के बाद प्रबंधन के लिए प्रशिक्षित किया गया। इस अवधि के दौरान कुल 57 छात्रों को फसल कटाई के बाद इंजीनियरिंग और प्रबंधन के क्षेत्र में प्रशिक्षित किया गया। संस्थान ने विभिन्न कृषि प्रदर्शनियों और मेलों जैसे की बिजनेस इनक्यूबेटर कॉन्क्लेव, सीआईआई एग्रीटेक साउथः पीजेटीएसएयू, पूसा कृषि विज्ञान मेला, इंडिया इंटरनेशनल फूड एंड एग्री वीक 2020 आदि में भी भाग लिया। उच्च गुणवत्ता वाली राष्ट्रीय और अंतर्राष्ट्रीय जर्नल और पत्रिकाओं में 40 से अधिक शोध पत्र प्रकाशित हुए। संस्थान के अन्य प्रमुख प्रकाशनों में संग्रह, पुस्तक, पुस्तक अध्याय, लोकप्रिय/तकनीकी लेख, तकनीकी बुलेटिन, वार्षिक रिपोर्ट, समाचार पत्र और पत्रक शामिल हैं।

जय जवान, जय किसान
जय विज्ञान, जय अनुसंधान

Executive Summary

ICAR-CIPHET is a pioneer organization entrusted to undertake lead research in the area of post-harvest engineering and technology suitable to agriculture production catchment and agro-processing industries. During the reported period (2020), the institute has made significant progress in major areas of post-harvest engineering & technology including post-harvest equipment and machinery, agricultural structures, products and process protocols, food quality and safety, transfer of research findings through technology licencing, trainings, capacity building and extension activities. The institute executed its multidisciplinary research through various in-house and externally funded projects. The significant achievements marked during the year 2020 are presented below:

ICAR-CIPHET has developed machines/ systems to help the nation fight against the ongoing COVID-19 pandemic. In this context a portable smart ultraviolet-C disinfection system (UV*i*C) has been developed to disinfect personal items and office stationery. The working capacity of the unit in terms of the total surface area of the objects to be treated is 25×25 cm^2. The estimated cost of the unit is approximately Rs. 1500.

A low-cost portable ozone-based fruits and vegetables washer-cum-purifier (Ozo-C) has been developed to disinfect fruits and vegetables at house-hold level. The system works on the principle of the silent corona discharge method. This device is economical with a unit cost of Rs. 3500.

An IoT-based smart device for monitoring of storage structure (one tonne) for pulses has been developed based on the concentration of CO_2 for effective killing (100% mortality) of larval and pupal stages of *Callosobruchus maculatus* insect. It includes three sensor modules, a control panel, control valves, a carbon dioxide cylinder, and a distribution system (±2% CO_2). The data logging is performed by a Wi-Fi-connected data-logger that transmits internal environmental data of the storage bin over an internet protocol to a cloud. The developed system can be used for a single or battery of storage bins by wholesalers, retailers, and also at the domestic or community level.

A solar-operated phase change material (PCM) based fruits and vegetables vending pushcart has been developed. The cart is provided with an in-place charging unit (795 W) with PV based solar system for freezing of PCM. The cart has two quintal capacity to stock products with additional space at the bottom. The cost of the system is approximately Rs. 1 lakh.

Sensors based smart solar dryer has been programmed to control the environment of the drying chamber. A load cell sensor is used to measure the weight of the sample and the temperature sensor controls the drying temperature. An algorithm for control of the drying environment through sensors has been developed and integrated with the system.

A mechanized hot water pretreatment unit ((80-90 L capacity; food-grade SS) has been developed and synchronized with a green pea depoder machine to improve the efficacy and ease in operation of green pea pod shelling. The PID controller (UTC-7204) and thermocouple sensors are used to control the temperature of the water (70-85°C) for pretreatment.

A mechanized system has been developed for the removal of seed from peeled litchi without damaging the pulp. The system comprises of feeding unit, set of U-shaped feed channels, de-stoning tool unit, specially designed feed cups,

seed and pulp collection trays. The U-shaped channels are effective in the systematic feeding of peeled litchi in feed cups. The controlled vibrations offer smooth movement of peeled litchi in U shaped channel to feed in a vertical orientation in feed cups.

The pedal-operated seed removing tool has been developed for simultaneous de-stoning of two peeled litchis. It comprises two sets of pedals one for de-stoning and other for dropping the de-stoned litchi pulp in the collection tray. The use of pedals to press the toolsets is more convenient, easy to operate as compared to pressing toolsets downward with hand/ palm. The tool removes the seed from 6-8 peeled litchis in a minute with minimum damage (d" 6-7%) to the pulp.

A hot air maize cob dyer having overall dimensions (L×W×H) of 1.815×0.912×2.80 with 150 kg capacity has been tested. The freshly harvested maize cobs (with husk) having a moisture content of 39.13±2.09% (wet basis) are loaded manually into the dryer. The drying is carried out at 60 °C and it takes 24-27 h to reach the final moisture content of 17-18% (wet basis) at the atmospheric temperature (36.86 °C) and RH (51.37%). The dryer has heat utilization factor (HUF) and thermal efficiency of 0.86-0.47 and 79.63±1.54%, respectively, with electricity consumption of 1.2 ± 0.3 kWh.

A system has been developed for compacting the dry fish hygienically into an earthen container. The earthen pot is placed in a container holder that rotates around central support to enable sequential filling of dry fish followed by compaction. The feeding hopper is designed to deliver a metered amount of dried fish into the earthen container. The multilayer filling of containers and compaction of dry fish removes the air pockets and facilitates the partial anaerobic fermentation required to prepare *Shidol*.

ICAR-CIPHET has developed an ergonomically designed easy-to-handle lightweight hand tool for easy removal of scales from fish skin. It is made of polypropylene (PP) with bristles on both sides. Additional side bristles on the edges of the hand tool help to remove scales efficiently from the belly parts and narrow areas in between the fins. The cleaning efficiency of the hand tool is 99.5%.

A prediction model based on near infra-red spectroscopy in combination with chemometrics has been developed for detection and quantification of khesari dal flour adulteration in *besan*. Modified partial least squares (MPLS) regression has been used for the development of the NIRS prediction model that has coefficient of determination (RSQ), an estimate of RSQ (1-VR), standard errors of cross-validation (SEC) and standard error of cross-validation (SECV) of 0.999, 0.998, 0.922 and 1.422, respectively. Standard error of prediction (SEP) for cross validation and external validation is 0.907 and 2.22, respectively. The developed calibration model can be effectively used for the screening of the adulterated besan samples with khesari flour.

An FTIR-based non-destructive method for the detection of metanil yellow dye from chickpea flour (*besan*) has been developed. FTIR spectra of pure besan, pure metanil yellow, and adulterated samples are acquired in Attenuated Total Reflectance (ATR) mode in the wavenumber range of 400-4000 cm^{-1}. Partial least square regression (PLSR) model has been developed with R^2 value of 0.9889 and 0.9424 for calibration and validation, respectively.

An enzymatic process has been developed for the extraction of ACE-inhibitory peptides from Rohu fish (*Labeo rohita*) by-products (head, scales, fins and trimmings). Alcalase (Protease from *Bacillus licheniformis*) is used to hydrolyze the protein present in the fish by-

products. The optimum hydrolysis time is 129 minutes at 52.1 ºC to extract peptides with 55% ACE inhibition. Molecular weight of peptides is <3kDa.

The milling of pigeon pea annually produces a substantial quantity of by-products in form of husk, *chuni* and brokens. A process has been developed to extract phenolic compounds from this by-product. The total phenol content of husk extracts is found in the range of 88.51 - 405.07 mg GAE/g. The optimized conditions for extraction of phenolic compounds are: 40% ethanol concentration, 4 h extraction time at 45 °C.

An enzymatic (papain and bromelain) process has been developed to improve the yield and quality of collagen hydrolysates from buffalo (*Bubalus bubalis*) skin. SDS-PAGE shows maximum degradation of skin protein at 30 units of enzymes when buffalo skin samples are incubated with papain enzyme between 0-50 units at 40 ºC for 3 h. The molecular weight distribution of collagen hydrolysates is from 30 to 65 kDa. The collagen hydrolysates fractions obtained at 30 units and 50 units of papain and bromelain have shown higher antioxidant potential.

A biological method has been developed using two lactobacillus bacterial strains for the precipitation of extracted proteins from de-oiled soy meal. The biologically precipitated soy protein isolates (BPSPIs) have been prepared from de-oiled soy meal. The purity, yield, probiotic count, lightness, whiteness index, and degree of hydrolysis are significantly (pd"0.05) higher in BPSPIs. Functional properties (solubility, foaming capacity, water binding capacity, and dispersibility) are higher in BPSPIs. The results show that BPSPIs possess better properties over conventionally prepared acid precipitated soy protein isolates (APSPIs) and thus can be further explored for the development of novel and functional protein-based products.

Grass pea (*Khesari)* flour-based muffins have been developed with a mean overall acceptability score of 8.30±0.50 in comparison to 8.67±0.6 of the reference sample. Similarly, black gram-based muffins have been developed that have sensory acceptability at 60% black gram flour incorporation level in refined wheat flour. Pigeon pea-based protein-rich pasta has been developed using the cold extrusion technique. Pasta samples with pigeon pea flour and semolina (60:40) show a good sensory overall acceptability score of 7. Pigmented cereal extrudates with high anthocyanin and polyphenolic contents have been developed from black rice, red rice (*Jyothi* var.), and pigmented maize using a twin extruder machine. Low-fat, high-fibre meat products have been developed using food industry by-products as a source of fat replacer and fibres. The low-fat products show higher sensory acceptability at 4% fibre level. Anti-hypertensive peptide (55% ACE inhibition) from Rohu fish (*Labeo rohita*) by-products (head, scales, fins, and swim bladder) has been developed using protease enzyme. Collagen hydrolysate (CH) has been prepared from buffalo skin using enzyme treatment, which has low-molecular weight peptides with higher antioxidant and functional properties. Soy protein isolates (BPSPIs) have been prepared from de-oiled soy meal using a microbial-assisted method.

The AICRP on Post-Harvest & Technology (PHET) has developed various machines, products and process protocols namely wet red chilli seed extractor, briquettes from sugarcane bagasse without using binder, a portable non-destructive device to grade banana based on dielectric properties, a lateral flow device for the on-site, rapid detection of aflatoxin B1 in agricultural produce, HAU solar PV module assisted sugarcane juice extraction machine, coconut milk powder, mobile pork cutting, display cum selling unit, eco-friendly packaging material using banana leaves for packaging and hauling of meat and meat products, neat's foot

oil, street vending cart for fruits and vegetables, process for low temperature grinding of spices, foaming pre-treatment of modified aloe polysaccharide gel for powder formation, vacuum pan, small millets dehuller.

The achievements of AICRP on Plastic Engineering in Agriculture Structures & Environment Management (PEASEM) included development of sensor based light intensity meter for greenhouse, rooftop/terrace vegetable nutrition garden model for urban and peri-urban population using soil-less, UV filter for nutrient recycling, sensor network based irrigation system for improving agricultural water productivity, low cost water lifting device, mini tractor operated plastic mulch laying machine, economically viable and farmer friendly aquaponic systems for fish and plant biomass production, portable plastic enclosure for improved kid/lamb rearing, strategies for maximum vertical space utilization in growing of selected vegetables inside polyhouse in hot and arid region, phase change material based assembled type fruit ripening chamber, cost-effective soilless cultivation system for vegetable production in konkan region etc.

In 2020, our institute generated a revenue of around rupees fifty four lakhs eighty two thousand rupees (Rs. 54.82 lakh). ICAR-CIPHET also utilized 99.57% of budget with respect to allocation under plan RE 2020-21.

Our scientists were conferred with many awards and honours (including oral/poster presentation award) in recognition of their contributions in research and development in post-harvest sector. Our scientists are members of various committees and panels including FSSAI.

Ten technologies were licensed during 2020 which include wadi making machine, no-touch automatic dispenser for hand sanitization, portable smart ultraviolet-C disinfection system (UViC), ozone-based fruits and vegetable washer-cum-purifier (Ozo-C), ready to constitute makhana kheer mix, process for preparation of rose petal jam, process for preparation of fat free flavoured makhana, apparatus for production of microcapsules, mechanized system for primary roasting of raw makhana seeds and process thereof, and process for preparation of alcoholic beverage with nutraceutical properties from kinnow peels. The technology licensing generated a revenue of Rs. 475000 during the year. Six patents were granted and three were filed during 2020.

Our Post-Harvest Machinery and Equipment Testing Centre (PHMETC) tested 11 machines from different parts of the country, earning a total revenue of fourteen lakhs eleven thousand rupees approximately (Rs. 14.11 lakhs).

During the reported period, total of 450 participants were trained for post-harvest management of agricultural and livestock produce through entrepreneurship development programs (EDP), farmers' trainings, and sensitization programmes. A total of 57 students were trained during this period in the area of post-harvest engineering and management. We also participated in different exhibitions and melas such as Agri. Business Incubator's Conclave, CII Agritech South: PJTSAU, Pusa Krishi Vigyan Mela, India International Food and Agri Week 2020 etc.

More than 40 research papers were published in high quality national and international peer reviewed journals. The other major publications of the institute include Compendiums, Book, Book chapters, Popular/Technical Articles, Technical Bulletins, Annual Reports, Newsletters, and Leaflets.

OUR VISION

Achieving near zero post-harvest losses and high level of processing of agricultural commodities through excellence in research.

OUR MISSION

Evolving efficient post-harvest engineering and technological interventions to enhance farmers' income by transforming farmers and rural youth into entrepreneurs, providing products with quality and safety assurance to consumers, addressing environmental protection issues as well as acting as referral point for policy inputs, defining standards and networking with sister organizations to harness synergies for solving problems in post-harvest sector.

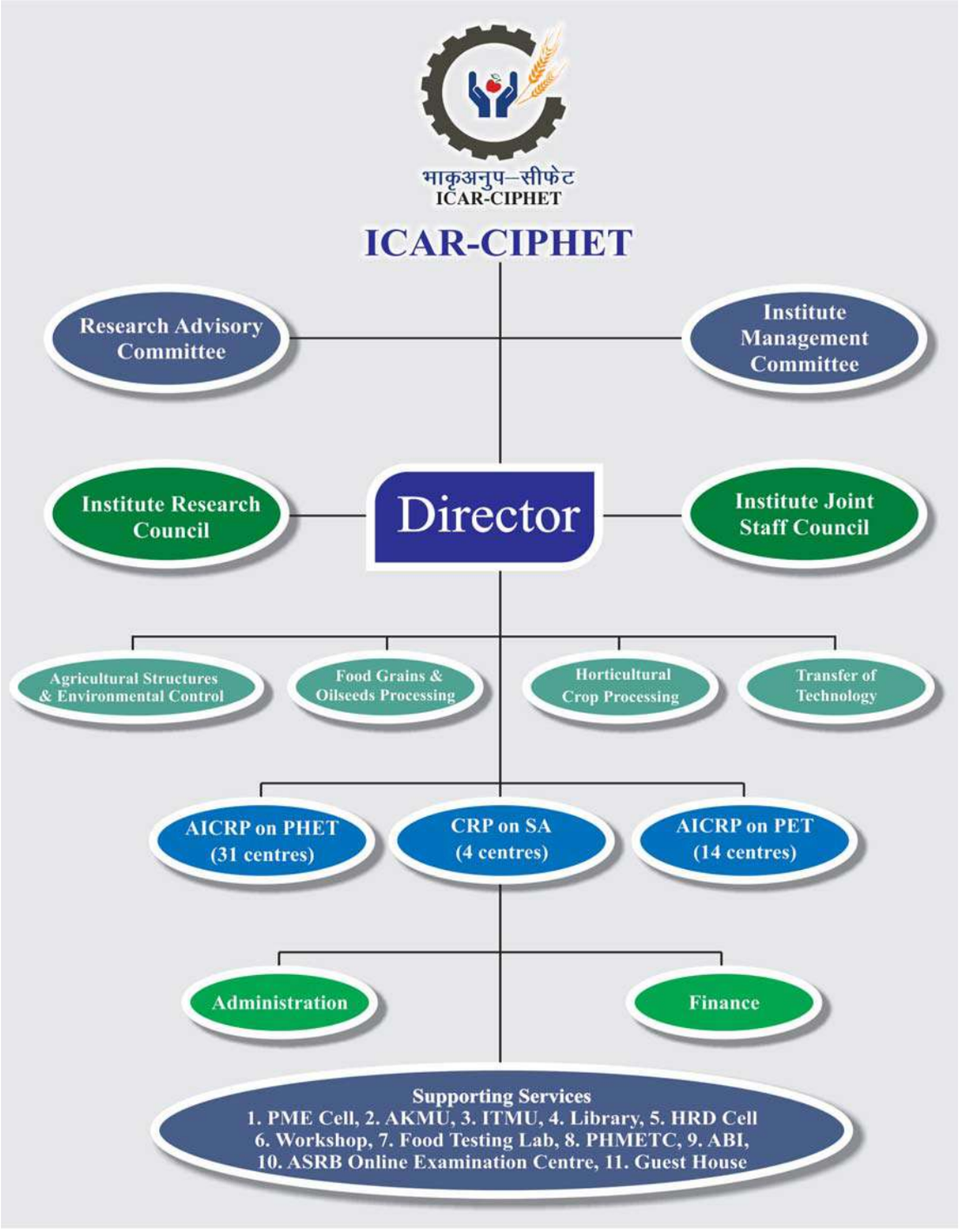
Higher profitability of agricultural production systems ensuring better income to farmers and increased employment opportunities in rural sector through efficient post-harvest engineering and technological interventions for loss reduction and value addition to agricultural produce and by-products resulting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

Mandates

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

- Human resource and entrepreneurship development in post-harvest engineering and technology.

Organizational Structure



Overview

ICAR-Central Institute of Post-Harvest Engineering and Technology (ICAR-CIPHET) was established on 03 October 1989 at PAU Campus, Ludhiana, Punjab, India. It is a nodal institute that undertakes lead researches in the area of the post-harvest engineering and value addition technologies appropriate to agricultural production catchments and agro-processing industries. Another campus of the Institute was established on 19 March 1993 at Abohar, Punjab, India, that is primarily responsible to undertake research and development activities for processing and value addition of fruits, vegetables and commercial crops. ICAR-CIPHET is also headquarters of two All India Coordinate Research Projects (AICRPs) *viz*. AICRP on Post-Harvest Engineering and Technology (PHET) with 31 Centres and AICRP on Plastic Engineering in Agriculture Structures & Environment Management (PEASEM) with 14 Centres across the country. ICAR-CIPHET is the only institute in India which works entirely on applied post-harvest technology and value addition of all commodities for farmers, orchardists, rural youth and entrepreneurs directly as well as generates basic knowledge by taking various basic and strategic research projects in the mandated areas. At present the institute has four divisions: 1. Food Grains and Oilseeds Processing 2. Agricultural Structures and Environmental Control 3. Transfer of Technology and 4. Horticultural Crop Processing (Abohar). The Institute has developed nearly 120 technologies containing several equipment for food processing, structures for safe handling and shelf-life enhancement of farm produce, process protocols for value added products, novel products and technologies for farmers and processors. Out of theses developed technologies, 65 technologies have been licensed/ commercialized to about 143 entrepreneurs/end users. The technologies developed by ICAR CIPHET helped the farming community in reduction in post-harvest losses, value addition to the farm produce, development of functional foods and food safety through interventions in the arena of protected cultivation, threshing, milling, processing, improved storage, preservation, non-destructive quality evaluation, enhancement of shelf life for crops and livestock produce and by-product utilization. These technologies have helped the relevant stakeholders in augmenting the income and employment generation. ICAR-CIPHET has filed 66 patents out of which 15 have been granted to its credit. ICAR-CIPHET has established Food Testing Laboratory, Agri-Business Incubation Centre, and Post-Harvest Machinery and Equipment Testing Centre.

Infrastructure

Workshop

The workshops at ICAR-CIPHET, Ludhiana and Abohar manage fabrication and modification of post-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/ equipment such as lathe machines, drilling machines, gas welding set, arc welding set, sheet bending machine etc. to deliver their services. Besides, various measuring instruments are also available in the workshops, which are useful in day to day research work.

Agro Processing Centre (APC)

Agro-processing centre 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, modest agro-processing centre has been established for processing of bengal gram, green gram, pigeon pea, maize, black pepper, turmeric, coriander etc. The processed products are being regularly sold to customers in and around ICAR-CIPHET. Besides, the APC facilities are also used to impart training to potential small rural entrepreneurs.

Food Testing Laboratory

The well-equipped Food Testing Laboratory funded by Ministry of Food Processing Industries (MoFPI) has been established. The laboratory houses basic and some of the semi advanced equipment 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. 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 of processers, entrepreneurs, small and medium enterprises and industry at reasonable testing charges.

Library

ICAR- CIPHET library plays an important role and act as a centre for knowledge and information related to the Institute's mandate. It has a good collection of books and journals in the area of post-harvest engineering, food processing, engineering, microbiology, biochemistry, biotechnology etc. During the reported year, the total number of books and standards in the library were 5265. The library as a member of consortium for e-Resources in Agriculture (CeRA) is getting access to online full text journals and e-books. In addition of these, a number of national and international serial, publications, annual reports, newsletters and research bulletins were received on gratis. Current content service of journals and list of new arrivals is also being circulated among the ICAR-CIPHET staff. Library received one Punjabi, two Hindi and three English Newspapers namely Ajit, Dainik Jagran, Amar Ujala, Hindustan Times, The Tribune and The Economic Times, respectively and also received Frontline and India Today magazine (both Hindi and English).

Guest House

Both Ludhiana and Abohar campus has guesthouse facilities for providing accommodation to ICAR/SAUs/Government employees and farmers. One International

Training Centre with 08 AC-rooms and dining hall with kitchen is also available at Ludhiana campus.

Units

Prioritization, Monitoring and Evaluation (PME) Cell

Prioritization, Monitoring and Evaluation concept is the key management tool in R&D system to enhance scientific productivity. It helps in setting a unified priority and monitoring of externally funded and in house projects. PME cell of the institute conducts Institute Research Council meeting and maintains the record of research projects. The monthly and quarterly reports of individual scientist are collected and compiled into progress reports, results framework document, quarterly and half yearly performance review reports. It also acts as link between various regional committee meetings, directors' conferences etc. and the institute scientists. The exchange of information takes place through PME cell. The database of parliament questions and their answers, action taken reports and issues related to scientific activities of the institute are dealt by PME cell. 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 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 66 patent applications have been filed through ITMU out of which 15 patents have been granted. Vigorous efforts of ITMU lead to commercialization of 65 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 twenty two desktop computers including two servers. More than 125 desktop computers of the institute are well connected through Local Area Network. During this year, AKMU has purchased nine computers, four colour printers, four mono printers, five Inverters, one 3 KVA online UPS and ten 1 KVA offline UPS. Wi-Fi connectivity is available through 300 MBPS Optical fibre based broadband line provided by BSNL, Ludhiana. AKMU has a number of analysis & design software such as SAS, Adobe Photoshop CS6, Corel Draw 2021, Adobe Premier Pro with Creature Cloud Apps. The Institute's website www.ciphet.in is also being maintained by AKMU. Besides this, AKMU provides assistance in software application in different research works, internet browsing, software and computer hardware support and assistance in online patent search through various databases.

Post-Harvest Machine and Equipment Testing Centre (PHMETC)

The Post-Harvest Machine and Equipment Testing Centre (PHMETC), ICAR-CIPHET, Ludhiana is approved by Mechanization & Technology Division, Department of Agriculture

& Cooperation, Ministry of Agriculture and Farmers' Welfare, Govt. of India. The institute is authorized for testing of all types of post-harvest equipment and machinery to ensure supply of quality post-harvest equipment & machinery by processing equipment & machinery manufactures to the end users. This is a unique facility in the country available at ICAR-CIPHET for testing of post-harvest technology equipment & machinery. Purpose of establishment of "PHMETC" at ICARCIPHET, Ludhiana (Punjab) is to provide platform and develop confidence in PHT machine and equipment manufacturers and also buyers / entrepreneurs who is going to start his business. PHMETC at ICAR-CIPHET is testing all machines related to processing of agricultural and allied produces.

All India Co-ordinated Research Projects (AICRP) on Post-harvest Engineering and Technology (PHET)

The All India Coordinated Research Project on Post-Harvest Engineering and Technology was launched by the Indian Council of Agricultural Research in September 1972. The Project is currently operating at 31 centres covering almost all the states and agro-climatic zones of the country. The aim is to develop location and crop specific post-harvest technologies and equipment to minimize quantitative and qualitative post-harvest losses and to produce value added products from agricultural crops including livestock and their by-products. The major activities are: (i) Adoption/development of equipment/technologies for reduction in post-harvest losses during critical stages/operations, (ii) Development of need based agro-processing centres (APCs) in different production catchments for income augmentation and employment generation, (iii) Value added products from agricultural crops/commodities, (iv) Prototype development and process refinement with a view to develop complete packages for post-harvest utilization of crops/ commodities and their by-products, (v) Multilocation trials and demonstrations of the post-harvest technologies.

All India Co-ordinated Research Projects (AICRP) on Plastic Engineering in Agriculture Structures & Environment Management (PEASEM)

AICRP on Plasticulture Engineering & Technology (PET) has been renamed as Plastic Engineering in Agriculture Structures & Environment Management (PEASEM). The project became operational in the year 1988 (VII Plan) by the name of AICRP on Application of Plastics in Agriculture (APA). The project is operative at 14 centers including six ICAR Institutes, seven SAUs and one CAU. The project has contributed in the development and modification of plasticulture technology in the area of water harvesting and management, surface cover cultivation, irrigation systems, plastic mulching, animal shelters, aquaculture technology and use of plastics in farm tools, machinery, post-harvest handling and packaging processes. The scheme has very good impact in farmers field particularly due to enhanced income per unit are of land and substantial saving inputs like water, fertilizer and manpower.

Staff Position

(31 December, 2020)

Category	Sanctioned	Filled		Total Filled	Vacant
		Ludhiana	Abohar		
Director (RMP Post)	**01**	01		01	00
Scientific	**76**	34	06	40	36
Administrative	**21**	14	03	17	04
Technical	**29**	18	07	25	04
Supporting	**03**	02	01	03	00
Total (Institute)	**130**	**68**	**17**	**86**	**44**

Statement of Budget Estimates and Expenditure 2020

ICAR-CIPHET **(Amount in Lakh)**

Approved allocation Plan RE (2020-21)	Total Remittance Plan (2020-21)	Total Expenditure	% Utilization with respect to allocation under Plan RE 2020-21	% Utilization with respect to remittance
1901 (2.10 Surrendered) 1898.90	1901 (2.10 Surrendered) 1898.90	1890.64	99.57	99.57

AICRP-PHET **(Amount in Lakh)**

Approved allocation Plan RE (2020-21)	Total Remittance Plan (2020-21)	Total Expenditure	% Utilization with respect to allocation under Plan RE 2020-21	% Utilization with respect to remittance
2347.15	2347.15	2344.54	100	100

AICRP-PET **(Amount in Lakh)**

Approved allocation Plan RE (2020-21)	Total Remittance Plan (2020-21)	Total Expenditure	% Utilization with respect to allocation under Plan RE 2020-21	% Utilization with respect to remittance
410.61	410.61	410.53	99.98	99.98

CRP-SA **(Amount in Lakh)**

Approved allocation Plan RE (2020-21)	Total Remittance Plan (2020-21)	Total Expenditure	% Utilization with respect to allocation under Plan RE 2020-21	% Utilization with respect to remittance
92.70	92.70	92.70	100	100

Revenue Generation

Revenue generation for the year 2020 is Rs. 54.82 lakhs.

Research Highlights

1. Machineries/Process/Products Developed by ICAR-CIPHET

1.1. Machineries Developed by ICAR-CIPHET

1.1.1. Portable smart ultraviolet-C disinfection system (UV*i*C)

Portable smart ultraviolet-C disinfection system (UV*i*C) was developed to help the nation fight against the ongoingball COVID-19 pandemic. In general, it is not feasible to disinfect each paper, file, and similar items using chemical sanitizers. Hence, the UV*i*C system was developed to disinfect personal items and office stationery using ultraviolet-C (UV-C) technology which does not leave a chemical residue. UV-C technology disinfects the surface of an object by destroying nucleic acid (DNA) of microorganisms available on the surface. The working capacity of the unit in terms of the total surface area of the objects to be treated is 25×25 cm^2. The estimated cost of the unit is approximately Rs 1500. ICAR-CIPHET Ludhiana has granted the license of this technology to three firms/entrepreneurs. One of the licensee M/s CRD Invotech, Maharashtra has started the manufacturing of this unit at the commercial level and the system is now available on various online shopping platforms like Amazon.

Fig. 1. Portable Smart UV-C Disinfection System (UV*i*C) available at amazon.in (Courtesy: M/s CRD Invotech, Maharashtra-Licensee)

1.1.2. Low cost portable ozone fruits and vegetable washer-cum-purifier (Ozo-C)

Keeping in view the present grim situation of Covid-19, ICAR-CIPHET, Ludhiana has developed a portable fruits and vegetable washer-cum-purifier (Ozo-C) which is based on ozone technology. The system works on the principle of silent corona discharge method. It uses electric discharge to produce ozone by splitting the normal oxygen molecules in the air into single atoms. These atoms recombine to form ozone (O_3). This device is economical with a unit cost of Rs. 3500. The technology has been licensed to various firms/entrepreneurs.

Fig. 2. Portable Ozone Fruits and Vegetable Washer-Cum-Purifier (Ozo-C)

1.1.3. Fish Descaling Hand-Tool

ICAR-CIPHET has developed a hand-tool for easy removing of scales from fish skin. It is an ergonomically designed easy-to-handle

Individual (interior) | Bulk | Individual (exterior)

Fig. 3. Fish descaling hand-tool: individual (interior), bulk and individual (exterior)

hand tool with light weight that can be used for fish retailers. It is made of polypropylene (PP) with bristles (2.0 mm thick, 10 mm long for big size fish and 2.0 mm thick, 3.0 mm long for smaller fish) on both sides. Additional side bristles on edges of the hand-tool help removing scales efficiently from the belly parts and narrow areas in between the fins. It is more hygienic than traditional hand-made tool made from wooden plank and common iron nails leading to discomfort in holding, injury to the handlers, difficulties in cleaning, less durability. The cleaning efficiency of hand tool is 99.5%.

1.1.3. IoT-based fumigation system using carbon dioxide for storage of pulses

A need was felt to develop automated monitoring system for safe storage of pulses by applying some green technology based pest-control system. A protocol for carbon dioxide fumigation was developed after treating four life stages of Callosobruchus at different CO_2 concentrations and residence times. The observations of insect mortality are given in Fig 1.

The stored green gram was infested with eggs, larvae, pupa and adult of Callosobruchus. CO_2 gas was injected at different concentrations, 5, 10, 15, 20, 30, 40, 50, 60 % for 18, 24, 48, 72 and 96 h with three replications for each life stage. At 5 % concentration of carbon dioxide for residence time of 24 h, 100% mortality of adult Callosobruchus maculatus insect was achieved. Similarly, at 40% concentration of Carbon dioxide for residence time of 72 h, 100% mortality of eggs of Callosobruchus maculatus was achieved. 50% concentration of Carbon dioxide for residence time of 48 h achieved 100% mortality of the larval stage of Callosobruchus maculatus insect. 60% concentration of Carbon dioxide for residence time of 96 achieved 100% mortality of the pupal stage of Callosobruchus maculatus insect. However, there was no significant effect on the quality of the green gram after fumigation and storage.

Subsequently, an IoT -based smart storage structure for pulses was developed based on the developed protocol. The system was initially tested for a small scale model bin and then replicated on one-tonne storage bin. It

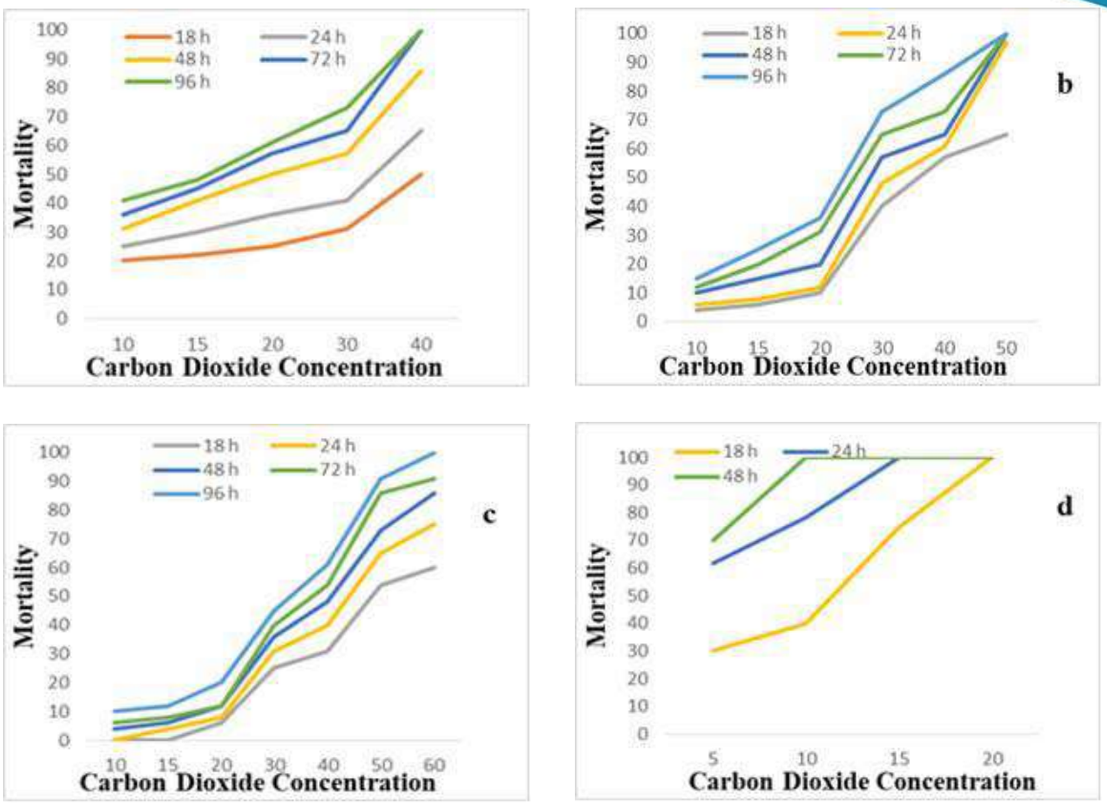


Fig. 4. Mortality of (a) eggs, (b) larva, (c) pupa and (d) adult stages of *Callosobruchus* at different CO_2 concentration and residence time

Fig. 5. IoT-based Smart Storage Structure for Pulses with Sensor module, HMI display for monitoring fumigation parameters from cloud and control panel

includes three sensor modules (Fig 2), control panel, control valves, carbon dioxide cylinder, and distribution system. Each sensor module has a carbon dioxide sensor, temperature & RH sensor, and a display unit, and one among the three modules has an oxygen sensor also. These sensor modules are positioned at three depths of one-tonne storage bin for monitoring and measurement of different parameters. The supply of CO_2 is regulated by a control panel which consists of a Controller Card, SMPS, Solid State Relay, Solenoid valve, and HMI LED display.

The data logging is performed by a Wi-Fi-connected data-logger that transmits internal environmental data of storage bin over an internet protocol to a cloud. This data can be accessed from any remote location either through a PC or any smart phone device for on-site decision making. The carbon dioxide concentration and residence time can be set at any value in the developed programme from HMI. The system was observed to maintain the concentration with an accuracy of ±2 percent. The developed system can be used for a single or battery of storage bins by wholesalers, retailers and also at domestic or community level.

1.1.4. Compression machine for fermented fish product, *Shidol*

A machine prototype has been developed for compacting the dry fish into an earthen container. The earthen pot is placed in container holder that rotates around a central support to enable sequential filling of dry fish followed by compaction. The feeding hopper is designed to deliver a metered amount of dried fish into the earthen container. The multilayer filling of containers and compaction of dry fish removes the air pockets and facilitates the partial anaerobic fermentation required to prepare *Shidol*. The machine is designed to mechanize the hygienic method for preparation of *Shidol*. (traditional food of NE India). Trials of different parameters are underway.

Fig. 6. Fermented fish compressor

1.1.5. Development of smart solar dryer

The program for load cell sensor and temperature sensor have been developed to control the environment of the drying chamber. The program for load cell sensor was developed for measuring weight of the sample from four different load cell sensor that are attached behind the tray and tested it on hardware component. Another program was also developed to control the variable fan speed with change in temperature which has to be incorporated in developed solar dryer. The algorithm for control of the drying environment through sensors are shown in figure below.

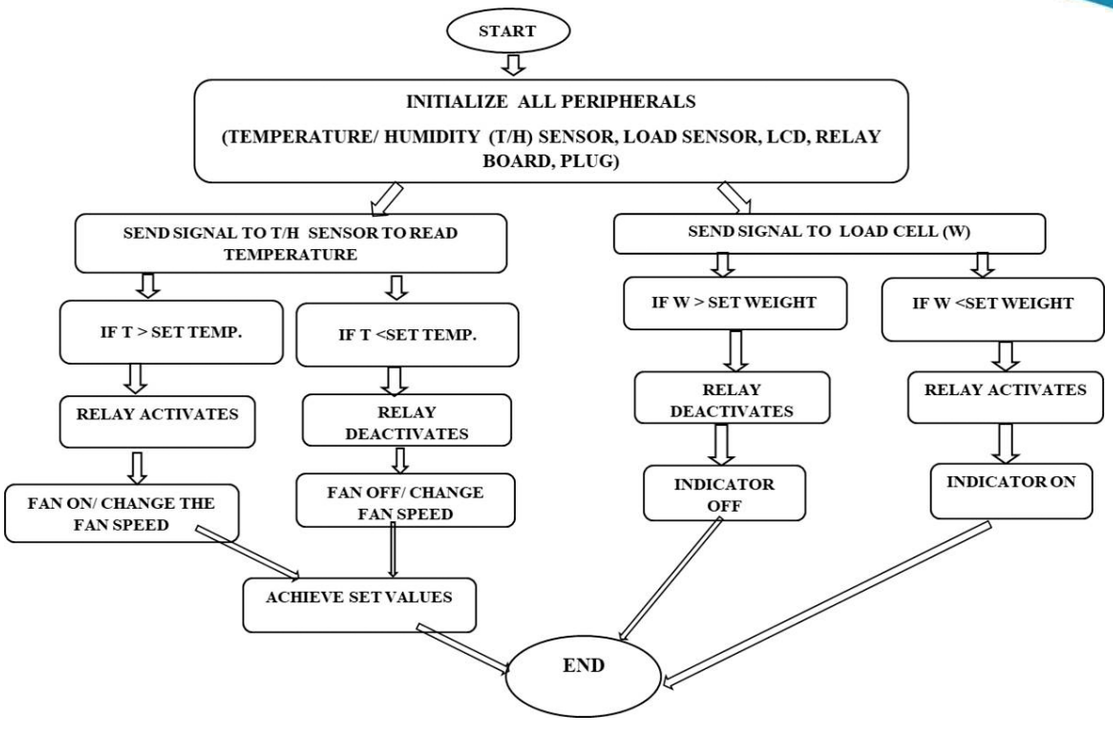


Fig. 7. Schematic of programme of smart solar dryer

1.1.6. Synchronized green pea depoder machine and mechanized hot water pre-treatment system

The mechanization of hot water pretreatment unit and its synchronization with green pea depoder machine was undertaken to improve the efficacy and ease in operation of green pea pod shelling. The designed cleated endless conveyor belt is fitted in the developed hot water pretreatment unit (80-90 liter capacity) made up of food grade stainless steel sheet. The arrangement is made to vary the depth of cleats submerged in the water as per the requirement. The PID controller (UTC-7204) and thermocouple sensors are used to control the temperature of the water (70-85°C) for pretreatment. The insulation chamber is filled with glass wool (25 mm thick) and wooden battens as insulating materials to reduce heat loss. The mechanized pretreatment unit is attached with the developed green pea depoder machine and synchronized with the speed of machine. The power drive to operate the endless belt at desired speed is given through motor of green pea depoder machine using set of pulleys and V- belts. The holding time of green pods is depending upon the speed of endless belt which is governed by speed of green pea depoder. The complete machine and pretreatment unit is operated using single set of motor and VFD drive and this has reduced the cost of machine by Rs. 22,000/- approximately.

1.1.7. Development of Mechanized Litchi De-stoner

A. Pedal operated seed removing tool for Litchi fruit

The pedal operated seed removing tool is developed for simultaneous de-stoning of two peeled litchis (Fig. 2). It comprise of two set of pedalsone for de-stoning and other for dropping the de-stoned litchi pulp in the collection tray. The components of tool are

Fig. 8. Pedal operated litchi seed removing tool

base frame, two feed cups mounted on hinged base plate, set of de-stoning tools, seed and pulp trays etc. The use of pedal to press the tool sets was found more convenient, easy to operate and ergonomic as compared to pressing tool sets downward with hand/ palm. This is not only reduced the force required for de-stoning but also found to be reduced time of de-stoning (increased capacity) as compared to manual method of de-stoning. The tool will help to remove the seed from peeled litchi with minimum damage (≤ 6-7%) to the pulp so that can be used for litchi canning. The tool can be useful to de-stone 6-8 litchis in a minute. The developed tool offers hygienic and ease in operation over the manual process and is woman friendly.

B. Automation attempt

The development of mechanized litchi de-stoning machine was undertaken for removal of seed from peeled litchi without damaging the pulp mainly for the canning purpose. The machine comprise of feeding unit, set of U shaped feed channels, de-stoning tool unit, specially designed feed cups, seed and pulp collection trays. The feeding mechanism and de-stoning tools are optimized by conducting rigorous trails on different developed mechanisms. The U shaped channels were found effective in systematic feeding of peeled litchi in feed cups. The controlled vibrations offer smooth movement of peeled litchi in U shaped channel to feed in vertical orientation in feed cups. The use of servo motor automation and synchronization of feeding and de-stoning unit is needed in developed machine. The isometric drawing and

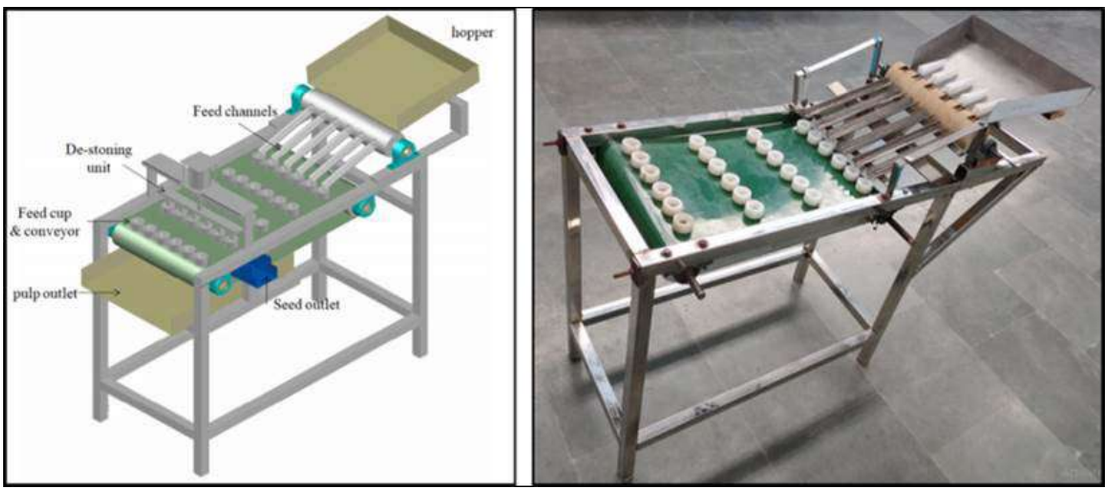


Fig. 9. Isometric drawing of Litchi destoner machine and Litchi De-stoner machine

developed mechanized litchi destoner are depicted below in Fig. 1.

1.1.8. Development of rapid quality monitoring system for wheat and its primary milled products

The studies on development of a rapid quality monitoring system for acquisition of the FTIR/ NIR range transmittance/ absorbance values of the field stored/fresh wheat flour samples and to predict the storage period and shelf-life of the same have been carried out. The chemical quality parameters *viz.* gluten content, crude protein content, flour moisture, ash content, fat acidity and peroxide value have been evaluated for the one year of storage period at an interval of 10 days as well as 30 days. The peroxide value (PV) is a parameter used to assess the quality and/ or stability of wheat flour, because it is originated from the primary products of lipid oxidation, and may decrease the shelf life and nutritional value of wheat flour. Among all the parameters studied, fat acidity and peroxide values of the wheat flour is changed significantly. The PV is increased from 6.63 Meq O_2 /kg to 19.63 Meq O_2 /kg indicating the storage changes in terms of lipid oxidation. PV values of wheat flour samples are being further used to classify the wheat samples stored for different periods by using IR/NIR models.

FTIR/NIR spectra have been acquired and analysed.The chemometrics analysis of the datasets obtained by FTIR spectra of the wheat flour samples has shown that significant differences are observed in the regions of 1180 cm^{-1} and 950 cm^{-1}. The range of 1180-950 cm^{-1} probably is containing information on the fats which can be an indicator of changes in the fat spectral signature during storage. This could be due to stretching vibration of (C–O), (C–C) bonds which is showing highest variation in the stored samples when compared to that of fresh wheat flour. The differences are also obtained by the narrow bands centered on 2850 cm^{-1} and the 2200–1400 cm^{-1} range. It predominantly reflects symmetric stretching vibration modes of the C–H bond in alkylic–CH_2 and –CH_3 groups and are primarily because of (bound) lipids, as peak of carboxyl C=O at 1745 cm^{-1}. These are identified as being characteristic of lipid and

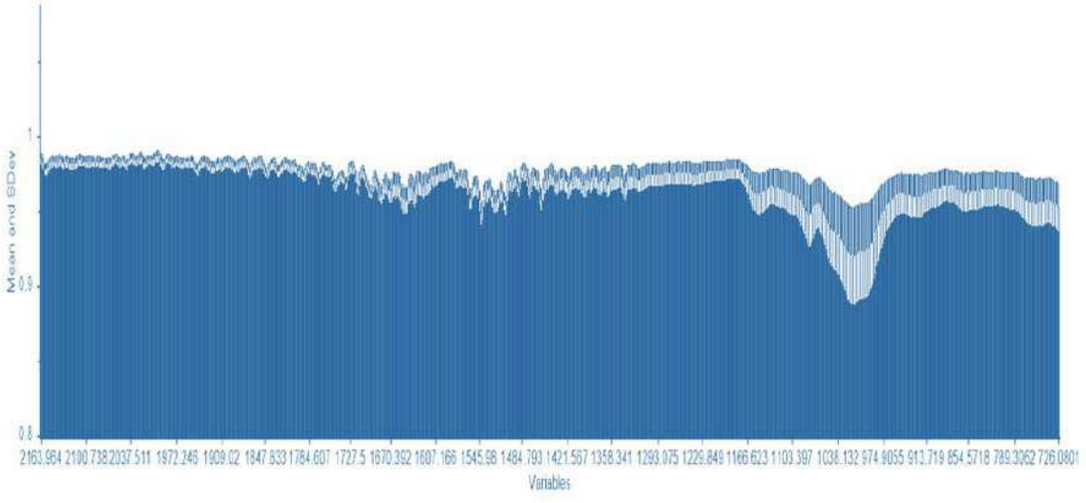


Fig. 10. Scatter effects with wave number in the region 1180-950 cm^{-1}showing highest variation in the mean transmittance values for the fresh and stored wheat flour samples

protein constituents in flour samples. The values are being used in development of PLS based model for tool development.

1.1.9. Performance evaluation of the Maize Cob Dryer

During the kharif season, Maize cobs are generally harvested at around 35% (wb) moisture content while shelling operation is performed at around 17% moisture content (wb). At the time of harvesting, the environmental conditions of high temperature and relative humidity favour the growth of fungi *viz. Aspergillus flavus and Aspergillus parasiticus* that produce toxic compounds called mycotoxins. Contamination of mycotoxins can be alleviated by drying the maize cobs soon after harvesting. A hot air maize cob dyer has been designed and developed with 150 kg capacity having overall dimensions (L×W×H) of 1.815×0.912×2.80 m. The performance of the developed maize cob dryer has been tested to evaluate the heat utilization factor (HUF), thermal efficiency, power consumption, drying time, loading and unloading time. The freshly harvested maize cobs (with husk) having moisture content of 39.13±2.09% (wb) are loaded manually into the dryer in its full capacity (150kg).The drying is carried out at 60°C and it takes 24-27 h to reach the final moisture content of 17-18% (wb) at the atmospheric temperature (36.86°C) and RH (51.37%). The maize cobs loading and unloading time is recorded as 7.75±0.43 min and 9.85±0.85 min, respectively. The dryer has shown heat utilization factor (HUF) and thermal efficiency of 0.86-0.47 percent and 79.63±1.54 percent, respectively, with electricity consumption of 1.2 ± 0.3 kWh.

Fig. 11. Maize Cob dryer

1.2. Process Technology developed by CIPHET

1.2.1. Development of process for detection of khesari dal flour in chickpea flour *(besan)*

Chick pea (*Cicer arietinum* L.) commonly known as Bengal gram is consumed either whole or in the form of dhal or dhal is further processed to make flour known as *besan*. Because of its high demand, and to get more economic gains its flour is often adulterated with cheaper legume flour of grass pea (*Lathyrus sativus* L.), commonly known as khesari. Near infra-red spectroscopy in combination with chemometrics has been employed to develop prediction model for detection and quantification of khesari dal flour adulteration in *besan.*

NIR spectra are recorded as the logarithm of reciprocal of reflectance (log 1/R) in the wavelength range of 400–2500 nm at an interval of 2 nm. Modified partial least squares (MPLS) regression has been used for the

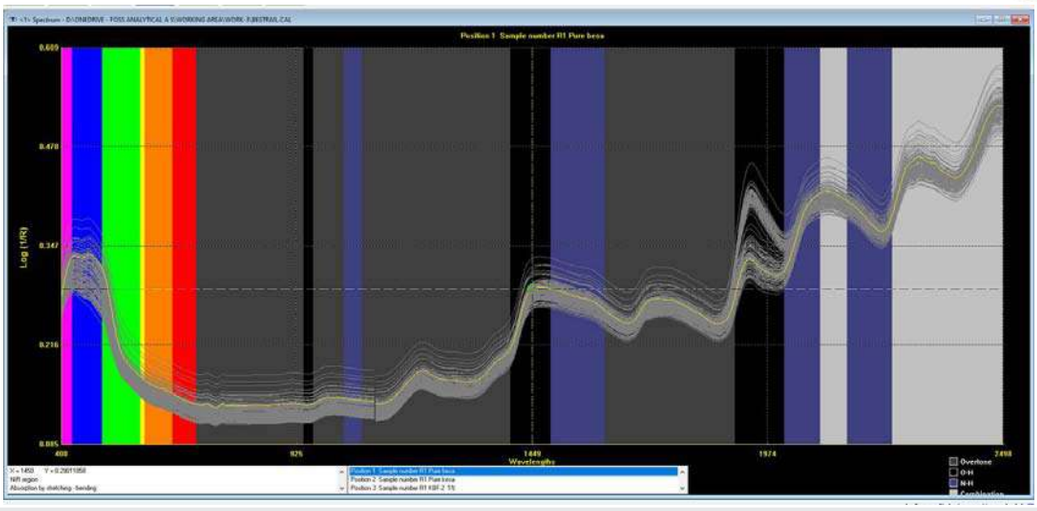


Fig. 12 (A). Reflectance spectra in the NIR range (700-2500 nm) of pure besan and adulterated samples with khesari dal flour (1-90%)

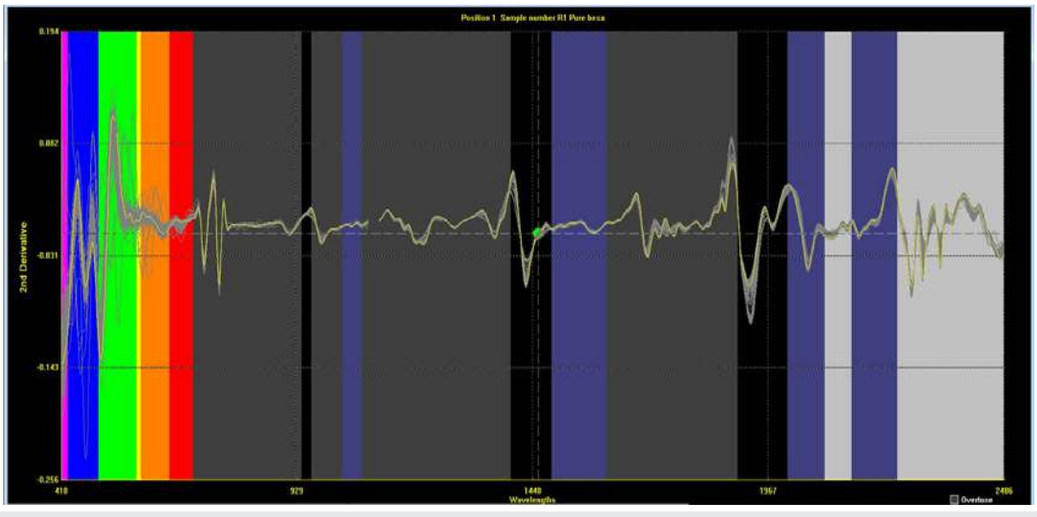


Fig. 12 (B). Smoothened plot of pure besan and adulterated samples with khesari dal flour (1-90%) after application of mathematical treatment

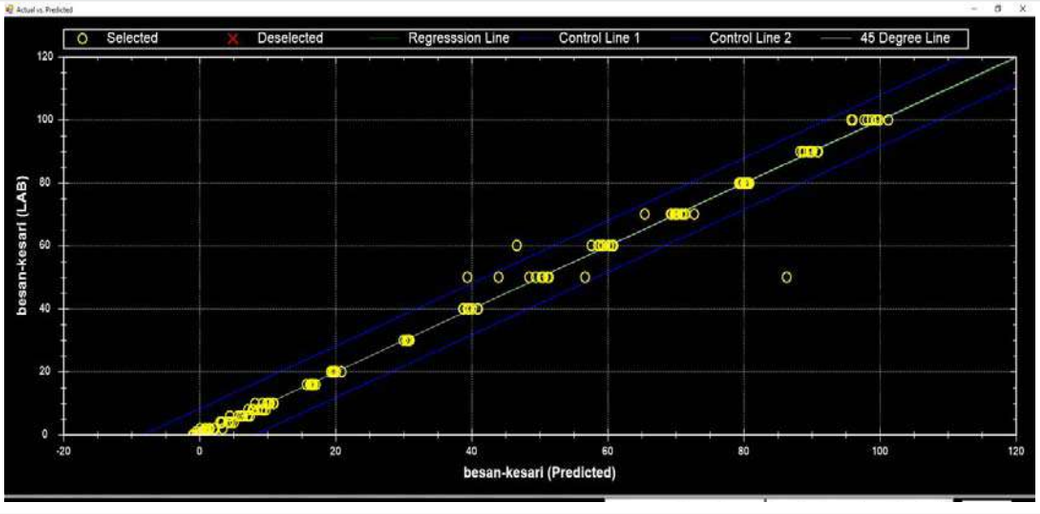


Fig. 13. Calibration model for predicted and laboratory values of pure and adulterated *besan* samples

Table 1. Calibration and validation statistics in NIRS model for the detection of khesari flour adulterant in *besan*

Constituents	No of samples (N)	Coefficient of determination of calibration (RSQ)	Standard error of calibration (SEC)	Standard error of cross validation (SECV)	One minus unknown variance (1-VR)
Besan & Khesari	165	0.999	0.0.922	1.422	0.998

development of the NIRS prediction model, on the basis of higher values of the coefficient of determination (RSQ), an estimate of RSQ (1-VR) and low values of standard errors of cross-validation (SEC), standard error of cross-validation (SECV). The developed calibration model for detection of khesari flour as adulterant in *besan* has shown RSQ, 1-VR, SEC and SECV of 0.999, 0.998, 0.922 and 1.422, respectively. Standard error of prediction (SEP) for cross validation and external validation is 0.907 and 2.22, respectively. The statistical data shows the developed calibration model can be effectively used for the screening of the adulterated *besan* samples with khesari flour.

1.2.2. Development of method for detection of metanil yellow in chickpea flour *(besan)*

Metanil yellow is a carcinogenic dye and is banned by the Govt. of India for food uses. Considering consumer safety and for faster detection of presence of metanil yellow in *besan*, FTIR based non-destructive method for detection of metanil yellow from chick pea flour (*besan*) has been developed. Adulterated samples of *besan* are prepared by spiking metanil yellow ranging from 0.05-20%; w/w. FTIR spectra of pure *besan*, pure metanil yellow and adulterated samples are acquired in Attenuated Total Reflectance (ATR) mode in the wave number range of 400-4000 cm^{-1}. Partial least square regression (PLSR) model has been developed with R square value of 0.9889 and 0.9424 for calibration and validation, respectively.

Effect of particle size on different properties of khesari flour

Milling and grinding produces flour samples which represent heterogeneous mixture of varied particle sizes. Sieving of such flour provides different flour fractions having uniform range of particle sizes. Particle size distribution of flour fractions affects their physicochemical and functional characteristics, which in turn influences the texture, mouth feel and quality of final end product. Grass pea is emerging as one of the potential cheap source of legume proteins and its flour can find applications in food industry. Therefore, different properties of flour fractions prepared from seeds of variety Mahateora have been studied. Different flour fractions are prepared through sieving (60-200 BSS). All the flour fractions have been evaluated for proximate composition, flow behaviour, functional properties as well as

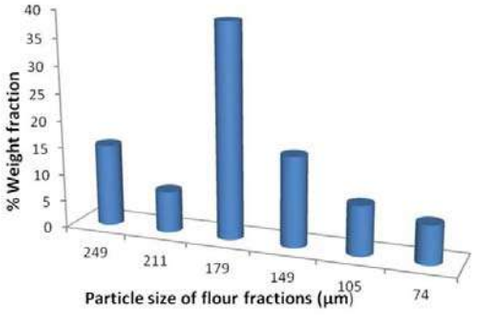


Fig. 14. Weight fraction (%) of flour retained on different sieves

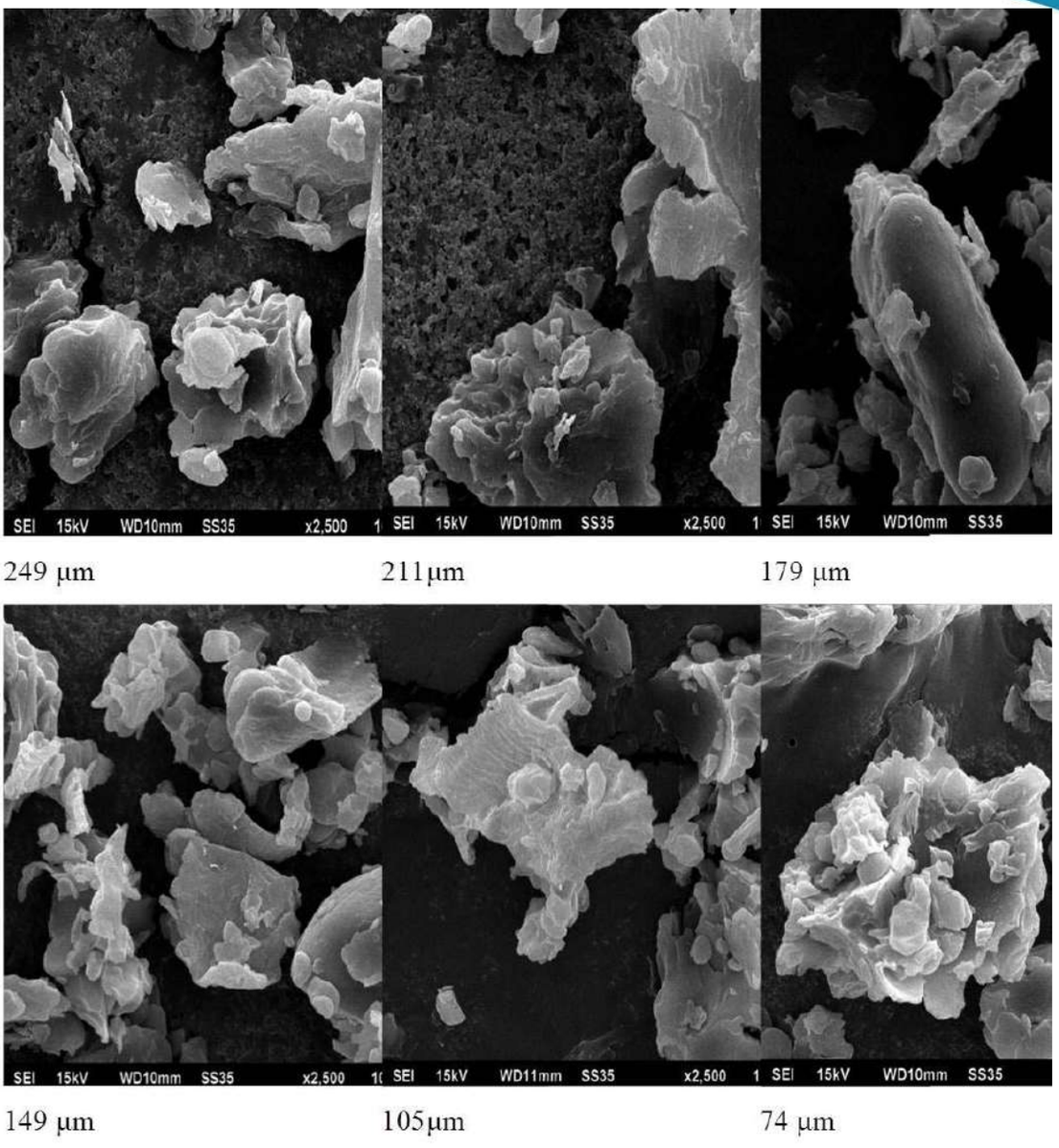


Fig. 15. Scanning electron micrographs of khesari flour samples of different sizes (x2500)

pasting and rheological characteristics. It has been observed that reduction in particle size has resulted in decrease in the decrease in protein, β-oxalyl-L-α,β-diaminopropionic acid (ODAP) content and increase in fat and carbohydrate content of the flour fractions, with no significant change in gross energy values. Decrease in the flowability, water absorption capacity, foaming capacity and foaming stability of flour fractions is observed while there is increase in swelling capacity, swelling index, oil absorption capacity with decrease in flour particle size. Results of scanning electron microscopy studies has shown that with decrement in the particle size of flour fractions starch granules become smaller and rounded. The study has found that different fractions of grass pea or khesari flour exhibit different physicochemical and functional properties, therefore, these flour fractions can be utilized for development of different end products.

1.2.3. Modelling the drying characteristics of Ashwagandha (*Withania somnifera*) roots

Fig. 16. Ashwagandha

Ashwagandha (*Withania somnifera*) is a medicinal plant, the roots of which have been used in Indian traditional system of medicines, Ayurveda and Unani. Generally, roots in powder form are utilized in pharmaceuticals industries. Drying behaviour of Ashwagandha is crucial as medicinal properties depends on essential oil content which is heat sensitive. Therefore, the drying behaviour of Ashwagandha roots has been investigated by performing mathematical modelling. The roots with initial moisture (250°C; db) are dried in shade as well as in a tray dryer at three different temperatures (45, 50 and 55°C). The experimental results are fitted into six semi-theoretical thin layer drying mathematical models. From the values of coefficient of determination and root mean square error the modified page model has been found to be the best fit for establishing the drying kinetics at all the studied temperatures. The effective moisture diffusivity is observed in the range of 6.35×10^{-8} to 9.92×10^{-8} m^2/s over the temperature range (45, 50 and 55°C) and drying has occurred in the falling rate period. This study will be helpful for predicting the drying behaviour of Ashwagandha roots.

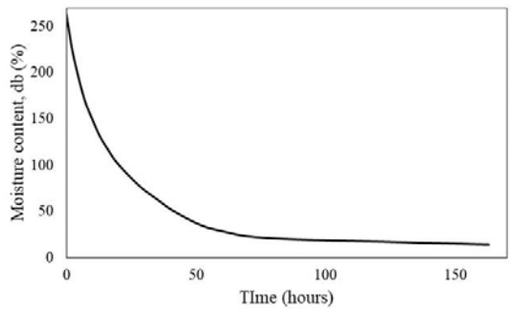


Fig. 17. Moisture content versus drying time of Ashwagandha dried in shade

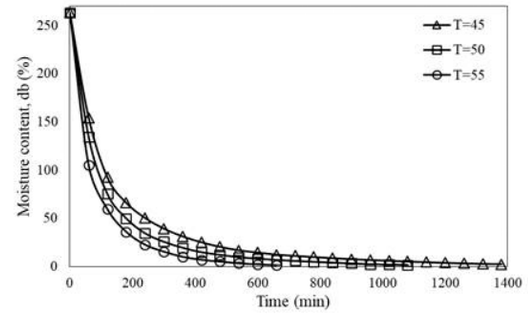


Fig. 18. Moisture content versus drying time of Ashwagandha at 45, 50 and 55°C

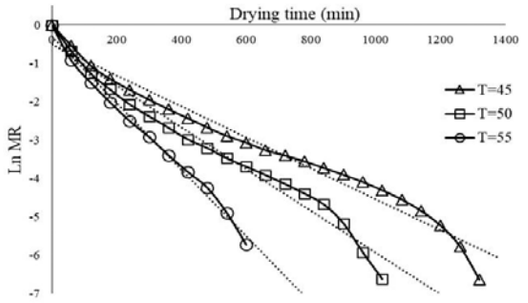


Fig. 19. Logarithmic moisture ratio versus drying time for effective moisture diffusivity at 45, 50 and 55°C

1.2.4. Process for Extraction of ACE-inhibitory Peptides from Fish Waste

Hypertension is one of the cardiovascular disease that kills people globally. It can be controlled, in one of the way, by Angiotensin-I Converting Enzyme (ACE) inhibitory peptide extracted from aquatic resources. Therefore, Rohu (*Labeo rohita*) fish wastes (head, fins, swim bladder and scales) have been used for the extraction of an antihypertensive (ACE inhibitory) peptide. It involves dressing rohu fish to collect waste,




Dressing, grinding, homogenising, mixing with buffer (PBS, 50 mM, pH 7.5), incubating (30 min.), enzymatic treatment (Alcalase @ 1%, v/w), enzyme inactivation (90ºC, 15 min.), filtration through syringe filter (0.45 µm then 0.2 µm) and MW cut off filter (10 kDa then 3 kDa), spray drying/ lyophilizing and storing in air tight vial in cool and dry place.

Optimum condition for enzymatic extraction: 52.1 ºC temperature and 129 minutes Hydrolysis time

ACE inhibition: 55%

Rohu fish waste **Extraction process** **ACE-inhibitory peptides**

Fig. 20.

grinding and homogenizing, mixing in phosphate saline buffer (PBS, 50 mM, pH 7.5) followed by incubation for 30 min. Then enzymatic hydrolysis using Alcalase @ 1%, v/w is done for 2 hours. Subsequently enzyme is inactivated by placing it in hot water (90ºC) for 15 min. It follows filtration through syringe filter (0.45 µm then 0.2 µm) and MWCO (10 kDa and then through 3 kDa), spray drying/ lyophilizing and finally storing in air tight container in cool and dry place. ACE inhibition (55%) was found at optimum hydrolysis time (129 minutes) and optimum temperature (52.1 ºC).

1.2.5. Evaluation of gelatinization changes using IR treatment and HIS imaging

An underutilized pseudocereal, Buckwheat has been treated with Infrared (IR) and hyperspectral imaging (HSI) technique has been used to evaluate gelatinization changes. The optimized parameters (voltage, 270 V; treatment time, 11.5 min. and buckwheat moisture, 43.5%) have been found. HSI images have been acquired using Specim DAQ software, pre-processing and analysis using MATLAB and identifying the difference between treated and untreated samples based on gelatinization using PCA plot. IR treatment of buckwheat at high moisture (44%) content improves the hulling efficiency. This work was carried out by CIPHET scientist at ICAR-CIAE, Bhopal during her Professional Attachment Training.

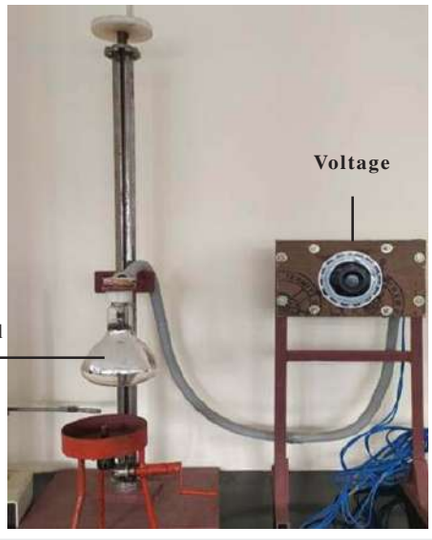


Fig. 21. Infrared treatment setup

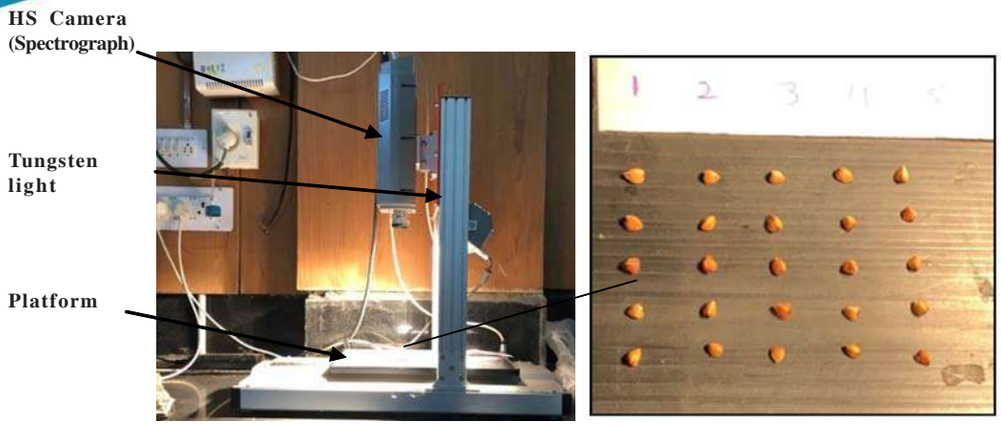


Fig. 22.

1. 2.6. Image based classification of guava (a climacteric fruit) using deep learning models

Three deep learning models (InceptionV3, VGG16 and Alexnet) have been trained using dataset of Guava images with fine tuning to classify images of Guava in cold storage chamber. InceptionV3 model has achieved excellent accuracy (90.88%) followed by VGG16 model in classifying images successfully. This work was carried out by CIPHET scientist at ICAR-CIAE, Bhopal during her Professional Attachment Training.

1.2.7. Process technology for extraction of phenolic compounds from pigeon pea husk

In India, pigeon pea (*Cajanus cajan*) is mainly consumed in the form of dehusked split pulse as '*dhal*'. The milling of pigeon pea annually produces a substantial quantity of by-products in form of husk, *chuni* and brokens. These by-products are usually sold as cattle feed whereas these can find potential applications for extraction of bioactive phenolic compounds. Experiments have been conducted using response surface methodology (RSM) following Box–Behnken design with independent variables *viz*., solvent concentration (up to 80%), extraction temperature (up to 60°C) and extraction time (2-4h) for the extraction of bioactive compounds from pigeon pea husk.

The total phenol content (TPC) and DPPH Radical scavenging activity (%) of husk

Pigeon pea **Pigeon pea husk** **Ground pigeon pea husk**

Fig. 23.

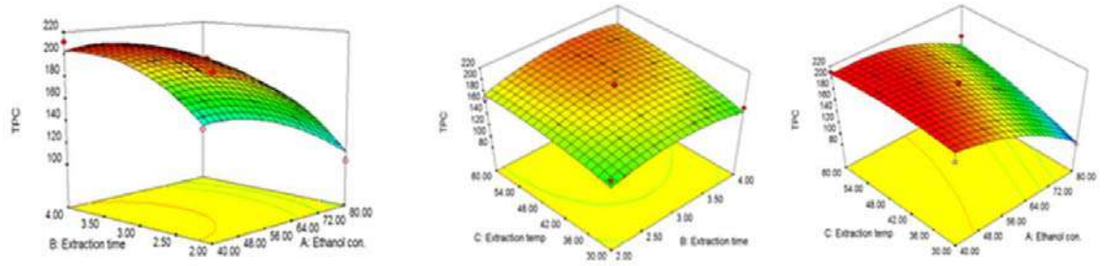


Fig. 24. Effect of ethanol concentration (%), extraction temperature (°C) and extraction time (h) on Total Phenol Content (mg GAE/g) of extracts

extracts is found in the range of 88.51 - 405.07 mg gallic acid equivalent/g and 86.04 – 93.13percent, respectively. The anthocyanins are not detected (ND) in the extracts. The optimized conditions for extraction of phenolic compounds are found as 40% ethanol concentration, 4 h extraction time at 45°C extraction temperature.

1.2.8. Enzymatic process for improving extraction efficiency and quality of collagen hydrolysates from buffalo (*Bubalus bubalis*) skin

The aim of this work was to investigate the effects of plant enzymes papain and bromelain on extraction efficiency and quality of collagen hydrolysates from buffalo (*Bubalus bubalis*) skin. The extraction was carried out at different time-temperature combination with various concentrations of enzymes. SDS-PAGE showed maximum hydrolysis of skin protein at 30 units of enzymes when buffalo skin samples were incubated with papain enzyme between 0- 50 units at 40 ºC for 3 h. Free amino group content (mmol/g of skin) in the degraded skin sample was higher at 30 units of papain and bromelain enzyme/g of skin when incubated for 3 h at 40 ºC. The molecular weight distribution of collagen hydrolysates ranged from 30 to 65 kDa. It was also found that fraction obtained at 30 units and 50 units of papain and bromelain showed higher DPPH antioxidant property and reducing power, respectively. Enzyme treatment also enhanced the foaming capacity, foaming stability, and emulsion stability index of hydrolysates, significantly ($P < 0.05$).

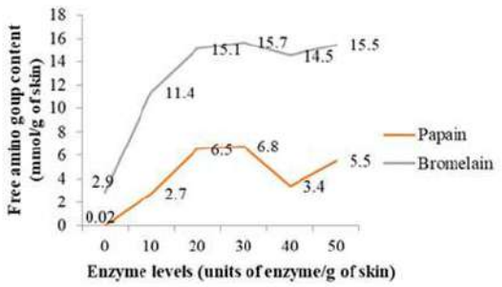


Fig. 25. Free amino group content (mmol/g of skin) in the degraded skin sample incubated with various levels of enzymes papain and bromelain for 3 h at temperature 40 and 25 °C, respectively

1.2.9. Optimized process for extraction of polyphenol from mango seed kernel

This study was conducted to extract high-value compounds from mango processing by-products. Response surface methodology (RSM- Box Behnken Design) was used to optimize the polyphenol extraction process from mango seed kernel. The pre-trial carried out to found the range of temperature, solvent and time to obtain maximum polyphenol yield. The three factors A: Solid-liquid ratio (w/v) (1:5 to 1:25), B: temperature (30-70 °C), C: Time (60-120 min) with three central points were used to optimize the polyphenol extraction process. The developed model was

significant with probability < 0.05. The linear terms solid-liquid ratio, solution temperature and interaction effect of solid-liquid ratio and soaking time showed significant effect on polyphenol yield. The predicted polyphenol yield was 21.40% and the results were validated.

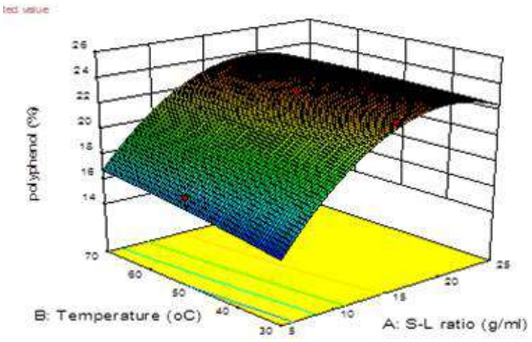


Fig. 26. Interaction effect of solid liquid ratio and temperature on polyphenol yield

Process for extraction of mango seed kernel oil using supercritical fluid extraction

Response surface methodology (RSM- Box Behnken Design) was used to optimize the extraction process for mango seed kernel oil with the factors A: Pressure (300-450 Bar), B: temperature (50-70 °C), C: Time (30-60 min) with three central points. The model was found significant with probability <0.05. The linear terms pressure, time and interaction effect of pressure and time showed significant effect on mango seed kernel yield. The optimum conditions for maximum oil yield obtained as follows: pressure- 400 Bar; temperature- 63°C and time of 52 min. The predicted mango seed kernel oil yield was 7.52% and the results were validated.

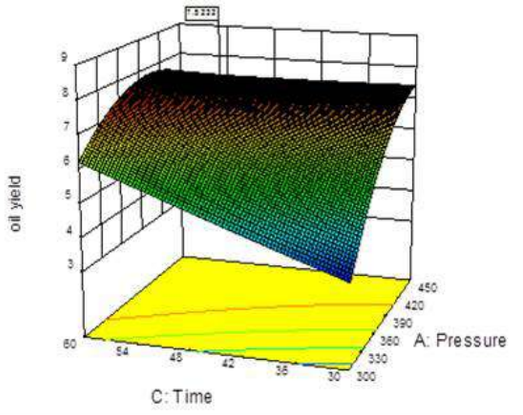


Fig. 27. Interaction effect of pressure and time on mango seed kernel oil yield

Antioxidant and antimicrobial activity of mango seed kernel extracts

The mango seed kernel extracts were prepared in different solvents such as methanol, acetone and water to evaluate the antioxidant activity using DPPH and ABTS methods. The maximum DPPH antioxidant activity was found in the methanolic extracts (88.37%) following acetonic extracts (85.03%) and water extracts (75.11%). The antioxidant activity via ABTS method showed 89.43%, 78.16% and 67.5% antioxidant activity in methanolic, acetonic and water extracts, respectively. It was found that the methanolic extract showed maximum antioxidant activity in both methods. Further, antimicrobial potential of the mango seed kernel methanolic extracts were evaluated against bacteria (*Xanthomonas campestris* and *Escherichia coli*) using well diffusion method using different concentration of methanolic extract. Streptomycin was used as positive control whereas methanol was used as negative control. It was found that

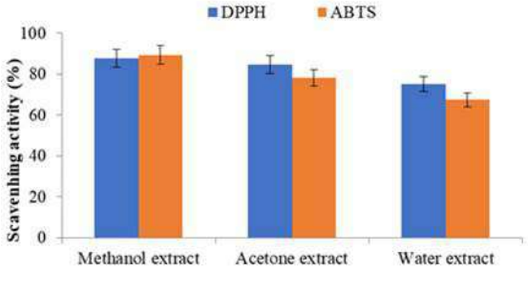


Fig. 28. Antioxidant activity of mango seed kernel extracts using different extraction solvents

the antibacterial activity of mango seed kernel extract with concentration of 200 mg/ml showed maximum zone of inhibition.

1.2.10. Development of Steeping based Preservation Method for Longer Shelf-Life of Ker

Ker is an excellent source of phytochemicals and minerals - short duration - seasonal crop. It perishes during glut season due to poor post-harvest management, inadequate processing facilities and unawareness in other parts of the country. Therefore, a suitable steeping based preservation technology may be helpful in harnessing the useful characteristics of vegetables during lean season. Steeping was done with green ker, steeped in sodium chloride (NaCl, 3%), acetic acid (0.8%), ascorbic acid (200 and 400 ppm) and zinc chloride (200 and 400 ppm), KMS (0.2%). The ker samples steeped in 3% NaCl, 0.8% acetic acid, 200 ppm zinc chloride and KMS (0.2%) were rated best with maximum mean overall acceptability (OAA) score (7.23) after 180 days of storage. The optimum concentration for maximum desirability in the preservation of ker consisted of 3.0% sodium chloride, 0.8% acetic acid and 200 ppm zinc chloride.

Fig. 29. Steeped green ker fruits 1) control, 2) Ascorbic acid (200 ppm), 3) Ascorbic acid (400 ppm), 4) Zncl2 (200 ppm), 4) Zncl2 (400 ppm)

Applications and advantages of steeped ker

- A suitable steeping preservation method is a low cost technology that may be helpful in harnessing the useful characteristics of ker during lean season.
- Ready to cook ker with no rehydration required therefore saves time
- Direct use in curry preparations, pickle preparation and snack preparations along with the steeping solution
- Good shelf life: six to twelve months at room and low temperature
- Good sensory quality

1.2.11. Reduction in astringency of ker fruits

The present study was conducted for developing a method to reduce the tannins content of *Capparis decidua* fruits commonly known as ker, delle or teent in different languages. The fruits are astringent in taste due to presence of tannins. Tannins are polyphenolic compounds having many biological activities, such as anticancer, antioxidant, anti-inflammatory, anti-asthmatic, and antimicrobial activities, however, its large amount is associated with unpleasant acrid taste and an astringent feel. Therefore, different treatments were explored to reduce the astringency of ker fruits. In this experiment ker fruits were treated with different chemical compounds at various concentrations. Treatments were namely; alum (1, 3, 5%), sodium chloride (3, 5, 7%), sodium bicarbonate (1, 3, 5%), hot water at 50æ%C and butter milk (Fig.3). The experiment was continued for five days at room temperature and analyzed for tannin content after every 24 hours of interval. It was observed that with time, tannin content reduced in all the samples irrespective of the concentration of the chemical compound applied. Highest reduction in tannin content was observed in sodium chloride (83.60 to 98.72%) followed by sodium bicarbonate (range from 60.45 to

90.21%) and alum (40.07 to 71.99%) Whereas, least reduction in tannin content was observed in butter milk (27.06%) and hot water (59.32%)

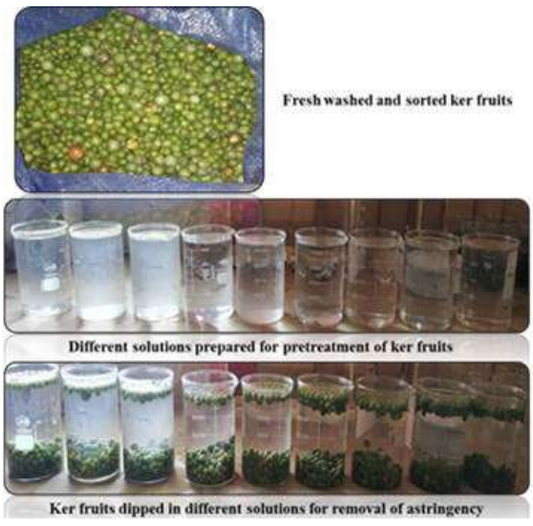


Fig. 30. Experimental set up for astringency removal of ker fruits

1.2.12. Extraction of Medicinal Compounds from Ker and Sangri

Ker and sangri are dry region crops with high quantity and quality of macro and micro nutrients and in order to explore this there

Fig. 31. Conventional extraction using different solvents a) Ker powder; b) Sangri powder

Fig. 32. Set up for microwave assisted extraction of medicinal compounds from ker and sangri

extraction method was optimized following two methods viz., solvent (SE) and microwave assisted extraction (MAE). Ker and sangri powder were obtained after drying them at 55ËºC and respective powders were used for extraction of medicinal compounds at five different temperatures viz., 50, 60, 70, 80 and 90ËºC and four time duration i.e. 2, 4, 6 and 8 hours via SE using 80% ethanol. Maximum extraction was observed at 80ËºC for 6 hours and MAE of medicinal compounds was done at 930 W at four different temperatures viz., 25, 50, 75, 100ËºC and four time duration 20, 40, 60 and 80 minutes using 80% ethanol with sample to solvent ratio of 1:40. Maximum extraction was observed at 50^{0}C for 60 minutes. Different solvents including *water, methanol, acetone and ethanol* were used for extraction at optimized conditions of 80^{0}C

Table 2. Medicinal compounds extracted from solvent and microwave assisted extraction

Samples	Extraction (sample: solvent) (1:40)	Total Phenolic content (mg/g GAE)	DPPH (% inhibition)
Solvent extraction (80^{0}C/6 hours)			
Ker	Acetone	5.837	57.546
Sangri	Ethanol	4.725	55.266
Microwave assisted extraction (50^{0}C/60 min)			
Ker	Acetone	5.712	68.512
Sangri	Ethanol	5.025	64.386

for 6 hours in SE and at 50^{0}C for 60 min in MAE with sample to solvent ratio of 1:40. Followed by extraction, the samples were oven dried (50-55^{0}C for 3-4 hours) followed by estimation of antioxidants and polyphenolics. In both SE and MAE, the highest extraction was observed in 80% ethanol for *sangri,* whereas for ker the highest extraction was observed in 80% acetone (Table 2).

1.2.13. Deodorization and safe handling of dried fish

Dried fish generates obnoxious smell due to oxidation of fish oil and liberation of volatile compounds and thereby making fish unpleasantly stinky. For addressing this problem pre-treatment of dry fish has been done with various botanicals. Different botanicals i.e., ginger extract, green tea extract, lemon juice and turmeric extract have been used for drying and deodorization of dried fish of different sizes: small (*Moka, Puthi*), medium (Croaker, *F travelly*) and large (*Rita rita*). Insect infested dry fish samples collected from the Jagiroad dry fish markets, Assam have been studied for identification of insects. The emerged out dead insects from those collected samples are pinned and identified as *Necrobia* sp. and *Dermestes* sp. based on the morphological identification. The insects (10-15 nos.) have been released into the containers with dry fish (approx. 150g) and kept for the biological studies. The collected insects laid eggs in laboratory conditions.

Colour of treated dried fish samples studied using Hunter colorimeter has found L, a, b and Z values ranging from 32.93 to 69.91, -0.71 to 8.13, 7.05 to 55.56 and 3.64 to 24.95 respectively for all treatments (turmeric, lime, ginger and green tea extract). In the studies on organoleptic properties on a 9-point hedonic scale, ginger extract treated croaker scored the highest for appearance (7.8), turmeric treated *mok*a highest for colour and lime treated *puthi* highest for aroma (7.62).

1.2.14. Process optimization of drying conditions for preparation of mango peel and kernel powder for production of microbial polyhydroxybutyrate (PHB)

The aim was to optimise the drying conditions for preparation of peel and seed kernel powder by evaluating the effect of different drying temperature on the drying kinetics and its different biochemical attributes (especially carbohydrate and nitrogen). The drying experiment was performed using hot air drying method at four different temperatures (50, 60, 70, and 80 °C). The initial moisture content of mango peel (*cv. Chausa*) was

Fig. 33. Adult of *Dermestes* sp.

Fig. 34. Adult of *Necrobia* ap.

observed to be 70-72% *wb* and that of seed kernel was 37-39% *wb*. The time required to obtain the desired level of moisture (6-8% *wb*) for dried peel was recorded to be 1110, 750, 570 and 390 min for 50, 60, 70, and 80 °C, respectively. Total carbohydrates content ranged from 52.34±3.60 to 65.60±5.72% for 50 and 80 °C dried sample respectively. Carbohydrate content observed at 50, 60 and 70 °C was not significantly different (P<0.5). Likewise, the maximum CHO (%) in all the mango seed kernel powder was also was not significantly different (P<0.5). Also, the nitrogen content for mango peel powder ranged from 0.65±0.165 to 0.91±0.332% for 80 ^{0}C and 60^{0}C dried peel. The values were not significantly different (P<0.05). Likewise, N content value for the mango seed kernel powder ranged from 0.97±150 to 1.01± 0.189%. There was non-significant difference among the treatment. This experiment findings showed that hot air drying at 70°C is able to yield high-quality mango peel powder in terms of CHO and N parameters with lesser drying time.

1.2.15. Comparative study of soy protein isolates prepared by acid and biological precipitation methods

Conventionally, alkaline extraction followed by acid precipitation is used for the preparation of protein isolates from plant sources. Acidic conditions produced by hydrochloric acid used for precipitation of proteins can impair the digestibility as well as can lead to racemization, thus destroy some amino acids which results in the formation of lysinoalanine. In this context, we have developed a biological method using two lactobacillus bacterial strains for the precipitation of extracted proteins from de-oiled meals/cakes. In the present study biologically precipitated soy protein isolates (BPSPIs) have been prepared from de-oiled soy meal and characterized for physico-chemical, functional, anti-nutritional and structural properties as well as compared with acid precipitated soy protein isolates (APSPIs). The purity, yield, probiotic count, lightness, whiteness index, and degree of hydrolysis are found to be significantly (pd"0.05) higher in BPSPIs. Functional properties (solubility, foaming capacity, water binding capacity, and dispersibility) are found higher in BPSPIs. Solubility has been measured at different temperatures (40, 50, 60, 70, 80°C) and nitrogen solubility has been measured at different pH values (2.0, 4.0, 6.0, 8.0 and 10.0), respectively. The solubility is found in the range of 67-75% and 32-50% for BPSPIs and APSPIs, respectively (Fig 1). Nitrogen solubility is found to increase with increase in pH and is highest at pH 10.0. However, water and oil absorption capacity does not differe significantly in both BPSPIs and APSPIs. Phytic acid content of 1.85 g/ 100g and 3.65 g/100g and trypsin inhibitor content of 1.44 TIU/mL and 3.16 TIU/mL has been observed for BPSPIs and APSPIs, respectively. FTIR spectra of BPSPIs have shown a sharp bend in the wave number region of 3700-3900 cm^{-1} depicting some structural differences. The SEM analysis has

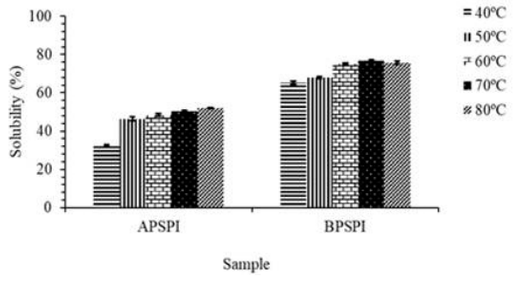


Fig. 35. Solubility of acid precipitated soy protein isolates (APSPIs) and biologically precipitated soy protein isolate (BPSPIs) at different temperatures

revealed that particles of APSPIs are larger in size than that of BPSPIs samples.

No probiotic count has been found in case of APSPIs while BPSPIs show probiotic count of $21x10^{11}$ CFU/ml. The storage study of BPSPIs for a period of 10 months under refrigerated conditions have shown decline in probiotic count ($71.2x10^{7}$ CFU/ml) at the end of 10 months (Fig. 2). The results have shown that BPSPIs possess better properties over conventionally prepared APSPIs and thus can be further explored for the development of novel and functional protein based products.

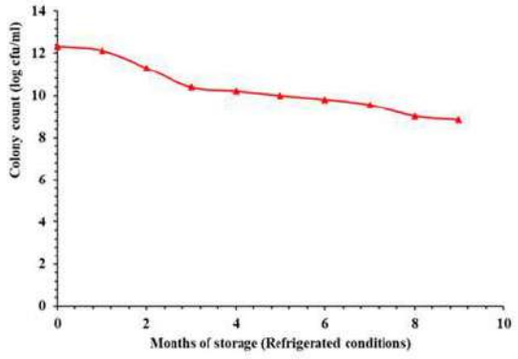


Fig. 36. Probiotic count of soy protein isolates prepared through biological method during refrigerated storage

1.3. New products

1.3.1. Grass pea (*Khesari*) Flour based Muffins

Fig. 37. Grass pea flour muffin

The consumption of grass pea (*Khesari*) flour has been limited in different food applications because of presence of undesirable compound known as α-N-oxalyl-L-β, α-diaminopropionic acid (ODAP). Although the crop is having good nutritional profile still its uses are limited due to over emphasis given to the undesirable compound. Development of Indian varieties having low levels of ODAP compound (0.07-0.10%), has opened avenue for the effective value addition of protein rich crop. Protein enriched muffins have been developed from grass pea flour. Colour, nutritional, textural and sensory characteristics of all the muffins samples has been studied. The optimized product has shown hardness of 1.84±0.20 kg, springiness of 0.95±0.001, instrumental 'L', a, b values 70.52±0.08, 3.72±0.17 and 39.03±0.43 in comparison with the values of 1.49± 0.35, 0.96±0.005, 77.42±0.66, 1.3±0.28 and 27.04±0.35 for wheat flour based reference muffin samples. The mean overall acceptability score of 8.30 ±0.50 is observed in comparison to 8.67 ±0.6 of the reference sample.

1.3.2. Black gram based Muffins

Black gram (*Phaseolus mungo*) or *urd* is widely used to prepare a large number of traditional foods by drying/steaming/frying that are either ready-to-fry or ready-to-eat, and most of them are fermented. There is need to diversify its uses in other food products also. Black gram flour (BGF) has been incorporated into muffins by progressive replacement (0-100%; w/w) of refined wheat flour. Pasting properties of muffin flour blends has shown increase in the pasting temperature and final viscosity with increasing black gram flour incorporation. Incorporation of BGF has resulted into a decrease in baking weight loss, muffin height, lightness of the muffins and springiness, chewiness, resilience and cohesiveness of muffins while increase in hardness of muffins has been observed. Of

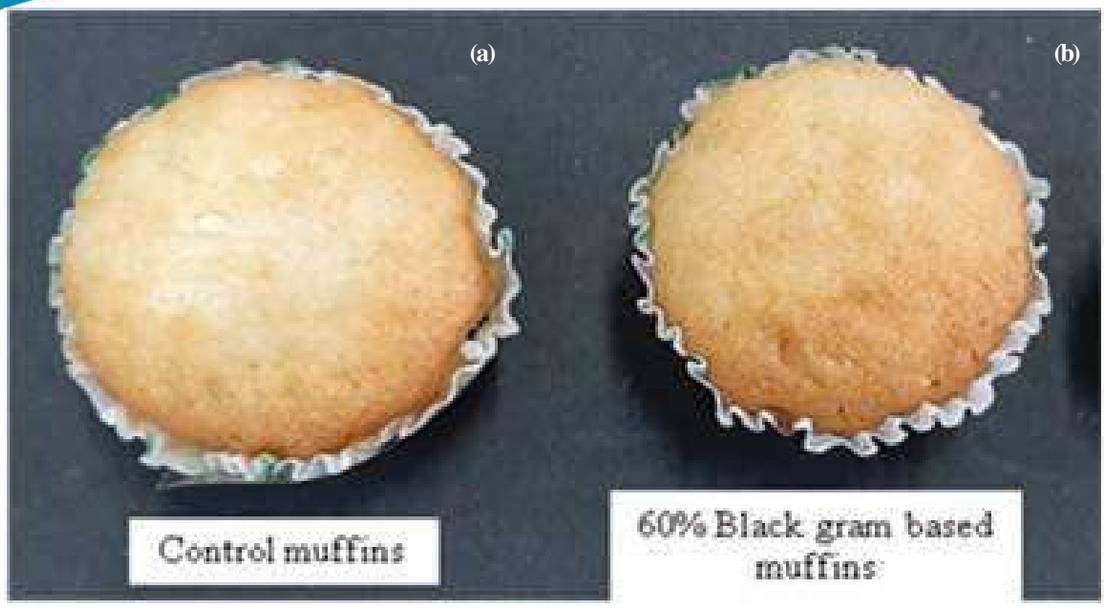
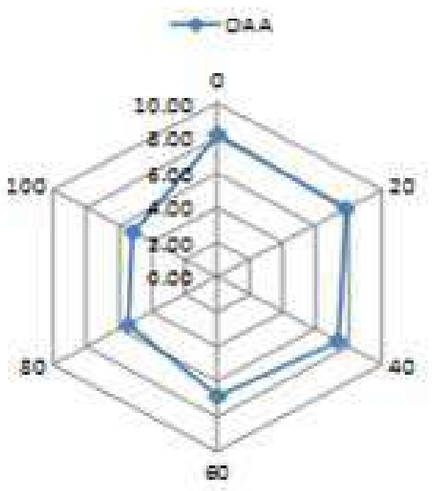


Fig. 38. (a) Control muffins (0% BGF); and (b) 60% BGF muffins

all the developed muffins, 60% black gram flour incorporated is found to be acceptable in terms of sensory properties.

1.3.3. Pigeon pea based pasta

Pigeon pea (*Cajanus cajan*) is one of the major pulses grown in India and is mainly consumed in the form of dehusked split pulse as '*dal*' and also used in preparation of traditional dish '*sambhar*'. But there is scope for further diversification of its use in processed food products. In this context, cold extrusion technique has been employed to develop protein rich pasta by using pigeon pea (PP) flour (0-100%). Cooking, colour, nutritional and sensory characteristics of all the pasta samples has been evaluated.The cooking time of the PP based pasta samples has been found to be more than the control sample (4 min). Incorporation of pigeon pea flour enhances the water uptake ratio, volume expansion ratio and gruel solid loss, the lightness and yellowness of pasta. The phytic acid content of pigeon pea flour containing pasta samples is found to be lower than control due to low phytic acid content in pigeon pea flour (262 mg/100g) in comparison with semolina (881.40 mg/100g). Pasta sample having with pigeon pea flour and semolina (60:40) has shown good sensory overall acceptability score of 7.



Overall acceptability

Fig. 39. Sensory acceptability score of pigeon pea based pasta

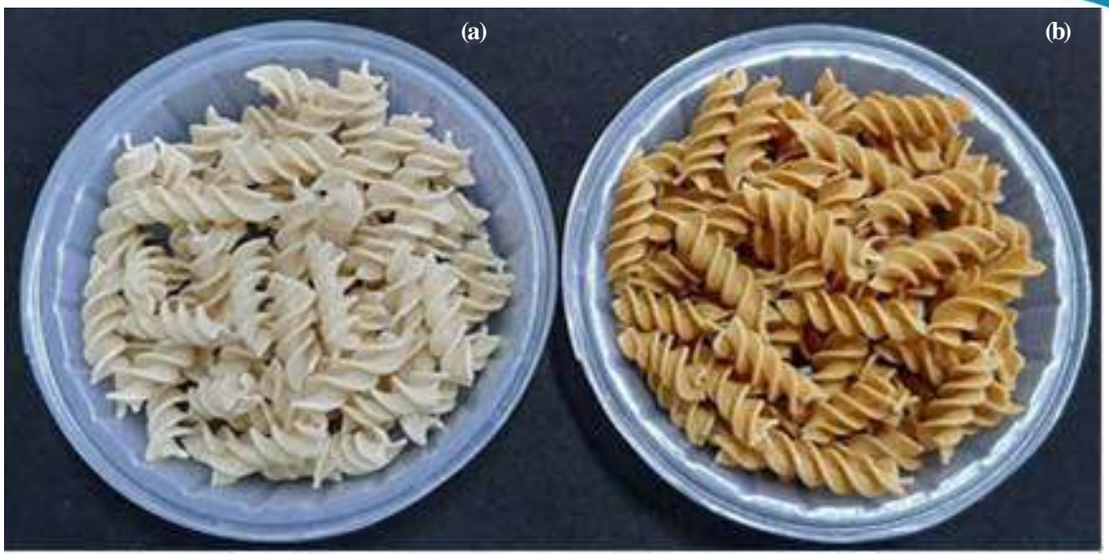


Fig. 40. (a) Control pasta (0% PP flour); and (b) 60% PP pasta

1.3.4. Anti-hypertensive peptide from Rohu fish waste

ICAR-CIPHET has produced an anti-hypertensive (ACE-inhibiory) peptide, a very high value product from Rohu (*Labeo rohita*) fish waste (head, scales, fins and swim bladder) using Protease (from *Bacillus licheniformis*) enzyme. This peptide showed Angiotensin-I Converting Enzyme (ACE) inhibitory property with ACE inhibition of 55.0 % at 19.27% DH and peptide content of 51.4 %.

Fig. 41. Spray dried rohu fish waste-based ACE inhibitory peptide

1.3.5. Extrudates from pigmented cereals

Black rice, red rice (*Jyothi* var.) and pigmented maize been have been extruded in twin extruder to get pigmented cereal extrudates with the benefits of high anthocyanin content (TAC), polyphenolic content (TPC) and high antioxidative capacity (radical scavenging activity, RSA). The optimum process conditions of extrudates are:

Table 3.

Extrudate type	Feed Moisture (%)	Screw Speed (rpm)	Barrel temperature (°C)
Black rice	14	550	130
Red rice	16	550	130
Pigmented maize	14	550	130

The percentage retention of TAC, TPC and %RSA in optimized extrudates

Table 4.

Extrudate type	TAC mg Cyanidin /100g		TPC mg GAE/100g		% RSA	
	Initial Value	% retention	Value	% retention	Value	% retention
Black rice	130.69	34.00	282.40	75.96	83.71	23.88
Red rice	4.79	39.66	314.32	76.44	93.75	37.35
Pigmented maize	25.51	36.03	187.01	65.96	59.86	24.40

Fig. 42. Optimized black rice, red rice and pigmented maize extrudates

2. AICRP-PHET

2.1. Machines developed by ICAR-AICRP-PHET

2.1.1. Wet red chilli seed extractor

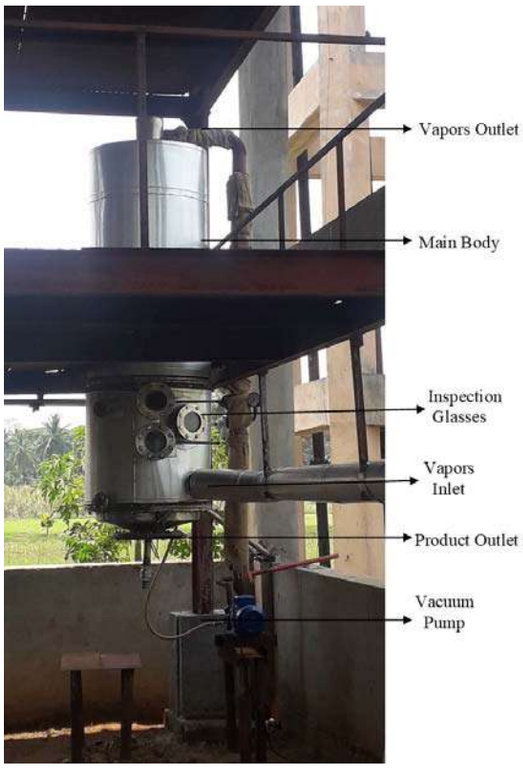
The wet red chilli seed extractor has been developed at Dr PDKV Akola centre of AICRP on PHET. The developed extractor consists of feed hopper, two stage extraction drum, pulp outlet and seed outlet. It has a capacity of 300 kg/h and extraction efficiency of 97.5 percent. The mechanically extracted red chilli seed has shown germination rate of 94.8 percent. A separate batch type cleaning mechanism has been developed for cleaning of chilli seed. The system has two kg seed capacity per batch and eight minutes cleaning time. The developed machine is technically feasible and economically viable.

2.1.2. Rapid testing (Lateral flow immunoassay, LFIA) for detection of *aflatoxin B1* in agricultural produce

The existing methods of detection of aflatoxins are laborious and expensive. The developed LFIA device works on competitive ELISA principle and is the first lateral flow device for detection of toxins in the field of agriculture in India. The extraction takes about 20 minutes and the test can be conducted within 10 minutes. The result can be interpreted by visual observation. The limit of detection was set to be 10 ppb, which is crucial for export of the produce to most of the countries.

2.1.3. Vacuum pan

The concentration of sugarcane juice is an energy intensive process and critical for



obtaining quality jaggery products. The temperature and time are important parameters that affect the final quality of the product. It was envisaged that lowering the temperature of the process and shortening the duration would give a better quality jaggery and also reduce the energy requirement. Thus, a vacuum pan of 800 litres/batch capacity has been developed to concentrate the juice at lower temperature and in shorter duration. It resulted in time saving of 60 min compared to conventional method of 150 min to raise brix of sugarcane juice from 60 to 75 °Bx.

2.1.4. Small millets dehuller (Abrasive type)

There has been a growing interest for consumption of small millets due to their nutraceutical properties. This has resulted in the growth of many millet processing plants in India. However, there are availability of only few millet dehullers. Moreover, these have a lower efficiency and not suitable for all types of millets. There is a need of developing a dehuller for all small millets with a different dehulling mechanism (other than centrifugal mechanism). The prototype of small millet dehuller consists of a hopper, dehulling chamber and a hull aspiration unit that are mounted on a sturdy angular frame work. The machine is operated by 5 hp electric motor and the capacity of the machine is 100 kg/h. The machine works on abrasive mechanism and an emery coated cylinder (slightly tapered) rub the millets against the ribbed concave to separate the outer hull (husk) from the endosperm of grain. The gap between the cylinder and concave is slightly reduced from feed to discharge end, in order to create sufficient grain pressure in the dehulling chamber. The dehulled grain along with husk come out of dehulling chamber and fall by gravity into the husk aspiration unit where the hull is separated out and carried away by the air stream. The hull laden air is passed to a cyclone separator to separate hull from the air. The dehulling efficiency is >95% for most small millets except for brown-top millet for which it is about 75% (2 passes).

2.1.5. Rice puffing machine

Puffed rice is commonly consumed in many parts of the country. Currently, rice puffing is done in a very crude way in batches employing huge labour and energy. A continuous machine with lesser energy requirement would definitely benefit many cottage industries and small processing units. This machine is thus developed for continuous puffing of rice. Liquid petroleum gas (LPG) is used as fuel and the machine is portable. The machine can also be used for puffing or

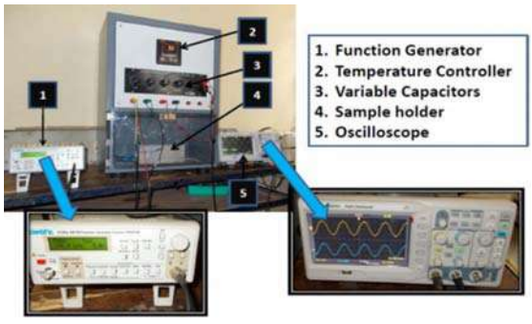
roasting of different grains like gram, paddy etc. The capacity of the machine is 50 kg/h with the cost of Rs 1.25 lakh approximately.

2.1.6. On-farm ventilation storage system for potato

There is the need of on-farm storage systems that would benefit farmers those do not have access to cold stores. The developed on-farm ventilated storage system for potato consists of a blower, temperature controller with sensors, plenum chamber, storage bin, air regulator and a refrigerant unit. It consists of compressor, condenser and expansion valve. A solenoid valve is provided to avoid freezing of the evaporator coil by giving the hot line. The compressor compresses the gaseous refrigerant (R22). The condenser receives the vaporized refrigerant from the compressor and converts it back to liquid and expels the heat outside. Expansion valve is located between the two sets of coils (the chilled coils of the evaporator and the hot coils of the condenser). It keeps tabs on the amount of refrigerant moving towards the evaporator. The capacity of the machine is 500 kg. The dimensions of the outdoor unit are 88 x 31 x 62 cm and it is mounted over proper frame.

2.1.7. Development of a portable non-destructive device to grade banana based on dielectric properties

Grading is an important unit operation that helps in getting better price for agricultural produce. Bananas need to be graded as per their ripeness to decide their potential market. A portable non-destructive device to determine the ripeness of banana has been developed. It is equipped with a function generator, temperature controller, variable capacitors, sample holder and oscilloscope. The function generator produces sinusoidal sweep signal with variable magnitude and frequency generates 5V sine wave over the frequency range of 10 kHz to 1MHz. Current flow in the circuit is measured by industrial multimeter. The sample holder has been designed in such a way that when the fruit is placed between the capacitor plates, the spring arrangements automatically adjust the plate distance according to the fruit thickness. The input (Vi) and output (Vo) voltage were measured continuously for banana and empty chamber during the ripening period. Sample testing time is 30 seconds.



2.1.8. Peeling machine of *Perkia speciosa*/burghii (local Yongchak)

Perkia beans are commonly consumed in North-east region of the country. However, the peels of the beans is very sticky and difficult to separate. Currently, the separation is done manually by women folk involving a lot of drudgery. Hence, this machine has been developed to mechanize this operation. The developed machine is able to reduce drudgery involved in the peeling process of very sticky perkia bean. It can peel about 60-70 beans/h against 30-50 beans in conventional method.

2.1.9. Mobile pork cutting, display-cum-selling unit

Generally, pork is cut, displayed and sold in open conditions. This attracts microbes and pests rendering the meat unsafe and unhygienic. The owners or sellers are not generally resource-rich and thus cannot afford expensive meat display units. A mobile unit that can display, store the pork at chilled temperature and has provision for cutting the pork chunks into smaller pieces is developed for small vendors. A tricycle has been modified and designed to form the base of the mobile pork cutting, display cum selling unit. The unit is made up of stainless steel top and is having freezer for storage of bulk pork, water storage tank, wash basin, cutting area with butcher's log, and cabinet for safe keeping of knife, apron and other accessories.

2.1.10. Cocoa bean fermenter

Fermentation is an important operation for cocoa processing and responsible for imparting the typical colour and flavour in the final product. Traditionally, farmers ferment the cocoa by heaping a batch of cocoa beans and covering the heap with perforated plastic sheets. This method is crude, unhygienic and susceptible to adverse environmental conditions besides taking more than 14 days to complete. A cocoa fermenter has been thus developed to avoid the problems faced by farmers and cocoa processors. Five kg of fresh cocoa beans are loaded in the cocoa fermenter (75% capacity) through the top opening. The chamber is closed and kept idle for 24 h to collect the cocoa sweating (cocoa honey). Sweating is released due to the breakdown of mucilaginous pulp surrounding the cocoa beans. After 24 h, the cocoa beans are properly mixed by rotating the agitator blades inside the cocoa chamber. Again, the chamber is kept idle for another 6 more days after providing proper insulation to the chamber using jute gunny bags. The mixing of cocoa beans is done at every two days interval. The fermentation is completed in 5 days in comparison to 10-14 days taken by traditional fermentation.

2.2. Process protocol developed by AICRP-PHET

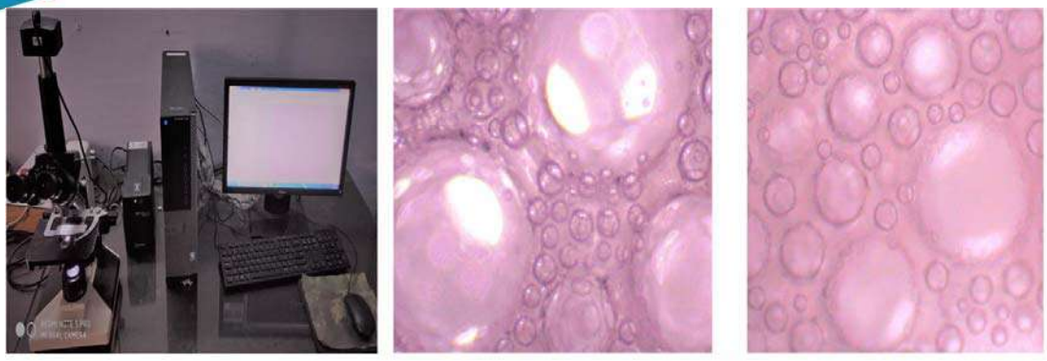
2.2.1. Modified aloe polysaccharide gel (MAP) and Powder

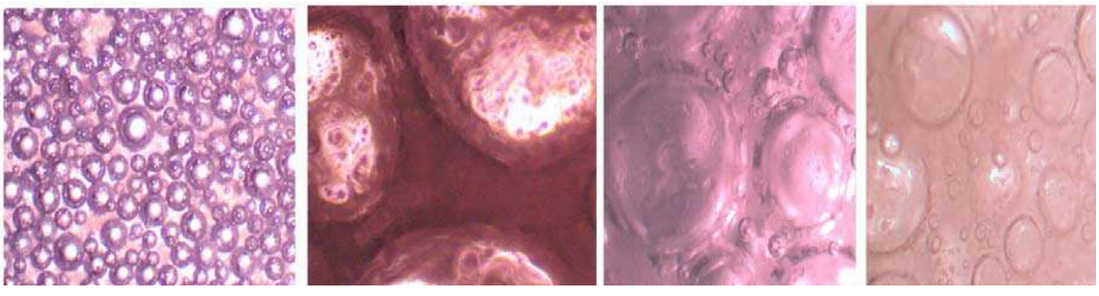
The aloe gel currently available in the market has lower pharmaceutical effect owing to

higher molecular weight of the polysaccharides. Thus, a process has been developed to obtain the low molecular weight polysaccharide chains in the aloe gel. The optimum conditions for developing modified aloe polysaccharide gel (MAP) gel are 0.64% of cellulose enzyme concentration, 60 min of exposure time, and temperature at 37.25 oC. This process resulted in MAP aloe gel with total soluble solids (TSS) of 0.8920 °Brix, Colour (*L*) value of 30.287, optical density (OD) of 0.3167, viscosity of 1.0598 cP, polysaccharide content of 46.99% and molecular weight of 46.956 kDa with desirability of 0.820.

2.2.2. Modified aloe polysaccharide powder

A process for manufacturing of quality MAP powder has been developed. The developed MAP gel was treated with varying foaming agents like glycerol monostearate/soy-protein isolate concentration, foaming stabilizer carboxymethyl, cellulose concentration and whipping for various time periods to get MAP aloe powder with maximum foam stability, foam expansion, average bubble diameter and minimum foam density.





2.3. Product developed by AICRP-PHET

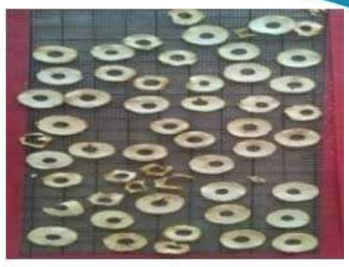
2.3.1. 'Kalpa bean to bite' chocolate

'Kalpa Bean to Bite' is a nutritious and tasty product of ICAR-CPCRI centre of AICRP on PHET. It is a lactose-free, low glycemic index, vegan dark brown chocolate. Cocoa beans of finest quality and purity are blended with coconut sugar. Coconut sugar is a natural concentrate from fresh and hygienic sap of *coconut spadix* (Kalparasa®) that is collected in a scientific way using 'coco-sap chiller'. It produces the finest texture and tastes of chocolate. Each bite is loaded with amino acids, polyphenols, antioxidants, minerals and vitamins. A complete processing protocol consisting of fermentation, drying, roasting and winnowing of cocoa beans, refining of nibs with coconut sugar and cocoa butter, tempering, moulding, refrigeration, demoulding, packaging and storage for the preparation of bean to bar chocolate using cocoa and coconut sugar has been standardized.

2.3.2. Ultrasonicated osmo-dried apple rings and pear cubes

Dried apple and pear are consumed in many parts of the country especially in Himachal Pradesh, J&K etc. Traditionally, these fruits are cut manually and sun dried. However, sun drying leads to browning and unhygienic products. Many drying methods have been

Ultrasonication treatment



Dried in mechanical drier at 50°C and 60°C

used to dry these fruits that lead to relatively better product quality in comparison to sun drying. A new method of hybrid drying has been standardized to dry apple and pear rings. This hybrid drying method is suitable for 4 mm thick apple rings with skin and pear cubes of 3 cm3 volume without skin. Other standardized parameters are; sucrose concentration of 50 and 60 °Bx for apple and pear respectively, and ultrasonication treatment time of 30 min in syrup. Drying kinetics of apple and pear have been studied by using different mathematical models. Midilli model was found to be best for both fruits and drying curve of fruits showed that maximum water removal occurred at a falling rate, thereby major phenomenon of drying is through moisture diffusion. In the slope method, the effective moisture diffusivity varied between 1.45 to 1.77 X 10-9 and 5.38 to 5.94 X 10-10 due to increase in the temperature from 50 to 70 °C for apple rings and pear cubes, respectively and activation energy is calculated to be 5.69 and 5.65 kJ mol-1 for drying of both the fruits. Reduction in total drying time 38% for apple and 33% for sand pear fruits was observed.

2.3.3. Eco-friendly packaging material using banana leaves for packaging and hauling of meat and meat products

With the growing menace of single-use plastics and subsequent ban by the government, there is a dire need to find alternative solutions that are environment-friendly and bio-degradable. Investigations were conducted for banana leaf-based packaging material to carry fish and meat. It was observed that the packages prepared for carrying the perishable items (fish/ meat) were satisfactory as the material did not stick with the packaging material. The approximate cost is Rs.4 for a 3-4 kg capacity banana leaf based bag.

2.3.4. Activated carbon from walnut shell

A by-product of walnut processing units is walnut shell which needs to be utilized to enhance the profitability of these units. In this connection, a process has been standardized for production of activated carbon from walnut shells.

The activated carbon produced thereof had moisture content 1.5-2%, ash content 0.8-1.1% and iodine vale 182-185 mg/gram. Ash and moisture content of activated carbon

developed from walnut shell is found to be lower than reported by others. Due to lower ash and moisture content, the activated carbon can prove to be more efficient in water adsorption.

2.3.5. Binder-free briquettes from sugarcane bagasse

Bagasse briquettes are an alternative to wood as fuel and facilitate easy handling and cost reduction in transportation. The calorific value of bagasse briquettes is 4452 kcal/kg, which is higher than raw bagasse and thus could be well utilized as a fuel in the food processing industries.

Sugarcane bagasse obtained after crushing of sugarcane was sun dried up to moisture of 2-3% (d.b.). Dry bagasse material is fed to the screw feeder in briquetting machine to transfer the same to grinder, where the material is crushed and passed through screens. The sieved material is mixed with hot air and conveyed through pipe to the cyclone, where the material is forced through a die system to convert into briquettes. Using briquetting machine, cylindrical briquettes of 4 cm diameter and 25 cm length can be prepared with sugarcane bagasse without using any binder. Briquettes from sugarcane bagasse can reduce the volume of biomass by 88-92%.

3.1. Machineries by PEASEM

3.1.1. UV based filtration system and its evaluation

The UV radiation filtration system has been designed based upon the field requirement which is 200 liters per hour but tests indicate that it works effectively even at influent flow rate of 250 liters per hour. It has been evaluated in comparison to slow sand filter for nutrient recycling. The filtration system is quite effective as it is able to kill more than 95% of pathogens. With increase in the flow rate of influent the decrease in effectiveness of the system is observed.

3.1.2. Mini tractor operated plastic mulch laying machine

JAU, Junagadh centre has developed and evaluated mini tractor operated plastic mulch laying machine. It consists of adjustable components like furrow openers, press wheels, soil covering shovels etc.The developed machine is suitable for laying of plastic mulch film up to 1000 mm. The plastic mulch film is stretched effectively without tearing on the beds. Both the edges of film are covered properly by the soil gathered by shovels. The effective field capacity and field efficiency of the developed machine is found to be 0.301 ha/h and 72.60 percent respectively. The saving in time and cost is 92.91 and 80.37 percent as compared to manual plastic mulch film laying method.

3.1.3. Sensor network based irrigation system

Sensor based irrigation control and wireless telemetry system plays an important role in precision farming for improving agricultural water productivity. ICAR-VPKAS, Almora centre has developed one such system. The developed sensor works on electrical resistance principle and signal transmission from sensor to micro controller wirelessly. The performance evaluation of developed sensor has been compared with gravimetric method and time domain reflectometry. Satisfactory results are found. Further studies are under progress.

3.1.4. Aquaponic systems for fish and plant biomass production

A Nutrient Film Technique (NFT) aquaponics system has been designed and developed at CIFA, Bhubaneshwar centre. It is equipped with Fibre Reinforced Plastic (FRP) with circular fish culture tank (Ø 2.15×0.9 m, operational capacity of 2800 liter), trickling bio-filtration unit utilizing 85 liter volume filled with 10-25 mm gravels and seashell (S:V=12.77), hydroponics tanks (4×0.9×0.35 m) with an optimum water column of 0.25 m containing trays with 72 perforations (Ø2.5") to hold the plastic mesh pots and a 200 liter sump made of HDPE with three conductive water level sensors and a 0.3 HP submersible water pump for the recirculation. The system has been operated for 45 days with pangas and tilapia (ratio 1:1) in the fish rearing tank with stocking density 1.8, 3.6 & 5.4 kg/m^3 in T-1, T-2 & T-3 respectively and marigold plant 24 nos/m^2 in the hydroponics tank. It has been observed that the average fish growth is 0.8 kg/m^3 and plants height gain is 250, 230 and 130 mm in hydroponics with T-1, T-2 & T-3, respectively. Marigold flowers are harvested thrice with an average of 260, 200,150 flowers in 1st, 2nd & 3rd harvest, respectively. Least Flower production is observed in the unit with the highest stocking density.

3.1.5. Growth Performance of the Goat kids in two tier housing vs. traditional housing system

Initial findings of growth trial shows that animals housed in two tier system have shown more body weight gain (up to 22.81 % in Barbari breed and 7.63 % in larger breeds Further, in this two tier system

Initial findings of growth trail show that animals housed in two tier system had higher body weight gain (up to 22.81 % in Barbari breed and 7.63 % in larger breeds). Further, in this two tier system, double number of animals can be housed in same area land.

3.1.6. Modified solar operated PCM based push cart

Solar operated phase change material based fruits and vegetables vending push cart" has been developed with capacity of 02 quintal of produce. Comprises of two chambers, one is cool chamber for fruits and vegetables and another chamber is for commodities like onions, garlic, potato etc. It is made of polypropylene sheets, FRP sheets, stainless steel (sheets, angle, flats), EPF thermocol, solar PV panels, batteries etc. with Sliding/ collapsable solar panels costs about Rs. 1 Lakh (approx.) (*varies depending on cost of PCM*)

3.1.7. Rectangular Plastic feeder for adult goats

The feeding and watering devices used for goats vary widely in different goat farms of the country. The feed wastage recorded to the tune of 30-40% in goat farms due to faulty feeding devices in addition to feeding habit and normal tendency of goats to contaminate feed, which is great loss to goat keepers who rears goats under stallfed conditions. In any organized livestock farm, feed cost accounts for seventy percent of their running expenditure. Therefore, it is necessary to reduce the feed loss for sustainably running the farm on long run. To minimize this loses, a rectangular plastic feeder (CIRG-RP) has been developed from 1" PVC pipe, PVC joints, 2-3 mm FRP sheets, nut and bolts etc.

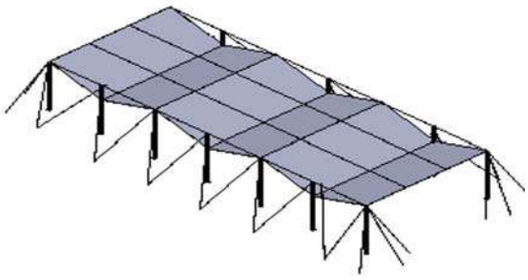
This feeding device is made of plastic materials hence avoids recurring expenses like painting and wear & tear as compared to conventional feeders made of iron. Lighter in weight, hence less man power is required to handle in the goat farm i.e. easy to move in the paddocks. It can accommodate all type of feeding materials simultaneously like concentrate, dry fodder and green fodder**.** It eliminate contaminations of feed through urine and faeces**.** It reduces feed wastage in goat farm i.e. almost nil wastage in concentrate feed, 5-10 percent wastage in case of dry and green fodder. The height of feeding trough is fixed at shoulder point height of animals, therefore, height of feeder varies with the breed and age categories. This developed feeder has the scope of adjustment of height using joints as per need. It reduces agonistic feeding behavior among goats like butting at the time of feeding, competition for feed etc.

Capacity: Suitable for feeding 10-12 adult goats, 5 to 6 in each side.

Cost: Rs.3500-4000/-

3.1.8. Anti Hail-net Structures

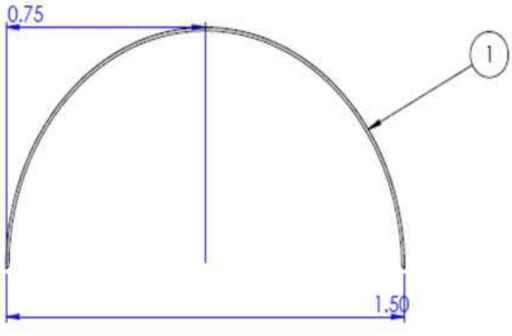
Various types of structures have been designed and installed at four locations namely, ICAR-CIPHET, Ludhiana, ICAR-VPKAS Almora, SKAUST-K Srinagar and CSKHPKV Palampur. Retractable anti hail-net structure with length x width x height of 21 x 8x 4.5 m and cladding material of silver white color having mesh size of 3x3 mm, has been installed at ICAR-CIPHET, Ludhiana, over the mango orchard. Flat type anti hail-net structure having length x width x height of 25x 20 x 3.66m has been installed over the high density apple orchards at SKUAST-K, Srinagar. Two type of structures namely modified Quonset shape and even span anti hail-net structures with length = 22m, width = 5m, side height = 2.5m and Centre Height = 3.5m have been installed over the Blue berry crop at CSK HPKV, Palampur. Single tree model of anti-hail structure with diameter of 2-4m and height of 3-6m depending on the type of tree are installed at VPKAS, Almora on the farmer's field.



All the structures are capable of preventing crop from hails. However, retractable type anti hail-net of 3x3 mm mesh size of nylon type has been found to be most suitable. This type of structure is self-cleaning. The accumulated hails fall automatically between the rows of trees/ plants. It costs approximately Rs. 250/m^2 and the life of structure is about 12-15 years.

3.1.9. Low Tunnel Structures

Quonset type Low tunnel is a miniature portable poly house which can be put on the crop or removed as per the climatic conditions. These structures have been installed at ICAR-CIPHET, Ludhiana, SKUAST-K, Srinagar and VPKAS, Almora centres.The design of low tunnel for



strawberry cultivation in semi-arid areas and for cultivation of vegetables and onions in temperate areas has been standardized. The central height of tunnel is 75 cm with covering of 250 microns UV stabilized LDPE sheet is found to the most suitable. Life of structure is approximately 2 years with a setup cost of Rs. 40/m^2. Even bamboo frame can be used for construction of low tunnels. It is observed that yield of strawberry increases by 50% from 400 gm per plant to 600 gm per plant. Fruiting period has been extended by 35 days. In temperate and in cold desert regions, low tunnel technology is useful for production of vegetables.

3.2. Process Technology by AICRP-PEASEM

3.2.1. Post-harvest management of fresh litchi

BAU, Ranchi has conducted the study on post-harvest management of fresh litchi. The TSS and pH of fresh litchi is observed 19-22° Brix and 4.6, respectively. The weight of fresh litchi varies between 5.4 to 13.4 g. The fresh litchi have been dried in tray dryer at 50°C and 60°C.The without treated and pretreated fresh litchi are used for drying study. The pretreatment of litchi is done with sodium metabisulfite (1%) and citric acid (1%) for 10 min. The drying time for the litchi samples without treated and pretreated litchi samples is 54 h and 50 h, respectively at 50°C while it is 52 h and 46 h, respectively at 60°C.

The storage study of dried litchi nuts both without treated & pretreated and dried at 50°C and 60°C have been conducted under pet jar, LDPE pouch and Al pouch. The quality parameters of dried litchi in terms of visual color, flavor, texture and overall sensory acceptability and for moldy growth have been evaluated. Based on sensory evaluation of litchi (dried at 60°C) after 84 days of storage, the pretreated litchi has better score than without treated litchi.

3.2.2. Effect of cladding materials on microclimate of naturally ventilated polyhouse

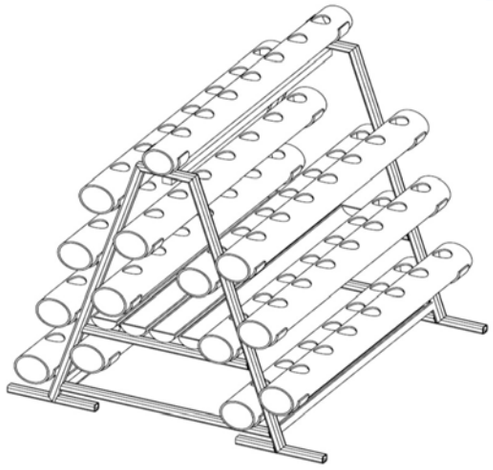
The BIS standard for bamboo based structure, design, cladding material etc., is considered in design of structure. The size of gable type even span polyhouse is 12m length, 4.5m width, center height 3m and side height 2m with slope 23.7° with East-West

IS Code	Details
IS14462: 1997	Recommendations for layout, design and construction of greenhouse structures
IS15912: 2012	Structural design using bamboo - Code of practice
IS 9096: 2006	Preservation of bamboo for structural purposes — Code of practice
IS 14485: 1998	Recommendations for heating, ventilation and cooling of green houses
IS 15827: 2009	Plastic film for greenhouses-Specifications
IS 875(Part 3) : 1987	Code of practice for design loads (other than earth quake) for buildings and structures- Part 3 wind loads

orientation. Ventilation area is 44% of floor area. The bamboo poles of large diameter (>8 cm) for columns, tie, beam and bottom chord and smaller diameter (>6 cm) for other supporting structure have been used in construction of polyhouse. The ANN modeling is being done for data monitoring (temperature, RH, light intensity etc.)

3.2.3. Technology of hydroponics system for balcony has been developed

Technology of vertical balcony hydroponics system (Fig. 11) is developed with the following specifications:



No. of pipes	14
Holes per pipe	7
Total no. of holes	98
Cropping area per hole	44.15 cm^2
Total cropping area of holes	4326.7 cm^2
4 pipes at center cropping area	5040 cm^2
Total cropping area	9455 cm^2
length of structure	1.95 m
Width of structure	1 m
Total cropping area	9455 cm^2
Total dead load	81.6 Kg
Total live load with coriander crop	72.2 Kg

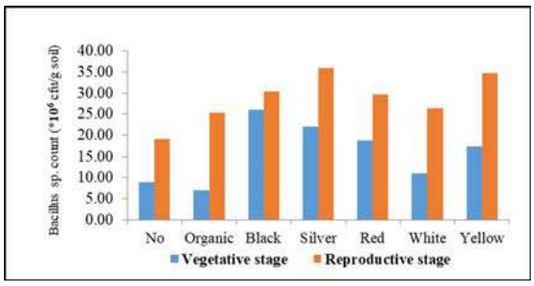
From results of different days after transplanting it is found that in case of vegetative character like number of leaves, plant height, number of branches and plant girth it was found highest under polyhouse. 45 days after transplanting number of leaves inside polyhouse was 182 while in open field it was 92.5 and highest number of leaves means higher chlorophyll which leads to more plant growth in terms of plant height 80.2 cm, number of branches 8.3 and stem girth 9.4 mm (Table 1).

Table 1. Variation in plant growth vegetative character of tomato crop under polyhouse and open field conditions

Number of leaves	Number of leaves		Height (cm)		Branches		Girth(mm)	
DAT	Open field	polyhouse	Open field	polyhouse	Open field	polyhouse	Open field	polyhouse
15DAT	22.8	37.2	23.8	34.7	0	3.9	4.2	5.4
30DAT	52.6	92.9	36.5	57.4	3.5	5.3	6.1	7.5
45DAT	92.5	182	46.8	80.2	7.8	8.3	8.65	9.4

3.2.4. Positive influence of different crop mulching on the plant beneficial rhizospheric microorganisms during at different tomato growth stages

The microbial quantity in tomato rhizosphere of different colored plastic mulch was found to be significantly higher than no mulch treatment. The highest population of phosphorous solubilizing microorganism (PSMs) at the vegetative stage (50.33± 1.44×10^6 cfu gm^{-1}soil) and reproductive stage (88.67±1.19×10^6 cfu gm^{-1}soil) was significantly higher in the rhizosphere of yellow mulch and organic mulched grown tomato plants. Likewise, the highest count of potassium solubilizing microorganisms (KSMs) during both growth stages was observed under the silver mulch treatment. In case of *Bacillus* sp., plants during their vegetative stage in black mulch film treatment had the highest bacterial population (26.00×10^6 cfu gm^{-1} soil), while the lowest abundance of soil *Bacillus* bacteria was recorded in organic mulched plant. *Bacillus* sp. population during reproductive/fruiting growth was recorded the highest in silver mulch treatment (36.00 × 10^6 $cfug^{-1}$ soil), while it was lowest in no mulch treatment.



3.2.5. Influence of different crop mulching on soil microbial biomass and dehydrogenase activity observed at crop harvest stage

Since, soil dehydrogenase activity and soil microbial biomass (SMB) are directly linked with soil microbial community abundance and structure, an increase in population of observed plant beneficial microorganisms could be responsible for increased soil dehydrogenase activity and SMB activity observed during crop harvest stage. The highest soil dehydrogenase activities that indicate the overall metabolical potential of agricultural soil was found the highest in the silver mulched plants (9.64±0.14 ug *triphenylformazan (*TPF) released/g/day), which were almost 111.22% higher than that of no mulched conditions. Likewise, SMB, which responsible for organic matter decomposition and release of plant available nutrients, was also recorded the significantly higher in the silver and black mulched soil while it was lowest in control (Table 2).

Table 2. Influence of different mulching on soil microbial biomass and dehydrogenase activity of tomato rhizosphere soil

Mulch treatment	Soil dehydrogenase activity(ug TPF/g/day)		Soil microbial biomass (ug/g soil)	
	2019-20	% changes over control	2019-20	% changes over control
No mulch	4.56±0.24D		64.60±0.83F	-
Organic mulch	5.84±0.30CD	28.00	106.20±0.83C	64.38
Black mulch	7.79±0.96B	70.57	178.32±1.46A	176.03
Silver mulch	9.64±0.14A	111.22	183.19±2.50A	183.56
Red mulch	5.94±0.21CD	30.11	95.58±2.92D	47.95
White mulch	6.80±0.12BC	49.09	77.44±2.29E	19.86
Yellow mulch	6.63±0.35BC	45.29	140.27±1.88B	117.12

3.2.6. Impact of plastic and organic mulching on nutrient status of tomato fruits

The highest concentrations of Mg (1.87gkg^{-1}), Zn (31.10 mgkg^{-1}) and Cu (17.82 mgkg^{-1}) was observed in the tomatoes plucked from yellow mulch treatment. Fruits harvested from black mulch treatment showed the highest uptake of P (4.42 gkg^{-1}) and Bo (15.28 mgkg^{-1}) in their tissue. Likewise, fruits harvested from silver mulch treatment showed the highest uptake of Mn and S in their tissue. Crop mulching that positively influenced rhizosphere microorganism's population could have further contributed to improved plant growth and better mineral uptake by the plant.

Effect of different crop mulching on tomato yield

In general, applications of the different colored plastic mulching had significant impact on the crop yield of tomato (Table 3). Highest tomato yield in the plant grown under silver mulch treatment (2.40 kg plant^{-1}), followed by the yellow mulch treatment (1.96 kg plant^{-1}). The lowest yield of tomato was observed in the no mulched condition. Two season experimental data, silver mulch treatment was showed more effective in increasing crop yield over other treatments. Almost, there was 135.33% increase in crop yield in silver mulch over the crop yield obtained from no mulched conditions.

3.2.7. Studies of mulching on growth, yield and quality of pulse (Cow pea) under drip irrigation system

The present study was conducted to assess the effect of different mulches (no-mulch, black, organic and silver) on physical, physiological and biochemical quality of cowpea beans. Results indicated that organic mulch was the best followed by silver mulch in terms of higher accumulation of bioactive compounds, major and micronutrients and quality pods (Table 4).

Table 3. Influence of different mulching on tomato fruit yield

Yield attributes/ mulch treatment	Average yield/plant (Kg/plant)			
	2018-2019	2019-2020	Mean of two season	% increase over control
No mulch	1.28	0.76	1.02	-
Organic mulch	0.94	1.14	1.04	1.80
Black mulch	1.95	1.59	1.77	73.50
Silver mulch	2.40	2.40	2.40	135.33
Red mulch	1.48	1.55	1.51	48.44
White mulch	1.84	1.20	1.52	48.75
Yellow mulch	2.42	1.96	2.19	114.53

Table 4. Effect of mulching treatments on physical and biochemical parameters of cowpea beans

Treatment	Dry matter (%)	Moisture content (%)	Protein content (%)	Total Phenolics (µg GAE/100 g FW)	Total Antioxidants activity (µmol trolox eq. /100g)
No mulch	10.89	89.11	24.16	11.83	24.56
Black	10.07	89.93	25.88	13.98	28.72
Organic	9.57	90.43	28.63	17.00	46.84
Silver	9.81	90.19	27.01	15.00	30.00

Awards and Recognitions

Awards

S. No.	Name of Awardee	Name of Award
1.	Dr. Khwairakpam Bembem	Best oral presentation in 'National Conference on Technological and Emerging Aspects in Agriculture and Community Science at International Buddhist Research Institute, Lucknow (7-8 February 2020).
2.	Mr. Vikas Kumar	Best Scientist Award 2020 on 32nd Foundation Day (3 October 2020), by ICAR-CIPHET, Ludhiana.
3.	Dr. B. M. Ghodki Er. Yogesh Kalnar Ms. Surya Tushir Dr. K. Narsaiah Dr. R. K. Singh	Best Technology Award 2020 for "Potable Smart Ultraviolet-C Disinfection System (UV*i*C)"on 32nd Institute Foundation Day (3 October 2020), by ICAR-CIPHET, Ludhiana.
4.	Dr. Th. Bidyalakshmi Devi	Best Sports Person Award 2020 on 32nd Institute Foundation Day (3 October 2020), by ICAR-CIPHET, Ludhiana.
5.	Dr. Mahesh Kumar Samota	Best Article Awards 2020 • Magical super foods (Pay less and stay healthy): A crisp view on wonder crop: Millets, Agriculture and Food E-Newsletter (ISSN 2581 8317), 2(6): article Id: 30068 • Sucrose-Starch Metabolism in plants under drought stress, Agriculture and Food E-Newsletter (ISSN 2581 8317), 2(7): article Id: 30683

Recognition

S.No.	Name of Scientist	Recognition as	Recognized by
1	Dr. D. N. Yadav	Member of Scientific Panel on Cereals, pulses & Legumes and their products (including bakery)	FSSAI, New Delhi
2	Dr. Ramesh Chand Kasana	Editor	Journal of Microbiological Research
3	Dr. B.M. Ghodki	Member of Food Group	Society of Chemical Industry (SCI), London

Intellectual Properties (Licensing and Patents)

Technology Licensed 2020

S. No.	Title	Firm	Licensing Fee (Rs.)*	Date of Licensing
1.	Wadi making machine	M/s Empire Bakery Machines Pvt. Ltd., opp. Gurudwara Somasar Sahib Vill.Tibba P.O., Sahnewal, Punjab – 141120	50000	31.01.2020
2.	No-Touch Automatic Dispenser for hand sanitization	M/s Forming & Forging Industries, #3858, St. - 1, New Janta Nagar, Gill Road Ludhiana-141003 Managing partner S. Dilraj Singh	15000	18.05.2020
		M/s Sakhi Soaps, Hindustan Soaps and Salts Company, Prakasam, Andhra Pradesh Manager Mr. A.Balaji sakhisoaps@gmail.com	15000	18.05.2020
3.	Portable Smart Ultraviolet-C Disinfection System (UViC)	M/s Sakhi Soaps, Hindustan Soaps and Salts Company, Prakasam, Andhra Pradesh Manager Mr. A.Balaji sakhisoaps@gmail.com	15000	18.05.2020
		M/s CRD Invotech, 38, Darda Nagar, Yavatmal - 445001, Maharashtra Proprietor Mrs. Snehal Dudhe crdinvotech@gmail.com	15000	02.06.2020
		Mr. Ishinder Dhir, S/o Mr. Narinder Kumar Dhir, H.No. 16-17 B, Tagore Nagar, Ludhiana, Punjab – 141001 dhirishinder@gmail.com	15000	27.06.2020
4.	Ozone based Fruits and Vegetable Washer-Cum-Purifier (Ozo-C)	M/s CRD Invotech, 38, Darda Nagar, Yavatmal - 445001, Maharashtra Proprietor Mrs. Snehal Dudhe crdinvotech@gmail.com	20000	02.06.2020
		M/s Siri Labs, Ongole, Andhra Pradesh through its Proprietor A. Sirisha	20000	02.06.2020
		Mr. Ikram Haider, 520 B Mutthiganj, Allahabad, Uttar Pradesh ikram007haider@gmail.com 8853920026	20000	30.06.2020

S. No.	Title	Firm Fee (Rs.)	Licensing Licensing	Date of
5.	Ready to constitute makhana kheer mix (Patent no. - 287541)	M/s Mithila Naturals Private Ltd., Village- Jarail-Arer, SH 52, District- Madhubani- 847223 (Bihar) manish@mcgpl.in	50000	07.07.2020
		Ms. Renu Mishra, U-173, 3rd Floor (left side), Upadhyay Block Shakarpur, Near Kotak Mahindra Bank, Shakarpur, Laxmi Nagar (East Delhi), Delhi-110092 weswf14@gmail.com 9810374208	50000	08.09.2020
6.	Process for Preparation of Rose Petal Jam (Patent application no. - 202011021332)	Ms. Shruti Goyal, C/O Baldev Krishan Goyal, H.No. 2628, Filly Gate, Jagraon, Ludhiana, Punjab-142026 shrutigoyal768@gmail.com	20000	24.08.2020
7.	Process for Preparation of Fat Free Flavoured Makhana (Patent application no. - 201911036120)	M/s Mithila Naturals Private Ltd., Village- Jarail-Arer, SH 52, District- Madhubani- 847223 (Bihar) manish@mcgpl.in	25000	07.07.2020
		Ms. Renu Mishra, U-173, 3rd Floor (left side), Upadhyay Block Shakarpur, Near Kotak Mahindra Bank, Shakarpur, Laxmi Nagar (East Delhi), Delhi-110092 weswf14@gmail.com 9810374208	25000	09.09.2020
8.	Apparatus for Production of Microcapsules (Patent No. 330252)	M/s Bio-Age Equipments & Services, Plot No. 468, Janata Land Industrial Park, Sector-82, Mohali-Chandigarh, Punjab-140306 CEO Mr. S. K. Rana ceo@bioageindia.com	20000	11.09.2020
9.	Mechanized System for Primary Roasting of Raw Makhana Seeds and Process Thereof	M/s Unitech Technocrats, Vill. Meerpur Gurudwara, Kala Amb (Sirmour)-173030 H.P.	50000	03.10.2020
10.	Process for Preparation of Alcoholic Beverage with Nutraceutical Properties from Kinnow Peels (Patent No. 337178)	M/s Bio-Age Equipments & Services, Plot No. 468, Janata Land Industrial Park, Sector-82, Mohali-Chandigarh, Punjab-140306	50000	17.10.2020

*: +GST 18% extra

Licensing of "Wadi making machine" to M/s Empire Bakery Machines Pvt. Ltd., Sahnewal (Punjab) on 31.01.2020

Licensing of "No-touch automatic dispenser for hand sanitization" to M/s Forming &Forging Industries, Ludhiana through its Managing partner S. Dilraj Singh and to M/s Sakhi Soaps, Andhra Pradesh through its Manager Mr. A.Balaji (through digital mode) on 18.05.2020

Licensing of "Portable smart ultraviolet-c disinfection system (UViC)" & "Ozone based fruits and vegetable washer-cum-purifier (Ozo-C)" to M/s CRD Invotech, Maharashtra through its Proprietor Mrs. Snehal Dudhe & M/s Siri Labs, Ongole, Andhra Pradesh through its Proprietor A. Sirisha (through digital mode) on 02.06.2020

Licensing of "Portable smart ultraviolet-c disinfection system (UViC)" to Sh. Ishinder Dhir, Ludhiana on 27.06.2020

Licensing of "Ozone based fruits and vegetable washer-cum-purifier (Ozo-C)" to Mr. Ikram Haider, Allahabad, Uttar Pradesh (through digital mode) on 30.06.2020

Licensing of "Ready to constitute makhana kheer mix" & "Process for preparation of fat free flavoured makhana" to M/s Mithila Naturals Private Ltd., Bihar on 07.07.2020

Licensing of "Ready to constitute makhana kheer mix" & "Process for preparation of fat free flavoured makhana" to Ms. Shruti Goyal, Jagraon on 24.08.2020

Licensing of "Ready to constitute makhana kheer mix" & "Process for preparation of fat free flavoured makhana" to Ms. Renu Mishra, Delhi on 09.09.2020

Licensing of "Apparatus for production of microcapsules" to M/s Bio-Age Equipments & Services, Mohali (through digital mode) on 11.09.2020

Licensing of "Process for preparation of alcoholic beverage with nutraceutical properties from kinnow peels" to M/s Bio-Age Equipments & Services, Mohali on 17.10.2020

Patents Granted (2020)

S.No.	Application/ Registration No.	Title	Date of grant	Patent No.	Inventors
1	121/DEL/2012	Design of guar dehulling machine for guar gum split production	29.12.2020	354655	Dr. R.K. Vishwakarma Dr. S.K. Nanda Dr. U.S. Shivhare
2	398/DEL/2011	Tray dryer having a unique design of plenum chamber	19.06.2020	338839	Dr. K.K. Singh Dr. D.M. Kadam Dr. R.T. Patil
3	1049/DEL/2013	Process for preparation of alcoholic beverage with nutraceutical properties from kinnow peels	21.5.2020	337178	Dr. H.S. Oberoi
4	3050/DEL/2011	Automatic machine forscooping out the pulp from custard apple fruits	05.03.2020	334054	Dr. V.E. Nambi Dr. R.K. Gupta Dr. R.K. Vishwakarma
5	3878/DEL/2012	Air powered sausage filler	18.02.2020	332317	Dr. K. Narsaiah Dr. S.K. Devatkal
6	10/DEL/2011	Apparatus For Production of Microcapsules	24.01.2020	330252	Dr. K. Narsaiah Dr. H.S. Oberoi

Patents Filed (2020)

S. No.	Application Number	Title	Date of Filing	Inventors
1	202011012279	Novel process for preparation of soft aonla candy	21.03.2020	Ms. Prerna Nath Dr. Sakharam J. Kale Dr. R.K. Vishwakarma Dr. D.N. Yadav Dr. R.K. Singh
2	202011021332	Process for preparation of rose petal jam	21.05.2020	Dr. Mridula D. Dr. Deepika Goswami Dr. R.K. Vishwakarma Er. Akhoon A. Bashir Er. Indore Navnath Dr. R.K. Singh
3	202011037651	Mechanized system for primary roasting of raw makhana seeds and process thereof	01.09.2020	Ms. Kalyani Sharma Dr. S. Patel Dr. R.K. Vishwakarma Dr. Mridula D. Dr. S.N. Jha

Post-Harvest Machinery and Equipment Testing Centre (PHMETC)

The Post-Harvest Machinery and Equipment Testing Centre (PHMETC), ICAR-CIPHET, Ludhiana has tested 11 machines during 1 January - 31 December 2020 earning a total testing fees of Rs. 1411470 (Rupees Fourteen Lakh Eleven Thousand Four Hundred Seventy).

S.No.	Name of the Machine	Name of Industry	Testing Fee received (Rs.)
1.	Mini Rice Mill	Ramsons Impex, Bhagwanpur, Uttrakhand	207400.00
2.	Mini Rice Mill	S.R. Engineering & Services, Wardha, Maharashtra	125477.00
3.	Air Screen Grain Cleaner	M.G. Industries, Batala, Punjab	361911
4.	Mobile Tractor Operated Rice Mill		
5.	Mini Dhal Mill		
6.	Flour Mill (Cabinet Type)	Ramsons Impex, Bhagwanpur, Uttrakhand	354771
7.	Flour Mill 3HP		
8.	Flour Mill 5HP		
9.	Mini Rice Mill	Lal Ji and Sons, Roorkee, Uttrakhand	361911.00
10.	Pulverizer (Flour Mill- 3 HP)		
11.	Pulverizer (Flour Mill- 5 HP)		
	Total		**1411470**

Capacity Building

Capacity Building of Institute Scientific/Technical/Administrative Staff

	Scientific			Technical			Administrative		
	Within Institute	Outside Organizations (India)	Inter-national	Within Institute	Outside Organizations (India)	Inter-national	Within Institute	Outside Organizations (India)	Inter-national
Number of persons	0	26	1	1	7	0	1	15	0
Total number of days	0	339	7	14	65	0	15	30	0
Amount spent (Rs. in lakhs)					6.92 lakhs				

S. No.	Name	Title of HRD programme	Venue	Number of days
Scientific				
1.	Dr. Sandeep Mann	Management Development programmes on 'Leadership development' (a pre-RMP programme)	ICAR-NAARM, Hyderabad	14
2.	Dr. K. Bembem	FPO's linkage with extension, inputs, infrastructure, value addition and market	PAU, Ludhiana	2
3.	Dr. Renu Balakrishnan	Training programme on 'Innovative practices in extension research and Evaluation'	ICAR-NAARM, Hyderabad	5
4.	Dr. Renu Balakrishnan	Summer school on 'Cutting-edge epitome of processing, value addition and waste utilization of horticultural crops for augmentingfarmers income'	ICAR-CIPHET, Ludhiana	21
5.	Dr. D. N.Yadav	Management Development programmes on 'Leadership development' (a pre-RMP programme)	ICAR-NAARM, Hyderabad	14
6.	Dr. D. N.Yadav	Workshop on 'Preparation of EFC/PIB projects'	ISTM, New Delhi	2
7.	Dr. Mridula D.	Management Development programmes on 'Leadership development ' (apre-RMP programme)	ICAR-NAARM, Hyderabad	14
8.	Dr. Mridula D.	Training workshop for vigilance officer of ICAR for scientific staff	ISTM, New Delhi	2
9.	Dr. Bhupendra M Ghodki	Training programme on 'PLC and microcontrollers'	ICAR-CIAE, Bhopal	2
10.	Dr. Poonam	One day workshop on 'Challenges in sample preparation, column/chemistries selection with new chromatography instrument'	NIPHM, Hyderabad	1
11.	Dr. Poonam	Two days workshop on 'Lab forum India-2019'	NIPHM, Hyderabad	2

S. No.	Name	Title of HRD programme	Venue	Number of days
12.	Dr. Guru P. N.	One day sensitization workshop on 'Impending insect threats in Punjab'	PAU, Ludhiana	1
13.	Dr. Guru P. N.	Workshop on 'Preparation of EFC/PIB	ISTM, New Delhi	2
		projects'		
14.	Dr. Deepika Goswami	Winter school on 'Technological advances in functional foodingredients and validation of their claims'	ICAR-NDRI, Karnal	21
15.	Mr. Vikas Kumar	Winter school on 'Recent advances in fish processing, value additionand waste utilization'	CAU, Agartala	21
Technical				
1.	Sh. Vishal Kumar	One day sensitization workshop for head of the administration andfinance officers	ISTM, New Delhi	1
Administrative				
1.	Sh. B. C. Katoch	One day sensitization workshop for head of the administration andfinance officers	ISTM, New Delhi	1
2.	Sh. Rajendra Kumar Raheja	One day sensitization workshop for head of the administration andfinance officers	ISTM, New Delhi	1
3.	Sh. Gurdial Singh	One day sensitization workshop for head of the administration andfinance officers	ISTM, New Delhi	1
4.	Sh. B. C. Katoch	Training programme on 'Public procurement for central govt. officers'	ISTM, New Delhi	3
5.	Smt. Jasvir Kaur	Training programme on 'Public procurement for central govt. officers'	ISTM, New Delhi	3
6.	Sh. Iqbal Singh	Training programme on 'Public procurement for central govt. officers'	ISTM, New Delhi	3
7.	Sh. Hajari Lal Meena	Management development programme on 'Administrative and financial management for deputy secretaries, chief administrative officers, chief finance and account officers, SAO's undersecretaries and SFAOs'	ISTM, New Delhi	2
8.	Sh. B. C. Katoch	Workshop for improving skills of administrative staff of ICAR dealing with court cases	ISTM, New Delhi	2

Trainings Organized

Entrepreneurship Development Programme

Five entrepreneurship development programmes were organized under the CRP on SA Project on "Establishment of modern agro-processing centers for fruits and vegetables" at ICAR-CIPHET, Ludhiana. Eighteen budding entrepreneurs from different places of Punjab were trained and successfully completed the programme during this year.

S. No.	Title	No. of participants	Duration
1.	Processing and value addition of amla	02	6-10 January 2020
2.	Processing and value addition of onion	03	26-28 May 2020
3.	Processing and value addition of green chilli	03	24-26 August 2020
4.	Processing and value addition of green chilli	06	31 August-2 September 2020
5.	Processing and value addition of amla	04	23-28 December 2020

Entrepreneurship development programme on "Processing and value addition of onion"

Entrepreneurship development programme on 'Processing and value addition of green chilli'

An entrepreneurship development program was conducted on 'Tomato processing and value addition' during 11-13 March 2020 for one person. Dr. Pankaj Kannaujia, Scientist and Dr. V. K. Saharan, coordinated the training program at ICAR-CIPHET, Abohar Campus.

HRD Programmes Organized

S.No.	Programme Title	Number of Participants	Duration
	Entrepreneurship Development Programme (EDP)		
1.	Drying and dehydration of fruits and vegetables	12	01-04 January 2020
2.	Aonla processing and value addition	2	06-10 January 2020
3.	Drying technology of vegetable	17	24-26 February 2020
4.	Microencapsulation of food ingredients	1	26-29 February 2020
5.	Processing and value addition of tomato	1	11-13 March 2020
6.	Processing and value addition of onion	3	26- 28 May 2020
7.	Three days training to budding entrepreneur on chemical-free jaggery production	1	14-16 July 2020
8.	Processing and value addition of green chilli	3	24-26 August 2020
9.	Processing and value addition of green chilli	6	31 August - 2 September 2020
10.	Ready to constitute makhana kheer mix	1	7 July 2020
11.	Process for preparation of fat-free flavoured makhana	1	7 July 2020
12.	Process for preparation of rose petal jam	1	24 August 2020
13.	Ready to constitute makhana kheer mix	1	7-8 September 2020
14.	Process for preparation of fat-free flavoured makhana	1	9 September 2020
15.	Training on groudnut/soya processing	2	8-9 October, 2020
16.	Preparation of soy milk and tofu	2	8-9 October 2020
17.	Processing and value addition of amla	4	23-28 December 2020
	Farmer's Training		
1.	Importance of post-harvest technology	30	06-10 January 2020
2.	Post-harvest management of paddy and value addition of rice	50	16-18 January 2020
3.	Packaging of coarse food grains specially millets and its processed products	26	12-14 March 2020
4.	Production of solid and granular Jaggery	02	15 July 2020
5.	Rabi crops management	40	03 December 2020
6.	Soil management	21	05 December 2020
7.	Demonstration of fruit and vegetable processing machine	41	11 December 2020
8.	Demonstration of sprinkler irrigation for crop production	20	27 February 2020
9.	Grain storage and warehousing	50	15 December 2020
	SCSP Training		
1.	Post-harvest management of paddy and value addition of rice' at Sanjenthong, Imphal East	50	16-18 January 2020
2.	Processing and value-addition of cereals	15	25- 27 November 2020
	ATMA Sponsored		
1.	Post-harvest management of fruits and vegetables	25	10-14 February 2020

Farmers training on Importance of post-harvest technology

Farmers training on 'Importance of post-harvest technology' was conducted at ICAR-CIPHET for 30 farmers from Jalgaon district of Maharashtra during 06-10 January 2020. The training programme was sponsored by Project Director, ATMA, Taluka Agricultural Office, (Bodwad Chopda & River), Maharashtra.

Farmers training on Post-harvest management of paddy and value addition of rice

Farmers training on 'Post-harvest management of paddy and value addition of rice' was conducted at Manipur during 16- 18 January 2020 under the Scheduled Caste Sub-Plan (SCSP) scheme of Government of India. The training programme was conducted in collaboration with the Department of Agriculture, Govt. of Manipur wherein 50-members participated in this.

Agri business training programme on packaging of coarse food grains specially millets and its processed products

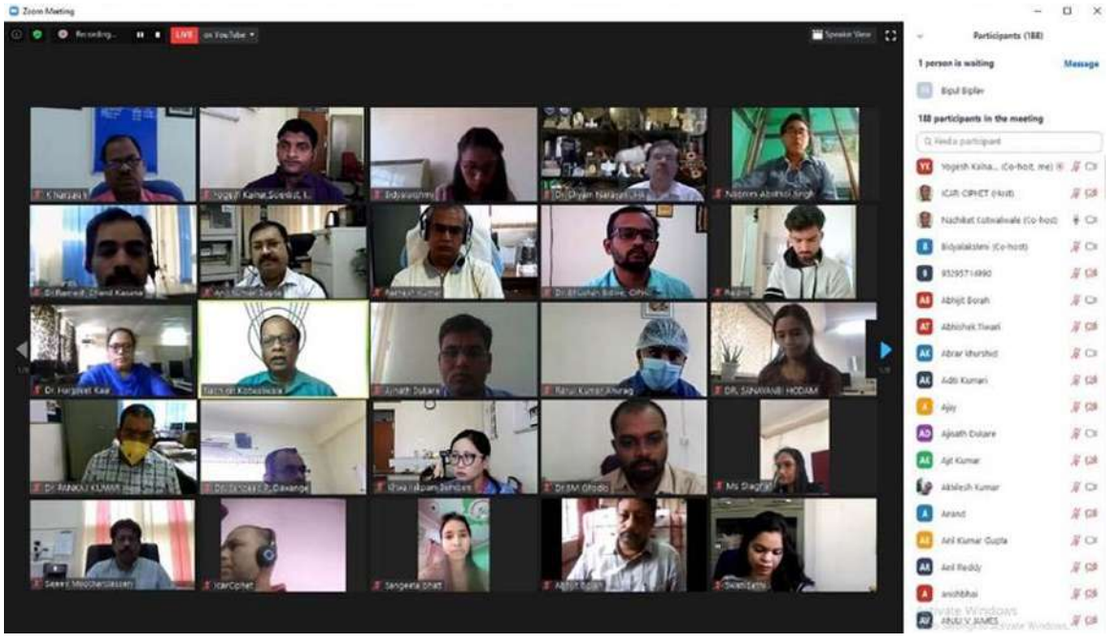
Agri Business training Programme for farmers on 'Packaging of coarse food grains specially millets and its processed products' was organized from 12-14 March 2020 at ICAR-CIPHET, Ludhiana. Twenty six farmers and aspiring young agripreneurs from Chamoli District of Uttarakhand were trained in processing and packaging of millets and coarse grains under the Agri-Business Incubation scheme of ICAR, Ministry of Agriculture and Farmers welfare. The programme aimed to impart hands-on training and upgrade the technical skills of the progressive farmers and budding entrepreneurs in, processing, packaging of coarse food grains especially foxtail, pearl millet, sorghum, quinoa and buck wheat.

Agri business training programme on Groundnut/ Soy processing

Agri Business training Programme on 'Groundnut/ Soy processing' was organised at ICAR-CIPHET, Ludhiana during 08-09 October 2020. Two budding entrepreneurs Mr. Hitesh Sharma & Ms. Rinkal Handa attended this training.

Online training program on Post-harvest management of agricultural produce during natural calamities/disaster

ICAR-CIPHET organized three days online training program on 'Post-Harvest Management of Agricultural Produce during Natural Calamities/Disaster' from 19-21 October 2020 through video conferencing mode, in collaboration with the National Institute of Disaster Management (NIDM), New Delhi.



Skill development training on Processing and value-addition of cereals under Scheduled Caste Sub Plan (SCSP)

Skill Development Training on 'Processing and Value Addition of Cereals' under Scheduled Caste Sub Plan (SCSP), GoI was conducted from 25 - 27 November 2020 at ICAR-CIPHET Ludhiana. A total of 15 participants from weaker section of the society were provided hands-on training. Series of lectures on Processing and Value Addition of cereals were conducted. Value added products from wheat, barley, popped maize and sorghum and bakery products such as gluten free muffins were prepared by the participants.

HRD training on effective health management for enhancing work efficiency

HRD training programme on 'Effective Health Management for Enhancing Work Efficiency of ICAR Employees' was organised during 28-30 December 2020. Ten personnel (including Technical, Administrative, Skilled Support Staff) participated in it. The objective was to acquaint the participants regarding managing their health effectively such that they are able to discharge their duties efficiently in these pandemic (COVID-19) times. The training comprised of sessions on physical health, mental health, stress management, etc. through both online and offline mode.

Students Training

S. No.	Name of College/ University	Degree	Duration	No. of Students
1.	Islamic University of Science & Technology, Awantipora, Kashmir, J&K	B. Tech, Food Technology	1 January to 31 March 2020	30
2.	Vision Institute of Technology, Hathipur, Maharajpur, NH-2, G.T. Road, Kanpur, Uttar Pradesh	B. Tech student	09 January - 08 February 2020	1
3.	Acharya N. G. Ranga Agricultural University, Andhra Pradesh	B.Sc (Hons.) / B.Tech (Agri Engg.)	01-29 February 2020	25
4.	MPUAT, Udaipur, Rajasthan	B.Tech. (Food Tech.)	21 December 2019- 31 March 2020	1
5.	Baba Banda Singh Bahadur Engineering College, Fatehgarh Sahib, Punjab	B.Tech.	01 January- 31 March 2020	1

Dr. Guru, P.N. delivering lecture in HRD programme

Dr. Rahul Kumar Anurag interacting with participants

Skill development training programme on Mechanization of post-harvest operations

Skill Development training programme on 'Mechanization of post-harvest operations' was conducted during 01-29 February 2020. The training programme was sponsored by ANGRAU- IDP, under World Bank NAHEP, for 25 number of students from 4 different colleges of Acharya N. G. Ranga Agricultural University, Andhra Pradesh.

Director, ICAR-CIPHET with scientists and trainees

Krishi Vigyan Kendra (KVK)

Trainings

Training on Drying technology of vegetable

Three days training programme was conducted on 'Drying technology of Vegetable' from 24-26 February 2020 at KVK, ICAR-CIPHET, Abohar. Seventeen Anganwadi workers from surrounding villages of Abohar were trained for preparation of pickles from different vegetable crops.

Training on Management of rabi crops

One day training Programme on 'Management of Rabi Crops' was conducted at KVK, ICAR-CIPHET, Abohar on 03 December 2020. Forty farmers from surrounding villages of Abohar participated and completed the training programme.

Training on Soil health management on World Soil Health Day

KVK, ICAR-CIPHET, Abohar celebrated World Soil Health Day and organized training on 'Soil health management' on 05 December 2020. Twenty farmers took part in this training programme.

Training and Demonstration on Post-harvest machine for fruit processing

Training cum Demonstration on 'Post-harvest machine for fruit processing' was conducted on 11 December 2020 at KVK, ICAR-CIPHET, Abohar. About 41 farmers were introduced to mechanised operation of fruit processing.

Training cum awareness programme on Grain Storage and Warehousing

Training cum awareness program on 'Grain Storage and Warehousing' was organized at KVK, ICAR-CIPHET, on 15 December 2020 in collaboration with Central Warehousing Corporation (CWC) Abohar. About 50 farmers from surrounding villages of Abohar participated in this training.

Demonstrations

Demonstration of Sprinkler irrigation for crop production

Demonstration of 'Sprinkler irrigation for crop production' was conducted on 27 February 2020 at KVK, ICAR-CIPHET, Abohar. Twenty farmers from surrounding villages of Abohar participated and completed the training programme.

Crop Residue Management (CRM) demonstrations

Crop Residue Management Demonstrations were carried out in selected villages of Abohar and Fazilka block covering an area of about 35 hectare land using machinery from custom hiring Centre. In addition one CRM demonstration was also laid down by using KVK machinery in Gobindgarh village on an area of about 10 hectare.

Major Events Organized by Agro Business Incubation Centre (ABI)

S. No.	Title of Programme (Trainings /Workshop /Seminar /Program)	Date of Programme	No. of Participants
1.	Sensitization Program on Agribusiness Entrepreneurship Development through Agro Processing	3 March 2020	25
2.	Processing of Agricultural Commodities (wheat milling, pulse milling & spice grinding)	21-26 December 2020	01

Program on Agribusiness Entrepreneurship Development through Agro Processing at Malakpur Bet Ludhiana on 3 March 2020

Training on "Processing of Agricultural Commodities (wheat milling, pulse milling & spice grinding)" to Mr. Mandeep Singh, Ludhiana during 21-26 December 2020

Swachh Bharat Abhiyan

During the reporting period, the Swachh Bharat Abhiyan activities were performed enthusiastically as per the guidelines of the council. The activities such as cleanliness drive, awareness program, digitization of office records, disposal of old files and items, beautification of the institute campus and displaying banners showing the importance of swachhta have been conducted during the year. While engaging in physical activities, the standard norms of guidelines concerning COVID-19 (wearing mask/ maintaining Physical distance/ avoiding physical contact etc.) circulated by the Government of India /ICAR have been strictly followed.

The "Swachhata Pakhwada" was celebrated with high spirit from 16 – 31 December 2020. All staff of ICAR-CIPHET, Ludhiana and Abohar actively participated in the events. The "Swachhata Pakhwada" was started by taking swachhata pledge through video conferencing on 16 December 2020. Dr. Nachiket Kotwaliwale, Director, ICAR-CIPHET, Ludhiana delivered a speech regarding the importance of swachhata in daily life and participation of each individual in the Pakhwada. Various types of activities were conducted in campus and nearby areas during this Pakhwada.

Among these activities, one activity was organized as Kisan Diwas on 23 December 2020 through online mode. Different farmers participated and a few of them shared their experiences in village cleanliness maintenance and they also appreciated the role of ICAR-CIPHET for post-harvest management.

Commencement of Swachhta activities at ICAR-CIPHET, Ludhiana

Dr. Nachiket Kotwaliwala, Director, ICAR-CIPHET planting and sapling

Staff involving in Swachhta activities at ICAR-CIPHET, Abohar

Sensiting villagers on Swachhta

Cleaning roads as a part of Swachhta Abhiyaan

Interaction of ICAR-CIPHET, Abohar staff with villagers

Poster displayed during poster competition

Swachhta Awareness Campaign in street

Major Events Organized

Sr. No.	Event	Date	Duration (day/s)
1.	Republic Day Celebration	26 January 2020	1
2.	World Potato Conclave Live Telecast	28 January 2020	1
3.	International Women's Day Celebration	08 March 2020	1
4.	International Yoga Day Celebration	21 June 2020	1
5.	Institute Research Council (IRC) Meeting	08-10 July 2020	1
6.	Independence Day Celebration	15 August 2020	1
7.	Live telecast program on PM Kisan Nidhi and Atamnirbhar Krishi	09 August 2020	1
8.	राजभाषा हिन्दी पखवाड़ा	14-28 September 2020	15
9.	पोषण माह	17 September 2020	1
10.	हिन्दी कार्याशाला एवं गांधी जी के सुविचार पर व्याख्यान	25 September 2020	1
11.	Yoga event to commemorate during 150th Birth anniversary of Mahatma Gandhi	30 September 2020	1
12.	Vigilance Awareness Week	27 October - 02 November 2020	7
13.	Rashtriya Ekta Diwas	31 October 2020	1
14.	Indian Constitution Day	26 November 2020	1
15.	World Soil Health Day	05 December 2020	1
16.	Virtual Business Meet on Post-Harvest and Value Addition Technologies Developed at ICAR-CIPHET, Ludhiana	10 December 2020	1
17.	Kisan Diwas	23 December 2020	1
18.	Live telecast of PM Kisan Samman Nidhi Yojna	25 December 2020	1
19.	Meeting of Scientific Advisory Committee (SAC) of KVK, Abohar	31 December 2020	1

Republic Day Celebration

ICAR-CIPHET celebrated 71st Republic Day to honour the date on which the Constitution of India came into effect. On this occasion Dr. R.K. Singh hoisted the tricolour and addressed the staff of the institute. Different cultural and sports activities were organized for staff and their family members after the flag hoisting ceremony.

Dr. R.K. Singh, I/c Director hoisting the National Flag on Republic Day

Kids participating in the race competition

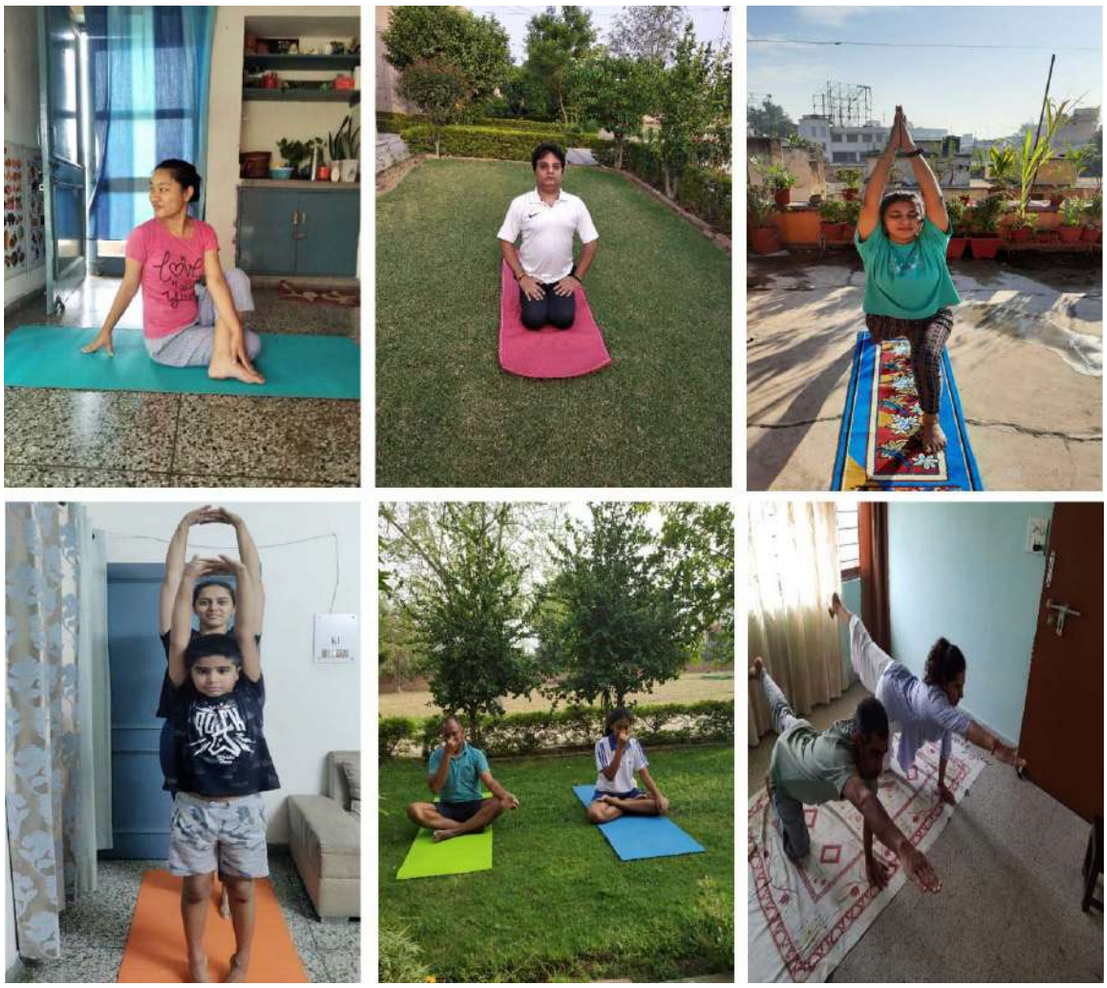
International Women's Day Celebration

ICAR-CIPHET celebrated International Women's Day (IWD) on 8 March 2020. Dr. (Mrs.) Gurinder Kaur Sangha, Dean, Post Graduate studies, Punjab Agricultural University, Ludhiana, was the chief guest of the function. The similar function was also organized at KVK, Abohar under ICAR-CIPHET Ludhiana where 44 participants attended the function. Dr. Manju Bala, chairperson, women cell and IWD organizing committee, ICAR-CIPHET, Ludhiana, welcomed all the participants and enlightened the gathering by sharing the history of International Women's Day. The chief guest Dr. (Mrs.) Gurinder Kaur Sangha, Dean, Post Graduate studies, PAU, Ludhiana emphasized on the need of empowering women and gender equality for better society. She further added that gender equality can be achieved when we believe, we are equal, and independent socially as well as economically. She voiced the importance of upbringing of girl child and family values and urged everyone to support gender equality. Director, ICAR-CIPHET, Ludhiana elaborated the audience about the women centric programs organized by the Institute. He also accentuated that prevailing discrimination and preference for boy child in Indian society is still there, and discussed ways to mitigate gender disparity. Dr. Mridula D, I/C Head FG &OP division and chairperson of Institute women complaint committee stressed that self-confidence, and believe in one self is key to empower women. Shri HL Meena, Senior Administrative Officer, ICAR-CIPHET, Ludhiana shared his experiences on gender disparity that still exist in certain villages in some states of India. All women scientists also shared their views. A poem for women was recited by Dr. Vikas Kumar, Scientist, ICAR-CIPHET, Ludhiana. Dr. Bembem, Scientist, ICAR-CIPHET, Ludhiana proposed vote of thanks.

Dr. R.K. Singh, I/c Director welcoming Dr. (Mrs.) Gurinder Kaur Sangha, Dean, PGS, PAU on International Women's Day

International Yoga Day Celebration

ICAR-CIPHET celebrated International Day of Yoga (IDY) on 21 June 2020 at ICAR-CIPHET. This year's theme 'Ghar Ghar me Yog' which signifies the importance of staying at home and practice Yoga with family while observing social distancing. Staff and their entire family celebrated the day staying at home keeping away from contagious Corona virus as suggested by Ministry of AYUSH.



CIPHET staff with their kids participation in International Yoga Day

Independence Day Celebration

The institute celebrated 74th Independence Day at both the campuses on 15 August 2020. Dr. R.K. Singh, Director (Acting), ICAR-CIPHET unfurled the Tricolour in Ludhiana campus and addressed the staff on the occasion. He stressed upon the importance of post-harvest management, maintaining health and hygiene, taking Covid-19 precautions, and staying positive.

Dr. R.K. Singh, I/c Director hoisting the National Flag on 74th Independence Day

राजभाषा हिंदी पखवाड़ा

प्रत्येक वर्ष की भांति, संस्थान में इस वर्ष दिनांक 14 से 28 सितम्बर 2020 तक राजभाषा हिन्दी पखवाडा मनाया गया। समारोह का उद्घाटन दिनांक 14 सितम्बर 2020 को मुख्य अतिथि, डा. आर. के. सिंह, निदेशक, भा.कृ.अनु.प.– सीफेट, लुधियाना के कर कमलों द्वारा किया गया। इस अवसर पर वैज्ञानिक एवं स्टाफ सदस्यों को सम्बोधित करते हुए उन्होने हिन्दी के प्रचार–प्रसार के लिए दिनचर्या में सरल शब्दों के प्रयोग पर जोर दिया। भा.कृ.अनु.प.–सीफेट, लुधियाना मे वैज्ञानिक एवं प्रशासनिक कार्यो में हो रहे हिन्दी के उपयोग की मुख्य अतिथि ने सराहना की और संस्थान के समस्त वैज्ञानिकों से अनुरोध किया कि वे अपने शोध–पत्रों को हिन्दी भाषा में प्रकाशित करने पर जोर दें। इस अवसर पर संस्थान की हिन्दी पखवाड़ा समिति के अध्यक्ष रमेश चंद कसाणा ने हिन्दी के महत्व को उजागर करते हुए पखवाडे के दौरान 15 दिनों तक चलने वाली विभिन्न प्रतियोगिताओं एवं कार्यक्रमों की रूपरेखा बताई। राजभाषा हिन्दी पखवाड़ा समिती के सदस्य श्री विकास कुमार, श्री हजारी लाल मीना, श्री मन्नी लाल और श्री अशवनी कुमार का कार्यक्रम के आयोजन में महत्वपूर्ण योगदान रहा।

राजभाषा हिन्दी पखवाडा समारोह के अन्तर्गत विभिन्न संयोजकों एवं सह–संयोजकों के सहयोग से आठ प्रतियोगिताएँ जैसे हिंदी टिप्पण एवं प्रारूप लेखन प्रतियोगिता, प्रार्थना पत्र प्रतियोगिता, कंप्यूटर पर यूनिकोड में हिंदी टाइपिंग प्रतियोगिता, हिंदी निबंध प्रतियोगिता, हिंदी काव्य पाठ प्रतियोगिता, हिंदी अनुवाद प्रतियोगिता, वाद विवाद प्रतियोगिता, विज्ञान संबंधी शोध पत्र प्रतियोगिता आयोजित की गई। राजभाषा हिन्दी पखवाडा के अन्तर्गत आयोजित सभी प्रतियोगिताओं में संस्थान के सभी अधिकारियों एवं कर्मचारियों ने बढ़–चढ़कर हिस्सा लिया। दिनांक 28.09.2020 को डा. आर. के. सिंह, निदेशक, सीफेट, लुधियाना द्वारा प्रतियोगिताओं के विजेताओं के पुरस्कार घोषणा की गई। इसके अतिरिक्त संस्थान में हिन्दी में किये गये कार्यों का मूल्यांकन कर संस्थान के कर्मचारियों को भी पुरस्कृत किया गया एवं अधिक से अधिक हिन्दी में कार्य करने के लिए सभी को प्रोत्साहित किया गया।

डॉ. आर.के. सिंह, निदेशक, राजभाषा हिन्दी पखवाड़ा का ऑनलाइन शुभारम्भ करते हुए

संस्थान के अधिकारी एवं कर्मचारी राजभाषा हिन्दी पखवाड़ा में भाग लेते हुए

Vigilance Awareness Week

ICAR-CIPHET, Ludhiana and Abohar Campus observed the Vigilance Awareness Week and organized the different activities during 27 October- 2 November 2020. The week started with the pledge taking ceremony by the I/c. Director, Sr. Administrative Officer, Finance & Accounts Officer, all the scientists, technical and administrative staff of both the campuses of the Institute. Slogan and poster competition on 'सतर्क भारत और समृद्ध भारत' were organized with certificate distribution to the winners. A virtual workshop on 'Corruption Free INDIA, Prosperous INDIA' was organized on 2 November 2020 through google meet. The Chief Guest of valedictory function and Guest Speaker for the Workshop, Mr. Rohit Mehra, IRS, Assistant Commissioner, Income Tax Office, Ludhiana delivered his talk and shared his experiences and views to make India vigilant and prosperous. The week was concluded on 2 November 2020 with presentation of certificates to the winners of poster and slogan competition. Dr. Nachiket Kotwaliwale, Director, ICAR-CIPHET expressed his views on 'सतर्क भारत और समृद्ध भारत' and emphasized to work with highest level of honesty, integrity and dedication for the growth of the Institute and benefit of the stakeholders.

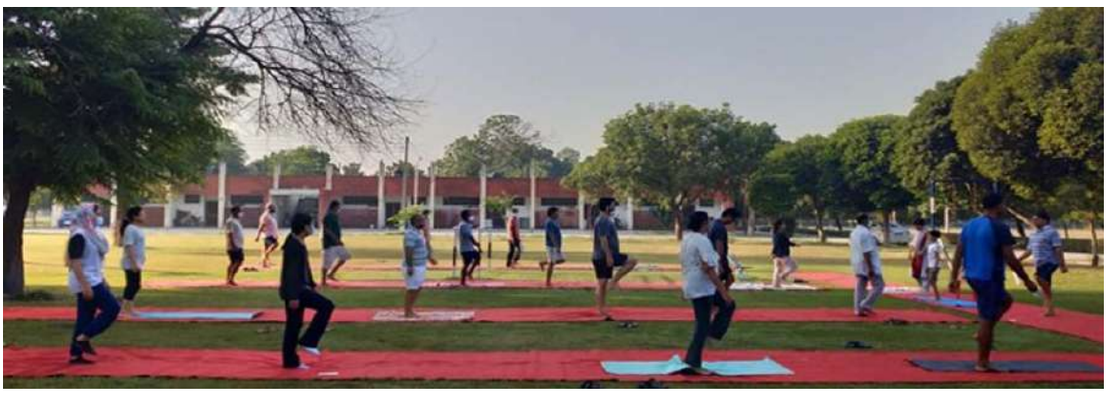
Commemoration of 151st Birth Anniversary of Mahatma Gandhi

राष्ट्रपिता महात्मा गाँधी जी की 151 वीं जयंती पर ऑनलाइन व्याख्यान का आयोजन

राष्ट्रपिता महात्मा गाँधी जी की 151 वीं जयंती के उपलक्ष्य में, 25 सितम्बर से 2 अक्टूबर 2020 के दौरान आयोजित विभिन्न कार्यक्रमों की श्रंखला के अंतर्गत, 25 सितम्बर 2020 को 'गाँधी जी के सुविचार' विषय पर इंटरनेट के माध्यम से एक व्याख्यान का आयोजन किया गया। इस विशेष अवसर पर श्रीमती किरण साहनी, सहायक निदेशक (राजभाषा) एवं सदस्य सचिव (न.रा.का.स.), लुधियाना को अतिथि वक्ता के रूप में आमंत्रित किया गया। इस विषय पर अपने उदगार व्यक्त करते हुए श्रीमती किरण साहनी जी ने हिंदी भाषा के प्रचार, प्रसार और इस भाषा के अनुसरण के बारे में महात्मा गाँधी जी के विचारों को पूर्ण रूप से लागू करने की प्रासंगिकता पर बल दिया। इस अवसर पर संस्थान के निदेशक डॉ आर. के. सिंह ने संस्थान के सभी कर्मचारियों को गाँधी जी के बताए हुए सत्य और अहिंसा के मार्ग पर चलते हुए, सादा जीवन और उच्च विचारों के आदर्श को अपनाते हुए संस्थान एवं देश की प्रगति में योगदान देने पर बल दिया। इस कार्यक्रम में संस्थान के दोनों कैम्पस के समस्त स्टाफ उपस्थित थे।

Yoga Event

To commemorate 150th Birth anniversary of Mahatma Gandhi, father of the nation, a series of programs were organized at ICAR-CIPHET, Ludhiana during 25 September- 2 October 2020.In this series, Yoga event was organized at Institute campus, on 30 September 2020 at 7.30 am. ICAR-CIPHET staff and their family members participated in this event.



Webinars

National Webinar on 'Business Opportunities in Fish Post-Harvest

Dr. R.K. Singh, I/c Head, ToT Division and Vikas Kumar, Scientist (FPT) coordinated a national webinar on 'Business Opportunities in Fish Post-Harvest' on 05 June 2020. Dr. C.N. Ravishankar, Director, ICAR-CIFT, Cochin was expert speaker. About 1200 participants registered for the event and 700 participated in live session.

Virtual Business Meet on Post-Harvest and Value Addition Technologies developed at ICAR-CIPHET, Ludhiana

ICAR-CIPHET organized a Virtual Business Meet on post-harvest and value addition technologies developed by the institute on 10 December 2020. The meeting aimed at showcasing some recently developed technologies to the prospective stakeholders, food processors, entrepreneurs, impending start-ups, machinery manufacturers, farmers and rural youths. A total of 450 national as well as international stakeholders attended the virtual meeting. Altogether 12 business viable technologies, including machines for makhana processing, wadi making, live fish carrier system, horticultural and speciality products processing machines, their related technologies and also processes for speciality product were showcased during the meeting to encourage the firms/entrepreneurs/ agripreneurs for establishing the agribusiness enterprise.

Live telecast on PM Kisan Money Transfer

ICAR-CIPHET organized live telecast on PM Kisan money transfer on 25 December 2020. Staff and 40 farmers participated in the live telecast under Pradhan Mantri Kisan Samman Nidhi (PM-Kisan) *via* video conferencing.

Farmers with CIPHET scientists participating in live telecast of PM Kisan Samman Nidhi via video conferencing

SAC (Scientific Advisory Committee)

Scientific Advisory Committee meeting was organized on 31 December 2020 by KVK, ICAR-CIPHET, Abohar under the chairmanship of Dr. Nachiket Kotwaliwale, Director ICAR-CIPHET. Dr. Ramesh Kumar I/c KVK, ICAR-CIPHET, Abohar and Member Secretory, SAC presented the achievements of KVK for 2020 and action plan for 2021. All together 30 Officers and Scientist from PAU, and ICAR-CIPHET participated in this meeting.

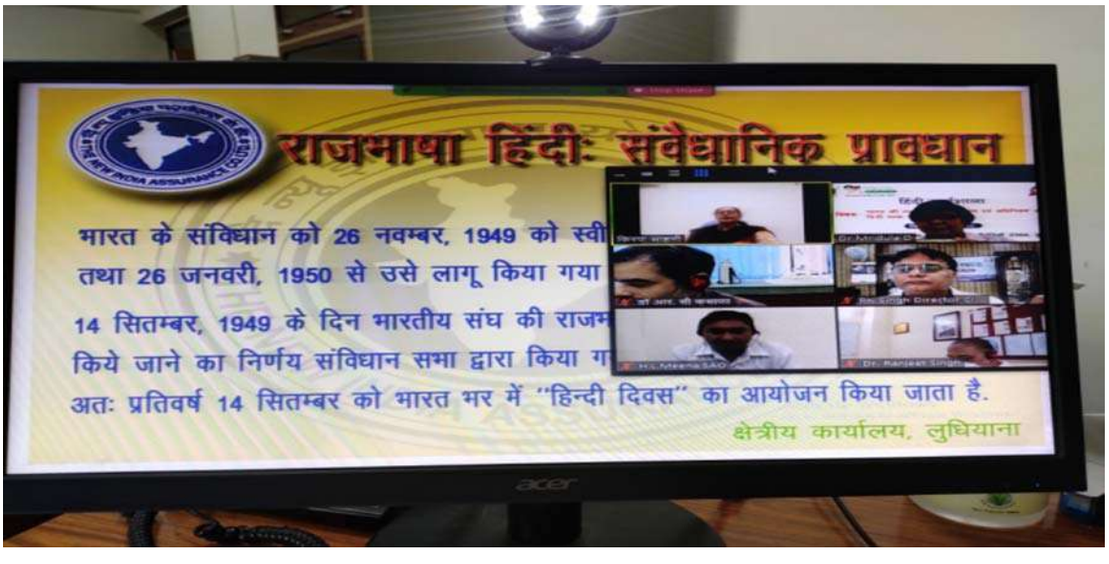
Dr. Nachiket Kotwaliwale, Director chairing the meeting of Scientific Advisory Committee at KVK,Abohar

हिंदी कार्यशालाएँ

- सीफेट, लुधियाना में 30 जून 2020 को सामाजिक दूरी के नियमों का पालन करते हुए हिंदी कार्यशाला का आयोजन किया गया। इस कार्यशाला के दौरान 'मुख्य प्रशासनिक शब्द', 'कार्यालय संबधी हिंदी में पत्राचार' एवं 'मत्स्य प्रसंस्करण उत्सर्जित अपशिष्ट का उपयोगः आय उपार्जन का एक अवसर' आदि विषयों पर, संस्थान के अधिकारियों द्वारा चर्चा की गयी।

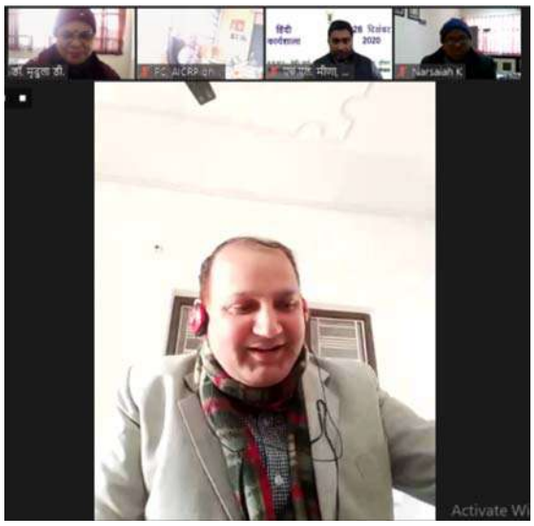
श्री विकास कुमार, वैज्ञानिक, हिन्दी कार्यशाला के दौरान व्याख्यान करते हुए

- सीफेट, लुधियाना में 25 सितम्बर 2020 को सामाजिक दूरी के नियमों का पालन करते ऑनलाइन 'हिंदी कार्यशाला' का आयोजन किया गया। इस कार्यशाला के दौरान संस्थान के अधिकारियों एवं कर्मचारियों के अलावा, मुख्या वक्ता श्रीमती किरण साहनी, सहायक निदेशक (राजभाषा) एवं सदस्य सचिव (न.रा.का.स.), लुधियाना ने 'भारत की राजभाषा नीतिः नियम एवं अधिनियम' एवं 'हिंदी भाषा एवं शिष्टाचार' विषयों पर अपनी प्रस्तुति देकर सभी को लाभान्वित किया।



ऑनलाइन माध्यम से हिन्दी कार्यशाला में भाग लेते हुए संस्थान के अधिकारी एवं कर्मचारी

- सीफेट, लुधियाना में 26 दिसंबर 2020 को सामाजिक दूरी के नियमों का पालन करते ऑनलाइन 'हिंदी कार्यशाला' का आयोजन किया गया। इस कार्यशाला के दौरान संस्थान के अधिकारियों एवं कर्मचारियों के अलावा, मुख्य वक्ता डॉ. कुलदीप सिंह, सहायक प्राध्यापक (हिंदी), गवर्नमेंट डिग्री कॉलेज, चौकी मनिआर, ऊना (हि.प्र.) ने 'मानक हिंदी वर्तनी' और 'भाषा, आचरण एवं व्यवहार' विषयों पर अपनी प्रस्तुति देकर सभी को लाभान्वित किया।



Linkages & Collaboration

ICAR-CIPHET inks MoU with IIFPT, Thanjavur, Tamil Nadu

ICAR-CIPHET signed MoU with Indian Institute of Food Processing Technology (IIFPT), Thanjavur on 13 January 2020 to facilitate a collaborative program of research, skill development, consultancy, institutional development, information dissemination and students in-plant training.

ICAR-CIPHET signs MoU with GADVASU, Ludhiana, Punjab

ICAR-CIPHET and Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana have entered into an agreement on 24 August 2020 under which both the institutions will cooperate with each other in academic and research pursuits.

ICAR-CIPHET in Media

वैज्ञानिकों ने तैयार की बड़ियां बनाने वाली आटोमैटिक मशीन

एक घंटे में तैयार होगी 300 किलो बड़ियां

डा संदीप मान।

लुधियाना, 31 जनवरी (सतूजा) : यदि आप बड़ियां खाने के शौकीन हैं तो फिर अब आपको अमृतसर जाने की जरूरत नहीं पड़ेगी। आप अपने घर बैठे ही करारी व कम करारी बड़ियों को स्वाद ले सकेंगे। सैंट्रल इंस्टीच्यूट ऑफ पोस्ट हारवैस्टिंग इंजीनियरिंग एंड टैक्नॉलोजी (सीफेट) के वैज्ञानिकों ने एक ऐसी कंप्यूटराइज्ड आटोमैटिक मशीन तैयार की है जो केवल एक घंटे में ही 300 किलो बड़ियां तैयार कर देती है। मूंग व उड़द की दाल से तो बड़ियां तैयार होती ही हैं लेकिन आप वेजिटेबल मिक्स वाली भी बड़ियों का स्वाद भी ले सकते हैं।

सीफेट के वैज्ञानिक डा संदीप मान ने बताया कि उन्होंने अपने सहयोगी वैज्ञानिक डा धरितमान के साथ मिलकर लगभग दो वर्षों की खोज के बाद ये बड़ियां तैयार करने वाली मशीन विकसित की है। उन्होंने बताया कि मशीन की खोज करने की प्रेरणा सीफेट के वैज्ञानिकों डा एस के त्यागी व डा एस एन झा से ही मिली। इससे 9 अलग-अलग तरह की बड़ियां बना कर उसका लुत्फ ले सकेंगे।

फलों व सब्जियों को कीटाणू मुक्त करने हेतु वैज्ञानिकों ने बनाया ओजोन सिस्टम

पोर्टेबल सिस्टम के साथ सीफेट के वैज्ञानिकों की टीम। (सीतमल)

लुधियाना, 27 मई (सतूजा): कोरोना महामारी के दौरान बाजार से खरीद कर घर लेकर आए फलों व सब्जियों का कैसे करें इस्तेमाल को लेकर बहुत से लोग आज तक दुविधा में पड़े हुए हैं। कई लोग तो पहले छिड़कने अथवा उसके बाद पानी निकालने पर फिर फलों व सब्जियों को कीटाणु मुक्त करने हेतु धोते हैं। कुछ लोग तो इन खाने वाले उत्पादों को अपने घर के ड्योढ़ी पर या किसी स्थान पर कुछ समय के लिए रखने के बाद इनका इस्तेमाल करते हैं। इसी बीच फलों व सब्जियों को बैक्टीरिया, खतरनाक कैमिकल व वायरस मुक्त करने हेतु सैंट्रल इंस्टीच्यूट ऑफ पोस्ट हार्वेस्ट इंजीनियरिंग एंड टैक्नोलॉजी (सीफेट) के वैज्ञानिकों ने ओजोन नामक एक नया पोर्टेबल सिस्टम विकसित किया है।

सीफेट के वैज्ञानिक डा. रणजीत सिंह ने बताया कि इस टैक्नोलॉजी का इस्तेमाल घरों, होटलों, छोटे प्रोसैसिंग यूनिटों में आसानी से करके फलों, सब्जियों, मीट आदि उत्पादों को कुछ मिनटों में कीटाणु मुक्त किया जा सकता है जोकि मौजूदा समय में बहुत फायदेमंद साबित हो सकता है।

उन्होंने बताया कि इस टैक्नोलॉजी को निदेशक सीफेट डा. आर.के. सिंह की अगुवाई में डा. के. नरसैया और मिस सूर्या ने तैयार किया है। उन्होंने दावा किया कि इस पोर्टेबल सिस्टम के इस्तेमाल करने से हानिकारक बैक्टीरिया, खतरनाक कैमिकल व वायरस का डर नहीं रहेगा।

2 उद्यमी महिलाओं ने सीफेट से प्राप्त की ओजोन टैक्नोलॉजी

उद्यमी महिलाओं को टैक्नोलॉजी प्रदान करने संबंधी पत्र प्रदान करते सीफेट के वैज्ञानिक। (सेठ बजाज)

लुधियाना, 3 जून (सतूजा): सैंट्रल इंस्टीच्यूट ऑफ पोस्ट हार्वेस्टिंग इंजीनियरिंग एंड टैक्नोलॉजी (सीफेट) से 2 उद्यमी महिलाओं ने ओजोन टैक्नोलॉजी प्राप्त की है। यह वह टैक्नोलॉजी है, जिससे आप फल, सब्जियां व मीट आदि उत्पाद मौजूदा कोरोना संकट की घड़ी में भी पूरी तरह सुरक्षित रखते हुए इस्तेमाल कर सकेंगे।

सीफेट के डायरेक्टर आर.के. सिंह ने महाराष्ट्र की उद्यमी महिला स्नेहल दूबे और मध्य प्रदेश की उद्यमी महिला ए. सिरोशा को शुभकामनाएं भेंट करते हुए उम्मीद जताई कि वे इस टैक्नोलॉजी को आगे शेयर करते हुए घर-घर तक पहुंचाने का काम करेंगी। इस अवसर पर खोज संस्था के वैज्ञानिक डा. के. नरसैया, डा. रणजीत सिंह, मिस सूर्या, इंजीनियर योगेश कलनार और डा. भूपेंद्र एम. घोडकी आदि उपस्थित थे।

नई सोच | कोरोना वायरस की महामारी के मद्देनजर सिफेट ने तैयार की यह मशीन

फल व सब्जियों को कीटाणु मुक्त करेगी ओजोसी

जागरण विशेष

Icar-Ciphet develops portable ultraviolet disinfection system

Times News Network

Ludhiana: Icar-Ciphet (Indian Council of Agricultural Research-Central Institute of Post-Harvest Engineering and Technology) director HK Singh informed that in its contribution to help the nation fight the coronavirus menace, the institute has come out with an ultraviolet-C disinfection system (UVDC), which can be used to sterilise daily use items. A few days ago, the institute had also developed a no-touch sanitiser dispenser.

K Narsaiah, head of AS&EC division, highlighted that non-ionising, germicidal properties of artificial ultraviolet (UV-C) radiation can be used for surface disinfection. Unlike chemical sanitisers, UV-C does not leave a residue, and does not require extensive safety equipment. It works as a mode of surface sterilisation by destroying nucleic acid and disrupting the DNA of micro-organisms.

The Icar-Ciphet developed disinfection machine

Bhupendra M Ghodki, Yogesh Kalnar and Surya Tushir designed this innovative system based on available studies on Severe Acute Respiratory Syndrome Coronavirus-1 (Sars CoV-1) that caused a global epidemic in 2002-2003.

The system is low-cost, based on UV-C technology, having an LCD and an alarm unit. The working capacity (surface area) of the unit is 10x10sq cm, with an estimated unit cost of Rs1,500. However, the system can be scaled up as per the need.

The portable system is made of food-grade stainless steel, coated with reflective material on inner surfaces. This system can be used in two modes: (i) a drawer arrangement for placing portable objects — for example, purse, wallets, phones, currency notes, papers, packed groceries, files, and masks; (ii) a hood-shaped arrangement that can be placed on fixed items, such as door handles, latches, and other surfaces.

The system has been tested for its disinfection properties against Escherichia coli after UV-C exposure of six minutes. The results showed that the growth was nil after incubation of 24 hours. Interest in this technology is quite high because of its easy implementation and inexpensiveness.

In general, it is not feasible to disinfect such paper, file, and similar items using an alcohol-based sanitising gel. Thus, such a compact and smart system is critical in reducing the risk of infection among people as well, and can be used by the corona warriors.

CIPHET develops low-cost washer-cum-purifier

Device to ensure food safety after buying commodities from vendors in the market

COMPACT DESIGN

KNOW THE SYSTEM

Ludhiana Tribune

ICAR-CIPHET organises national webinar on 'Business Opportunities in Fish Post-Harvest'

TOI

LUDHIANA: ICAR-CIPHET, Ludhiana organised a national webinar on 'Business Opportunities in Fish Post-Harvest' through Zoom and Youtube live.

Dr CN Ravishankar, director ICAR-Central Institute of Fisheries Technology, Cochin, Kerala was invited expert speaker. Ravishankar discussed the various opportunities in the line of development of value-added fish products, fish-byproducts, qualities issues, packaging concerns.

ICAR-CIPHET hosts webshop on effect of Covid on post-harvest food handling

The aim was to formulate a policy paper on combating the coronavirus in the production mechanism system for action and guidance of national agencies to ensure zero loss to farmers in production and post-production processing.

LIVE BLOG

ANN
Agri News Network

CIPHET Ludhiana develops Portable Smart Ultraviolet-C Disinfection System (UViC)

Dr. K. Narsaiah
Head AS & EC Division
ICAR-CIPHET, Ludhiana

Dr. Bhupendra M Ghodki
ARS Scientist, (Agricultural Structures and Process Engineering)
ICAR-CIPHET, Ludhiana

Er. Yogesh Kalnar
ARS Scientist, (Agricultural Structures and Process Engineering)
ICAR-CIPHET, Ludhiana

Ms. Surya Tushir
ARS Scientist
(Agricultural Microbiology)
ICAR-CIPHET, Ludhiana

Dr. R. K. Singh
Director
ICAR-CIPHET, Ludhiana

Employee Corner | ICAR old website

भारतीय कृषि अनुसंधान परिषद
Indian Council of Agricultural Research
(Ministry of Agriculture and Farmers Welfare)

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ICAR-CIPHET, Ludhiana develops "Portable Smart Ultraviolet-C Disinfection System" (UViC)

The ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab has developed a smart, compact and Portable Smart UV-C Disinfection System (named UViC) that is useful in fighting against the COVID-19 Pandemic.

The UViC is capable to disinfect the personal items and office stationery, papers, files and similar items for reducing the risk of infection among people. Unlike chemical sanitizers, UV-C does not leave a residue and does not require extensive safety equipments. It works as a mode of surface sterilization by destroying the nucleic acid and disrupting the DNA of micro-organisms.

The working capacity of the unit in terms of the total surface area of the objects to be treated / exposed is 25 25 cm2. Th e estimated cost of the unit is approximately Rs. 1,500. However, the system can be scaled up as per the need.

The Features of the Portable Smart Ultraviolet-C Disinfection System (UViC):

1. The portable system is made of food-grade stainless steel coated with reflective material on the inner surfaces.
2. The LCD can prompt the user to operate the system.
3. The system can be used in two modes
   - For lightweight removable objects: A drawer arrangement for placing objects, for example, purse, wallets, phones, currency notes, papers, packed groceries, files and masks, etc.
   - For items which are fixed on surfaces: A hood-shaped arrangement that can be placed on fixed items.
4. The alarm beeps after a minimum of six minutes of treatment time and a message for completion of the disinfection process is displayed on the LCD.
5. After the completion of irradiation / treatment, switch-off the UV-C light button and open the drawer to remove the objects. It is advisable to flip (top becomes bottom) the object and irradiate it.
6. The users should avoid direct exposure of UV-C radiation on body parts, especially eyes.

The system has been tested for inactivation of *Escherichia coli* as classic examples of gram-negative bacteria. In this experiment, *E. coli* was spread on LB agar plates and half portion of each plate was exposed to UV-C radiation. The influence of the treatment parameter, that is, the time has been investigated on *E. coli*. Findings indicated that no visible *E. coli* colonies were observed after six minutes of continuous UV-C exposure.

ICAR-CIPHET has granted a licence of this technology to M/s Sakhi Soaps Hindustan Soaps and Salts Company, Prakasam, Andhra Pradesh on 18.05.2020

The cost-effective system has been designed and developed by Dr. K. Narsaiah, Dr. Bhupendra M. Ghodki, Er. Yogesh Kalnar and Ms. Surya Tushir led by Dr. R.K. Singh, Director, ICAR-CIPHET, Ludhiana, Punjab.

(Source: ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab)

Employee Corner | ICAR old website

भारतीय कृषि अनुसंधान परिषद
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ICAR-CIPHET, Ludhiana develops Touch-free Automatic Dispenser for Hand Sanitization

With an aim to help the doctors, hospital staff members, media personnel and government officials in maintaining a proper sanitation practice, the ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab has designed a sensor-based Touch-free Dispenser of the Hand Sanitizer. The device has been developed to promote the practice of hand-sanitization for containing the spread of the deadliest COVID-19 infection.

The smart device works on the principle of automatic obstacle detection with Infra-red proximity sensor and programmable micro-controller. The device dispenses the alcohol-based hand rub sanitizer from a 3.0 litre tank using a small, yet powerful diaphragm pump. The software controls the dispensing volume of about 3 ml in one go; which can be further increased or decreased volumetrically, by changing the programme in the software. The instant dispense of the sanitizer is possible once the proximity sensor senses the presence of hindrance by hands. The user can collect the dispensed volume of liquid from the device in the cupped hand.

The efficient and touch-free mechanism reduces the infection's risk at use in public places and ensures right volume as per the requirement of the user for hand sanitation purpose. The device operates on 12V DC electric power supply. The prototype is built on a small stainless steel 316 encasing the electronics circuit. This small and smart device can play a vital role in reducing the infection's risk. The device has been developed by Er. Yogesh Kalnar and Dr. Rahul K. Anurag, Scientists under the guidance of Dr. R.K. Singh, Director, ICAR-CIPHET, Ludhiana. Punjab.

(Source: ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab)

Local resident bags licence for CIPHET tech

Tribune News Service

Ludhiana, June 27

The Central Institute of Post-Harvest Engineering and Technology (CIPHET) has granted three R&D licenses recently developed portable insect Ultraviolet-C Disinfection System (UVIC) technology to Ishinder Dhir, Raj Nagar, for its commercial production.

The young entrepreneur came to know about the technology through news on the ICAR website, Twitter, TV channels and newspapers. He contacted the institute for the UVIC technology and took a license on Saturda

He expressed his confidence in capturing the market as the device was compact and could be installed at public locations such as offices, shops, hospitals, and would play a key role in the fight against ongoing Covid-19 pandemic.

Dhir, a young businessman, said, "It is high time that all youth should venture into making India self-reliant focusing on making indigenous devices, equipment and contribute to the development of the country." He j to come up with the device on a large scale within minimum possible time.

ਸੀਫੇਟ ਦੇ ਵਿਗਿਆਨੀ ਨੌਜਵਾਨ ਉੱਦਮੀ ਨੂੰ ਟੈਕਨਾਲੋਜੀ ਦੇ ਅਧਿਕਾਰ ਸੌਂਪਦੇ ਹੋਏ।

ਸੀਫੇਟ ਨੇ ਕੋਵਿਡ-19 ਨਾਲ ਲੜਨ ਲਈ ਵਿਕਸਿਤ ਕੀਤਾ ਵਾਸ਼ਰ-ਕਮ ਪਿਓਰੀਫਾਈਰ

ਲੁਧਿਆਣਾ, 1 ਜੁਲਾਈ (ਸਰੁਸ਼ਾ)-ਸੈਂਟਰਲ ਇੰਸਟੀਚਿਊਟ ਆਫ ਪੋਸਟ ਹਾਰਵੈਸਟ ਇੰਜੀਨੀਅਰਿੰਗ ਐਂਡ ਟੈਕਨਾਲੋਜੀ (ਸੀਫੇਟ) ਦੇ ਵਿਗਿਆਨੀਆਂ ਦੀ ਟੀਮ ਨੇ ਕੋਵਿਡ-19 ਨੂੰ ਧਿਆਨ ਵਿਚ ਰੱਖਦੇ ਹੋਏ ਓਜ਼ੋਨ ਨਾਮੀ ਤਕਨਾਲੋਜੀ 'ਤੇ ਆਧਾਰਤ ਵਾਸ਼ਰ-ਕਮ ਪਿਓਰੀਫਾਈਰ ਤਿਆਰ ਕੀਤਾ ਹੈ, ਜਿਸ ਨਾਲ ਫਲ ਅਤੇ ਸਬਜ਼ੀਆਂ ਪੋਟ, ਕੀਟਾਣੂ, ਬਿਮਾਰੂ ਅਤੇ ਨੁਕਸਾਨਦੇਹੀ ਕੈਮੀਕਲ ਮੁਕਤ ਕੀਤਾ ਜਾ ਸਕੇਗਾ।

ਇਸ ਟੈਕਨਾਲੋਜੀ ਦਾ ਲਾਇਸੈਂਸ ਉੱਤਰ ਪ੍ਰਦੇਸ਼ ਤੋਂ ਨੌਜਵਾਨ ਉੱਦਮੀ ਵਿਕਰਮ ਧੋਦਰ ਨੂੰ ਦਿੱਤਾ ਹੈ। ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਵੀ ਇਸ ਮਸ਼ੀਨ ਦਾ ਲਾਇਸੈਂਸ ਦੋ ਅੰਤਰ ਉੱਦਮੀਆਂ ਨੂੰ ਦਿੱਤਾ ਗਿਆ ਸੀ। ਸ੍ਰੀ ਧੋਦਰ ਨੂੰ ਮਾਸ ਮੀਡੀਆ ਰਾਹੀਂ ਇਸ ਤਕਨੀਕ ਦਾ ਪਤਾ ਲੱਗਾ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਸੀਫੇਟ ਨਾਲ ਸੰਪਰਕ ਕੀਤਾ। ਉਨ੍ਹਾਂ ਕਿਹਾ ਕਿ ਇਸ ਸਮੇਂ ਨੌਜਵਾਨਾਂ ਨੂੰ ਅੱਗੇ ਆ ਕੇ ਸਵਦੇਸ਼ੀ ਤਕਨੀਕਾਂ ਨੂੰ ਉਤਸ਼ਾਹ ਵਿਚ ਆਪਣਾ ਕੇ ਦੇਸ਼ ਦੇ ਵਿਕਾਸ ਅਤੇ ਤਰੱਕੀ ਵਿਚ ਯੋਗਦਾਨ ਦੇਣਾ ਚਾਹੀਦਾ ਹੈ। ਮੌਜੂਦਾ ਵਿਚ ਖੁਰਾਕ ਸੁਰੱਖਿਆ ਦੀ ਚਿੰਤਾ ਨੂੰ ਦੇਖਦੇ ਹੋਏ ਇਸ ਤਰ੍ਹਾਂ ਦੀਆਂ ਮਸ਼ੀਨਾਂ ਦੀ ਘਰਾਂ, ਹੋਟਲਾਂ ਆਦਿ ਵਿਚਾਰਦੀਆਂ ਵਿਚ ਬਹੁਤ ਲੋੜ ਹੈ। ਇਸ ਬਹੁਮੁੱਲੀ ਤਕਨੀਕ ਦਾ ਨਿਰਮਾਣ ਡਾ. ਆਰ. ਕੇ. ਸਿੰਘ ਨਿਰਦੇਸ਼ਕ ਸੀਫੇਟ ਦੀ ਅਗਵਾਈ ਵਿਚ ਡਾ. ਰਣਜੀਤ ਸਿੰਘ, ਡਾ. ਕੇ. ਨਰਸਈਆ, ਸ਼ੀਮਤੀ ਸੁਰਭਾ ਨੌਰਯਨ ਅਨੁਸੰਧਾਨ ਨੇ ਮਿਲ ਕੇ ਕੀਤਾ ਹੈ।

ਕੋਰੋਨਾ ਨਾਲ ਲੜਨ ਲਈ ਸੀਫੇਟ ਦੇ ਵਿਗਿਆਨੀਆਂ ਨੇ ਤਿਆਰ ਕੀਤਾ ਪੋਰਟੇਬਲ ਸਿਸਟਮ

ਮਸ਼ੀਨ ਵਿਗਿਆਨੀਆਂ ਤਕਨੀਕੀਆਂ ਸਬੰਧੀ ਉੱਦਮੀਆਂ ਨਾਲ ਗੱਲਬਾਤ ਕਰਦੇ ਹੋਏ।

ਲੁਧਿਆਣਾ, 28 ਮਈ (ਸਰੁਸ਼ਾ)-ਸੈਂਟਰਲ ਇੰਸਟੀਚਿਊਟ ਆਫ ਪੋਸਟ ਹਾਰਵੈਸਟ ਇੰਜੀਨੀਅਰਿੰਗ ਐਂਡ ਟੈਕਨੀਕੀ (ਸੀਫੇਟ) ਦੇ ਵਿਗਿਆਨੀਆਂ ਨੇ ਕੋਰੋਨਾ ਨਾਲ ਲੜਨ ਲਈ ਇਕ ਅਧਾਰਤ ਸੋ-ਟੱਚ ਸਮਾਰਟ ਪੋਰਟੇਬਲ ਯੂ.ਵੀ.-ਟੀ.ਓ.ਸੀ. ਡਿਸਇੰਫੈਕਸ਼ਨ ਸਿਸਟਮ ਅਤੇ ਪੋਰਟੇਬਲ ਯੂਵੀ-ਸੀ ਲਾਈਟ ਅਧਾਰਤ ਪੋਰਟੇਬਲ ਡਿਸਇੰਫੈਕਸ਼ਨ ਸਿਸਟਮ ਵਿਕਸਿਤ ਕੀਤਾ ਹੈ। ਜਾਣਕਾਰੀ ਦਿੰਦੇ ਹੋਏ ਸੀਫੇਟ ਦੇ ਵਿਗਿਆਨੀ ਡਾ. ਰਾਹੁਲ ਕੁਮਾਰ ਅਠਗਰਾ ਨੇ ਦੱਸਿਆ ਕਿ ਦੋਵੇਂ ਹੀ ਤਕਨੀਕ ਕੋਰੋਨਾ ਵਾਇਰਸ ਮਹਾਂਮਾਰੀ ਖਿਲਾਫ ਲੜਾਈ ਵਿਚ ਇਸ ਮਜ਼ਬੂਤਾਰ ਅਤੇ ਘੱਟ ਖਰਚ ਵਾਲੀ ਸਮਾਰਟ ਪੋਰਟੇਬਲ ਤਕਨੀਕ ਹੈ, ਜਿਸ ਦੀ ਵਰਤੋਂ ਕਰ ਕੇ ਆਫਿਸਾਂ, ਹਸਪਤਾਲਾਂ, ਦੁਕਾਨਾਂ, ਮਾਲ ਆਦਿ ਸਾ ਹੋਰਨਾ ਜਗਹਾਂ ਦਾ ਘਰਾਂ ਵਿਚ ਇਸ ਨੂੰ ਵਰਤੋਂ ਵਿਚ ਲਿਆਂਦਾ ਜਾ ਸਕਦਾ ਹੈ। ਉਨ੍ਹਾਂ ਦੱਸਿਆ ਕਿ ਦੋ ਉਦਯੋਗਿਕ ਕੰਪਨੀਆਂ ਦੇ ਨਾਲ ਇਸ ਤਕਨੀਕ ਸਬੰਧੀ ਕਰਾਰ ਵੀ ਕੀਤਾ ਗਿਆ ਹੈ। ਉਨ੍ਹਾਂ ਦੱਸਿਆ ਕਿ ਡਾ. ਆਰ. ਕੇ. ਸਿੰਘ ਨਿਰਦੇਸ਼ ਸੀਫੇਟ ਦੀ ਅਗਵਾਈ ਵਿਚ ਵਿਗਿਆਨੀਆਂ ਦੀ ਟੀਮ ਵਿਚ ਡਾ. ਕੇ. ਨਰਸਈਆ, ਇੰਜੀਨੀਅਰ ਮਿਰੋਸ਼ ਬਾਲਕਰ ਬਲਨਾਰ, ਡਾ. ਸੁਪਿਦਰ ਅੰਮ. ਘੋਸ਼ਕੀ, ਨਿਸ਼ ਸੁਰਭਾ ਸ਼ਾਮਲ ਰਹੀ। ਨਿਰਦੇਸ਼ਕ ਡਾ. ਆਰ. ਕੇ. ਸਿੰਘ ਨੇ ਕਿਹਾ ਕਿ ਉਹ ਸਾਰੇ ਸਬੰਧਤ ਕਰਨਗੇ ਕਿ ਤਕਨੀਕੀ ਮਦਦ ਨਾਲ ਹੀ ਦੋਵੇਂ ਉੱਦਮੀ ਇਨ੍ਹਾਂ ਯੰਤਰਾਂ ਦਾ ਉਤਪਾਦਨ ਕਿਹਾ ਕਿਸੇ ਮੁਸ਼ਕਲ ਦੇ ਕਰਨ ਲੱਗੇ। ਕਰਾਰ ਦੇ ਸਮੇਂ ਡਾ. ਰਣਜੀਤ ਸਿੰਘ ਮੁਖੀ ਅਧਾਰਾ ਇੰਡਸਟਰੀ ਪ੍ਰਬੰਧਨ ਇਕਾਈ ਵੀ ਹਾਜ਼ਰ ਸਨ।

ਦਸਾਂ ਤੇ ਸਬਜ਼ੀਆਂ ਨੂੰ ਕੀਟਣੂ ਮੁਕਤ ਕਰਨ ਲਈ ਵਿਗਿਆਨੀਆਂ ਨੇ ਵਟਾਇਆ ਉਜ਼ੋਨ ਸਿਸਟਮ

ਲੁਧਿਆਣਾ, 1 ਜੁਲਾਈ (ਸਰੁਸ਼ਾ)-ਸੈਂਟਰਲ ਇੰਸਟੀਚਿਊਟ ਆਫ ਪੋਸਟ ਹਾਰਵੈਸਟ ਇੰਜੀਨੀਅਰਿੰਗ ਐਂਡ ਟੈਕਨਾਲੋਜੀ (ਸੀਫੇਟ) ਦੇ ਵਿਗਿਆਨੀਆਂ ਦੀ ਟੀਮ ਨੇ ਕੋਵਿਡ-19 ਨੂੰ ਧਿਆਨ ਵਿਚ ਰੱਖਦੇ ਹੋਏ ਓਜ਼ੋਨ ਨਾਮੀ ਤਕਨਾਲੋਜੀ 'ਤੇ ਆਧਾਰਤ ਵਾਸ਼ਰ-ਕਮ ਪਿਓਰੀਫਾਈਰ ਤਿਆਰ ਕੀਤਾ ਹੈ, ਜਿਸ ਨਾਲ ਫਲ ਅਤੇ ਸਬਜ਼ੀਆਂ ਪੋਟ, ਕੀਟਾਣੂ, ਬਿਮਾਰੂ ਅਤੇ ਨੁਕਸਾਨਦੇਹੀ ਕੈਮੀਕਲ ਮੁਕਤ ਕੀਤਾ ਜਾ ਸਕੇਗਾ।

ਇਸ ਟੈਕਨਾਲੋਜੀ ਦਾ ਲਾਇਸੈਂਸ ਉੱਤਰ ਪ੍ਰਦੇਸ਼ ਤੋਂ ਨੌਜਵਾਨ ਉੱਦਮੀ ਵਿਕਰਮ ਧੋਦਰ ਨੂੰ ਦਿੱਤਾ ਹੈ। ਇਸ ਤੋਂ ਪਹਿਲਾਂ ਵੀ ਇਸ ਮਸ਼ੀਨ ਦਾ ਲਾਇਸੈਂਸ ਦੋ ਅੰਤਰ ਉੱਦਮੀਆਂ ਨੂੰ ਦਿੱਤਾ ਗਿਆ ਸੀ। ਸ੍ਰੀ ਧੋਦਰ ਨੂੰ ਮਾਸ ਮੀਡੀਆ ਰਾਹੀਂ ਇਸ ਤਕਨੀਕ ਦਾ ਪਤਾ ਲੱਗਾ ਅਤੇ ਉਨ੍ਹਾਂ ਨੇ ਸੀਫੇਟ ਨਾਲ ਸੰਪਰਕ ਕੀਤਾ। ਉਨ੍ਹਾਂ ਕਿਹਾ ਕਿ ਇਸ ਸਮੇਂ ਨੌਜਵਾਨਾਂ ਨੂੰ ਅੱਗੇ ਆ ਕੇ ਸਵਦੇਸ਼ੀ ਤਕਨੀਕਾਂ ਨੂੰ ਉਤਸ਼ਾਹ ਵਿਚ ਆਪਣਾ ਕੇ ਦੇਸ਼ ਦੇ ਵਿਕਾਸ ਅਤੇ ਤਰੱਕੀ ਵਿਚ ਯੋਗਦਾਨ ਦੇਣਾ ਚਾਹੀਦਾ ਹੈ। ਮੌਜੂਦਾ ਵਿਚ ਖੁਰਾਕ ਸੁਰੱਖਿਆ ਦੀ ਚਿੰਤਾ ਨੂੰ ਦੇਖਦੇ ਹੋਏ ਇਸ ਤਰ੍ਹਾਂ ਦੀਆਂ ਮਸ਼ੀਨਾਂ ਦੀ ਘਰਾਂ, ਹੋਟਲਾਂ ਆਦਿ ਵਿਚਾਰਦੀਆਂ ਵਿਚ ਬਹੁਤ ਲੋੜ ਹੈ। ਇਸ ਬਹੁਮੁੱਲੀ ਤਕਨੀਕ ਦਾ ਨਿਰਮਾਣ ਡਾ. ਆਰ. ਕੇ. ਸਿੰਘ ਨਿਰਦੇਸ਼ਕ ਸੀਫੇਟ ਦੀ ਅਗਵਾਈ ਵਿਚ ਡਾ. ਰਣਜੀਤ ਸਿੰਘ, ਡਾ. ਕੇ. ਨਰਸਈਆ, ਸ਼ੀਮਤੀ ਸੁਰਭਾ ਨੌਰਯਨ ਅਨੁਸੰਧਾਨ ਨੇ ਮਿਲ ਕੇ ਕੀਤਾ ਹੈ।

ਪੋਰਟੇਬਲ ਡਿਸਇੰਫੈਕਸ਼ਨ ਸਿਸਟਮ ਦੇ ਨਾਲ ਸੀਫੇਟ ਦੇ ਵਿਗਿਆਨੀ ਡਾ. ਰਾਹੁਲ ਕੁਮਾਰ ਅਠਗਰਾ

Major Publications

Research Papers (National/International)

Adhikary T, Gill PS, Jawandha SK, Bhardwaj RD and Anurag RK. Browning and quality management of pear fruit by salicylic acid treatment during low temperature storage. J Sci Food Agric. 2021 Feb;101(3):853-862. doi: 10.1002/jsfa.10692

Adhikary, T Gill P.S. Jawandhaa, S.K. Bhardwaj, R.D. and Anurag R.K. (2020) Efficacy of postharvest sodium nitroprusside application to extend storability by regulating physico-chemical quality of pear fruit. Food Chemistry. doi.org/10.1016/j.foodchem.2020.128934

Awana M, Jain N, Samota M .K, Rani K, Kumar A, Ray M, Gaikwad K, Praveen S, Singh N K, Singh A. 2020. Protein and gene integration analysis through proteome and transcriptome brings new insight into salt stress tolerance in pigeonpea (*Cajanus cajan* L.). International Journal of Biological Macromolecules, 164: 3589-3602

Bala, M., Handa, S., Mridula, D. and Singh, R.K., 2020. Physicochemical, functional and rheological properties of grass pea (Lathyrus sativus L.) flour as influenced by particle size. Heliyon, 6(11), p.e05471.

Banerjee R, Sheoran S, Kumar S, Sanodiya R, Dhanya V G, Samota M K. 2020. Participatory rural appraisal techniques for problem identification and formulation of village agricultural development plan of chosla village. Asian Journal of Agricultural Extension, Economics & Sociology, 38(9): 80-99

Bembem K & Agrahar-Murugkar D (2020) Development of millet based ready-to-drink beverage for geriatric population. Journal of Food Science and Technology, 57:32783283.

Devi, M., Sharma, K., Narayan Jha, S., Arora, S., Patel, S., Kumar, Y., & Kumar Vishwakarma, R. (2020). Effect of popping on physicochemical, technological, antioxidant, and microstructural properties of makhana seed. *Journal of Food Processing and Preservation*, *44*(10), e14787.

Dhritiman Saha, Arun Kumar T.V., Swati Sethi, & Indore Navnath. (2020). Physical Properties, Pasting Characteristics and Rheological Behaviour of Paddy Varieties Suitable for Flaking. Food Science and Engineering, 1(2), https://doi.org/10.37256/fse.122020617.

Dukare A, Kannaujia P, Kale S, Indore N, Singh R K and Ram S. 2020. Plastic film and organic mulching increases rhizosphere microbial population, plant growth, and mineral uptake in low input grown tomato in the northwestern region of India, Journal of Plant Nutrition, DOI: 10.1080/01904167.2020.1860219

Dukare A, Kumar R, Singh R K, Bhushan B. 2020. Non-fungicides based promising technologies for managing post-production penicillium induced spoilage in horticultural commodities: a Comprehensive Review. Food Reviews International, DOI: 10.1080/87559129.2020.1727497.

Dukare A, Paul S, Arambam A. 2020. Isolation and efficacy of native chitinolytic

rhizobacteria for biocontrol activities against Fusarium wilt and plant growth promotion in pigeon pea (*Cajanus cajan* L.). Egyptian journal of biological pest control, 30, 56.

Dukare A, Paul S. 2020. Biological control of Fusarium wilt and growth promotion in pigeon pea (*Cajanus cajan*) by antagonistic rhizobacteria, displaying multiple modes of pathogen inhibition. Rhizosphere, 17:100278.

Ghodki B M, Srihari G, Dukare A S, Kannaujia P K, Kalnar Y B, Vishwakarma RK. 2020. Potential utilization of guar straw and wood wool in controlling relative humidity and temperature of storage environment. Journal of Food Process Engineering,13618

Ghodki B.M., Chhetri K.B., & Goswami T.K. (2020). Numerical modeling of granular flow in star valve type cryogenic precooler. *Journal of Food Process Engineering*, 43(4): e13376. https://doi.org/10.1111/jfpe.13376.

Ghodki B.M., Srihari G., Dukare A.S., Kannaujia P.K., Kalnar Y.B., & Vishwakarma R.K. (2020). Potential Utilization of Guar Straw and Wood Wool in Controlling Relative Humidity and Temperature of Storage Environment. *Journal of Food Process Engineering*. http://dx.doi.org/10.1111/jfpe.13618 (Early View 06 Dec 2020).

Goswami D., S. Sharma, B. Singh and S. K. Tyagi (2020) Effect of microwave-assisted processing of mustard meal on physicochemical and sensory properties of cookies. *International Journal of Current Microbiology and Applied Sciences*, 9(9): 2439-2446.

Goswami D., S. Sharma, S. K. Tyagi, B. Singh and Harshad M. Mandge (2020) Development and quality evaluation of supplementary food (*panjiri*) incorporating processed *B. juncea* meal. *International Journal of Current Microbiology and Applied Sciences*, https://doi.org/10.20546/ijcmas.2020.912.xx.

Gupta, K; Jaiswal, P; Gupta, H; Anurag, RK; Nain, L and Prasanna; R. 2020 Exploring the potential of Aloe vera as a carrier for developing a novel cyanobacterial formulation. South African Journal of Botany 135 (12), 437-443

Jalgaonkar K, Mahawar M K, Bibwe B, Kannaujia P K. 2020. Postharvest profile, processing and waste utilization of dragon fruit (*Hylocereus Spp*.): A Review, Food Reviews International, DOI: 10.1080/87559129.2020.1742152.

Jeet P., Ghodki B.M., Amat D., Anuja A.R., Balodi R., & Upadhyaya A. (2020). Enhancement of land and water productivity through Participatory rural appraisal. *Journal of AgriSearch*, 7(4): 234-240. Available at: http://jsure.org.in/journal/index.php/jas/article/view/733. (Published on 10 Dec 2020; ISSN 2348-8867).

Kannaujia P K, Asrey R, Singh A K, Varghese E. 2019. Effect of gum arabic and fruwash coatings on postharvest quality of summer squash (*Cucurbita pepo*). Indian Journal of Agricultural Sciences, 89(10): 1604–8.

Kannaujia P K, Asrey R, Singh A K, Varghese E. 2019. Postharvest treatments to reduce chilling injury in summer squash (*Cucurbita pepo*) fruits during storage. Indian Journal of Agricultural Sciences, 89(10): 1633–37

Kannaujia, P K, Asrey R, Singh A K, Mahawar M K, Bhatia K. 2020. Evaluation of Postharvest Quality Attributes of Gum Arabic and Fruwash Coated Summer

Squash. Indian Journal of Horticulture 77(2): 394-397. DOI : 10.5958/0974-0112.2020.00056.0

Kasana RC, Singh SK and Kumar P (2020) Antifungal activity of copper oxide nanoparticles against the fungal pathogens isolated from arid environment of Jodhpur. International Journal of Current Microbiology and Applied Sciences. 9 (11) 901-909.

Krishnan V, Awana M, Samota M K, Warwate S I. Kulshreshtha A, Ray M, Bollinedi H, Singh A K, Thandapilly S J, Praveen S, Singh A. 2020. Pullulanase activity: A novel indicator of inherent resistant starch in rice (*Oryza sativa*. L). International Journal of Biological Macromolecules, 152: 1213-1223.

Kumar P, Bala M., Singh RK and D Mridula (2020). Modelling the drying characteristics of ashwagandha (*Withania somnifera*) roots. International Journal of Chemical Studies. 8(4): 207-212.

Kumar S, Kumar R, Sharma P C, Nambi V E. 2020. Aqueous and microwave assisted extraction of pectin from grapefruit and Nagpur mandarin. International Journal of Current Microbiology and Applied Sciences. 9(7): 1938-1949.

Kumar S, Kumar R, Sharma P C. 2020. De-bittering studies of kinnow mandarin (Citrus reticulata Blanco) juice. Journal of Environmental Biology. 41: 1068-1074.

Kumar, Y., & Kumar, V. (2020). Comparative antioxidant capacity of plant leaves and herbs with their antioxidative potential in meat system under accelerated oxidation conditions. *Journal of Food Measurement and Characterization*, *14*(6), 3250-3262.

Kumar, Y., & Kumar, V. (2020). Effects of double emulsion (W1/O/W2) containing encapsulated Murraya koenigii berries extract on quality characteristics of reduced-fat meat batter with high oxidative stability. *LWT*, *127*, 109365.

Kumari K., Mridula D., Kishore A. and Chitranayak (2020). Extrusion processing of agri-horti and dairy products: A review. International Journal of Chemical Studies, 8(1): 1424-1433.

Mahawar M K, Jalgaonkar K, Bibwe B. 2020. Development of composite mechanical peeler cum juice extractor for kinnow and sweet orange. Journal of Food Science and Technology, https://doi.org/10.1007/s13197-020-04472-9

Meena V S, Jalgaonkar K, Mahawar M K, Bhushan B, Bibwe B, Kashyup P. 2020. Optimization of process variables for preparation of pomegranate juice fortified aonla candy. Current Science, 118(1): 114-118

Mridula D., Dhritiman Saha, R.K. Gupta, Sheetal Bhadwal and Malvika Bana. Quality and storage stability of dehulled de-skinned groundnut meal based muffins. Agricultural Research (Springer), https://doi.org/10.1007/s40003-020-00497-w.

Mridula D., Saha D., Gupta RK, Bhadwal S, Arora S., Kumar P. and Kumar Sonmati R (2020). Oil expelling from whole and dehulled sunflower seeds: Optimization of screw pressing parameters and Physico-chemical quality. International Journal of Chemical Studies, 8(4): 4002-4009.

Mridula Devi, Kalyani Sharma, Shyam Narayan Jha, Simran Arora, Shadanan Patel, Yogesh Kumar and Rajesh Kumar Vishwakarma (2020). Effect of popping on physicochemical, technological, antioxidant, and microstructural properties of makhana seed. Journal of Food Processing and Preservation, doi: 10.1111/jfpp.14787.

Mridula, D., Dhritiman Saha, R. K. Gupta, Sheetal Bhadwal, Simran Arora and Sonmati R. Kumar. 2020. Oil Expelling from Dehulled De-Skinned Groundnut Kernel using Screw Press: Optimization of Process Parameters and Physico-chemical Characteristics. International Journal of Current Microbiology and Applied Sciences, 9(09): 1101-1115.

Narsaiah, K., Kandi Sridhar, Minaxi Sharma (2020) Development of functional bread with flaxseed oil and garlic oil hybrid microcapsules, LWT, DOI: https://doi.org/10.1016/j.lwt.2020.110300.

Narsaiah, K., Sharma, M., Sridhar, K., Alka Choudhary (2020). Development of flaxseed and garlic oil hydrogel beads by novel ionotropic gelation method. Journal of Food Processing and Preservation. (Accepted) DOI: 10.1111/jfpp.14821.

Nileshwari Yewle, Ashwini M Charpe, Suchita Gupta, Bhagyashree Patil, Surya Tushir, Sandeep Mann. Impact of hermetic packaging on green gram (Vigna radiata) insect and microbial damage under environmental storage condition. J Entomol Zool Stud 2020;8(5):1883-1887. DOI: 10.22271/j.ento.2020.v8.i5z.7766 (NAAS, 2020: 5.53).

Pankaj Kumar, Charanjit Kaur and Harpreet Kaur Jambh. Use of extruded finger millet flour to enhance quality characteristics of barley chapatti, International Journal of Chemical Studies International Journal of Chemical Studies, 2020; 8(3): 507-513.

Pankaj Kumar, Charanjit Kaur, Swati Sethi, Harpreet Kaur Jambh. Effect of extruded finger millet on dough rheology and functional Quality of pearl millet-based unleavened flatbread. Cereal Chemistry, 2020; 00:1–8. https://doi.org/10.1002/cche.10321.

Poonam Choudhary and Dharam Paul Choudhary (2020). Comparison of protein composition of normal and quality protein maize. *Int. J. Curr. Microbiol. App. Sci., 9*(12): 3297-3302.

Poonam Choudhary, Nisha Kumari and Veena Jain (2020). Influence of selenium and chitosan on physico-chemical properties of guava (*Psidium guajava* L.) fruits under ambient storage conditions. *Indian Journal of Agricultural Sciences,* 90(2):351-355.

Poonam Choudhary, Surya Tushir, Manju Bala, Upinder Rajan Sharma. (2020). Evaluation of antioxidant and antimicrobial potential of mango seed kernel. Int J Chem Stud. 8(6):2921-2924. DOI: 10.22271/chemi.2020.v8.i6ap.11694.

Rekha Chawla; S Sivakumar,; Santosh Mishra,; Harsimran Kaur,; Rahul Kumar Anurag, (2021). Modified Atmosphere Packaging for milk cake: Assessment of ideal gas composition for extending shelf life. *British Food Journal*. Publication Date: 01 February 2021. DOI (10.1108/BFJ-09-2020-0785).

Salwan R, Sharma V, Kasana RC and Gulati A (2020) Augmentation of protease production from psychrotrophic *Acinetobacter* sp. IHB B 5011(MN12) from Western Himalayas. Biocatalysis and Agricultural Biotechnology. 29: 101795.

Sethi, S., Yadav, D. N., Snigdha, S., Gupta, A. (2021). Optimization of process parameters for extraction of protein isolates from Khesari dhal (Lathyrus sativus L), LWT-Food Science and Technology, 137: 110368. https://doi.org/10.1016/j.lwt.2020.110368.

Sridhar, K., Sharma, M., Alka Choudhary, Praveen K.D., Narsaiah, K. (2020). Fish and garlic oils hybridized microcapsules:

Fortification in functional bread. Journal of Food Processing and Preservation. (Accepted) DOI: http://doi.org/10.1111/jfpp.15346.

Swati Sethi, S K Nanda and Manju Bala. (2020). Quality assessment of pasta enriched with anthocyanin-rich black rice bran. Journal of Food Processing and Preservation, 44(12):e14952, https://doi.org/10.1111/jfpp.14952.

Thingujam Bidyalakshmi Devi and Indra Mani (2019). Effect of Temperature on Drying Kinetics of Vegetable Seeds. Journal of Agricultural Engineering. 56 (2): 100-110.

Vikas Kumar, Dr. Armaan U Mujaddadi, Dr. VK Mishra. Bioactive peptides from fishery by-products: A review. J Entomol Zool Stud 2020;8(5):2128-2131.

Vikas Kumar, Dr. RK Singh, Dr. VK Mishra. Assessment of participants' response in a national webinar on business opportunities in fish post-harvest. J Entomol Zool Stud 2020, 8(5):2124-2127.

VK Misra, Devananda Uchoi, CP Singh, Anup Kumar, Gyan Chandra, Vikas Kumar, Sanjeev Sharma, IJ Singh. Changes in hematological parameters of a freshwater fish, Cyprinus carpio (communis) exposed under pulp and paper mill effluent. J Entomol Zool Stud 2020, 8(5):2136-2142.

Y. Prabhabati Devi, Khwairakpam Bembem and Th Bidyalakshmi Devi, 2020. Empowerment of Rural Tribal Women through Value Addition of Carambola. Asian Journal of Agricultural Extension, Economics & Sociology. 38(12): 162-168. DOI: 10.9734/AJAEES/2020/v38i1230511.

Book chapter

Bembem K, Balakrishnan R, Devi TB (2020) Scope of processing and value addition of paddy and rice. Training manual on post-harvest management of paddy and value addition of rice. 1-7.

Deep N. Yadav, Sangita Bansal, Surya Tushir, Jasnoor Kaur, Kanika Sharma (2020). Advantage of biofortification over fortification technologies. In Om Prakash Gupta, Vanita Pandey, Sneh Narwal, Pradeep Sharma, Sewa Ram, Gyanendra Pratap Singh (Eds.), Wheat and Barley Grain Biofortification (pp 257-273). Elsevier Inc.

Devi TB & Dawange SP (2020) Packaging and storage of paddy and rice. Training manual on post-harvest management of paddy and value addition of rice. 18-26.

Devi TB, Bembem K & Kalnar YB (2020) Post-harvest processing technologies of paddy. Training manual on post-harvest management of paddy and value addition of rice. 8-17.

Dukare A, Paul S, Mhatre P, Divekar P. 2020. Biological disease control agents in organic crop production system. In: Mehmood et al. (Ed). Pesticide Contamination in Freshwater and Soil Environs: Impacts, Threats, and Sustainable Remediation (ISBN: 978-1-77188-953-7), Academic Press (USA).

Dukare A, Sangwan S, Maheshwari H, Guru P N. Khade Y, Vishwakarma R K. 2020. Utilization of antagonistic microbes for the eco-friendly management of fungal diseases of the harvested fruits during postharvest handling and storage. In: Food security and plant disease management. Ajay Kumar and Sameer Droby (Ed.). Elsevier Woodhead Publishing.Pg-307-322. ISBN: 978-0-12-821843-3

Hradesh Rajput, Deepika Goswami, and Gulzar Ahmad Nayik (2020). Peanut. In: Antioxidants in Vegetables and Nuts - Properties and Health Benefits. Gulzar

Ahmad Nayik and Amir Gull (Eds.). Springer Nature Singapore Pvt. Ltd. p 509-522.

Kale S J, Nath P. 2020. Application of plastics in post harvest management of crops. In: Rohitashw Kumar et al. (Ed.). Applied agricultural practices for mitigating climate change. ISBN-3: 978-0-367-34529-7, CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742

Kaur S, Samota M K. 2020. COVID - 19 Outbreak and Different Shades of ITS Crisis (ISBN-10: 8194484693; ISBN-13: 978-8194484691)" Published by Jain Brothers.

Malathi V M, Sharma K, Damale R, Samota M K, Singh J P, Yadav S K, Parveen S. 2020. Impact of climate change on the production of secondary metabolites in plants. In: Srinivasarao et al., (Ed.). Climate change and Indian agriculture: challenges and adaptation strategies (ISBN: 978-81-943090-7-9), ICAR-National Academy of Agricultural Research Management, Hyderabad, Telangana, India- 500 030.

Singh SK, Kasana RC, Yadav RS and Pathak R (2020) Current Status of Biologically Produced Nanoparticles in Agriculture. In Mansour Ghorbanpour et al (eds.) Biogenic Nano-Particles and their Use in Agro-ecosystems, Springer pp 393-406.

E-Articles

Bibwe B, Jalgaonkar K, Kannauji P. 2020. Canning of Litchi, Agriculture & food E-Newsletter, 2(6):558-559.

Dukare A., Kaur N. 2020. Food Bioterrorism: Concepts and Categories. Food and Scientific Reports 1: 39-41. A general/ popular article published in E-magazine.

Ghodki, B.M., (2020). Discrete element modeling to predict flow dynamics of black pepper in cryogenic precooler. *Agri News Network*, Agriculture Today Group: New Delhi. agrinewsnetwork.in/articles.php#art_75.

Narsaiah, K., Ghodki, B.M., Kalnar, Y.B., Tushir, S., and Singh R.K. (2020). Portable Smart Ultraviolet-C Disinfection System (UViC). *Agri News Network*, Agriculture Today Group: New Delhi. http://www.agrinewsnetwork.in/articles. php#art_99.

Th. Bidyalakshmi Devi, K. Bembem and Thongam Sunita (2020). Agricultural Engineering as career option. https://www2.slideshare.net/LakshmiKhuman/agricultural-engineering-as-career-option-239313731

Th. Bidyalakshmi Devi, K. Narsaiah, Yogesh B Kalnar and K. Bembem (2020). 3D Food printing: An emerging technology in food designing. https://www2.slideshare.net/LakshmiKhuman/3d-food-printing-an-emerging-technology-in-food-designing

Th. Bidyalakshmi Devi, K. Narsaiah, Yogesh B kalnar and K. Bembem (2020).Automation in Food Industry. Agriculture and Food E-Newsletter. 2(6), 237-240.

Th. Bidyalakshmi Devi, Renu Balakrishnan, Thongam Sunita and Shaghaf Kaukab (2020). Drying of fruits and vegetables: An approach for entrepreneurship development. https://www2.slideshare.net/LakshmiKhuman/drying-of-fruit-vegetables-an-approach-for-entrepreneurship-development

Tushir S (2020). Understanding Coronavirus (Covid-19). *Agri News Network*, Agriculture Today Group: New Delhi.

http://www.agrinewsnetwork.in/articles.php#art_97.

Leaflet

Vishwakarma R.K., Mridula D., Kumar Sonmati R., Arora S., R.K. Singh (2020). Process Technology for Antioxidant Rich Jamun Bar. ICAR-Central Institute of Post-Harvest Engineering & Technology, Ludhiana, Punjab, publication no. ICAR-CIPHET/Pub./2020-21/02, pp. 1-2.

E-Leaflet

Singh R.K, Narsaiah, K., Kalnar, Y.B., Ghodki, B.M. (2020). E-Leaflet on Pandemic and its impact: Post-harvest operation, pp. 1-5.

Technology Information Booklet

Singh, R.K., Singh, R., Narsaiah, K., Kalnar, Y. B., Ghodki, B.M., Anurag R.K., and Tushir. S. (2020). Information Booklet: Enduring Technologies developed by ICAR-CIPHET during COVID-19 Pandemic. pp. 1-24, (July 01, 2020). Ludhiana: ICAR-CIPHET.

Technology published

Surya Tushir, S.K. Tyagi, V. Chandersekar, A.K. Jaiswal (2020).Microbial Protein using Corn Cob. Published in Creating Wealth From Agricultural Waste, Indian Council of Agricultural Research, New Delhi. p. 9.

Surya Tushir, S.K. Tyagi, V. Chandersekar, A.K. Jaiswal (2020). Utilization of Corn Cob Powder for Kulhad Making. Published in Creating Wealth From Agricultural Waste, Indian Council of Agricultural Research, New Delhi. p. 10.

Paper in Conference Proceeding

Kalnar, Y. B., Kumari A., Devi, T. B. and Ghodki, B. M. (2020). Prototype development for automatic sorting based on the weight of tomato. Presented in 54th Annual Convention of Indian Society of Agricultural Engineers (ISAE) & International Symposium on Artificial Intelligence Based Future Technologies in Agriculture, Hyatt Regency, Pune India (07-09 Jan, 2020).

Popular articles (Hindi and English) in Summer School/Winter school / Technical bulletin //Training manual etc.

मृदुला डी. (2019), खाद्यान प्रसंस्करण एवं मूल्य संवर्धनः एक अवलोकन, प्रसंस्करण प्रगति, वर्ष 3, अंक 1 (जनवरी–जून), पेज 1–16.

गुरू पी.एन., मृदुला डी. एवं विशाल कुमार (2019), कटाई–उपरांत संग्रहित उत्पाद के कीड़े और उनके प्रबंधन। प्रसंस्करण प्रगति, वर्ष 3, अंक 1 (जनवरी–जून), पेज 17–23.

डी.एन. यादव, पी.एन. गुरू, स्वाति सेठी एवं आर के सिंह (2019), अनाजों और दालों के कीटषोधन के लिए माइक्रोवेव प्रौद्योगिकीः एक सिंहावलोकन, प्रसंस्करण प्रगति, वर्ष 3,अंक 1 (जनवरी– जून), 24–29.

अपूर्वा शर्मा, प्रेरणा नाथ एवं स्वाति सेठी (2019), हरी फलियों का प्रसंस्करण एवं मूल्य संवर्धन। प्रसंस्करण प्रगति, वर्ष 3, अंक 1 (जनवरी–जून), पेज 30–40.

संदीप कौर, मृदुला डी., सोनमती आर. कुमार, सिमरन अरोड़ा एवं दीपिका गोस्वामी (2019), मूंग का प्रसंस्करण एवं मूल्य संवर्धन। प्रसंस्करण प्रगति, वर्ष 3, अंक 1 (जनवरी–जून), पेज 41–47.

मंजू बाला, सूर्या तुशीर, स्वाति सेठी एवं अनु कालिया (2019), बेसन में मिलावट जांच के लिए अवरक्त स्पेक्ट्रोस्कोपी आधारित पद्धति, प्रसंस्करण प्रगति, वर्ष 3, अंक 1 (जनवरी–जून), पेज 48–53.

गुरू पी.एन, प्रज्ञा सिंह, विशाल कुमार, रेणु बालकृष्णन एवं मृदुला डी (2019), संग्रहित मक्के में कीट से होने वाले नुकसान और उनका प्रबंधन, प्रसंस्करण प्रगति, वर्ष 3, अंक 2 (जुलाई–दिसम्बर), पेज 1–6.

मृदुला डी. एवं सोनमती आर. कुमार. (2019), खाद्य उत्पादों की संवेदी गुणवत्ता का मूल्यांकनः एक अवलोकन, प्रसंस्करण प्रगति, वर्ष 3, अंक 2 (जुलाई–दिसम्बर), पेज 34–48.

दीपिका गोस्वामी, मृदुला डी., हर्षद मंडगे एवं ह्रदेष राजपूत (2019), भारत में खाद्य दलहनों के लिए नियंत्रणात्मक ढाँचा, प्रसंस्करण प्रगति, वर्ष 3, अंक 2 (जुलाई–दिसम्बर), पेज 49–59.

सिमरन अरोड़ा, मृदुला डी., आर.के. विश्वकर्मा एवं दीपिका गोस्वामी (2019), प्राकृतिक खाद्य सरंक्षकः भोजन की गुणवत्ता और सुरक्षा के लिए। प्रसंस्करण प्रगति, वर्ष 3, अंक 2 (जुलाई–दिसम्बर), पेज 60–67.

पंकज कुमार कन्नौजिया, एस जे काले, नवनाथ इंदौर, मनोज माहवार एवं चन्द्रभान (2020) सब्जियों के उत्पादन में जैविक पलवार का महत्व/फल फूल 41(9): 35–37.

आर. के. सिंह, मृदुला डी. एवं दीपिका गोस्वामी (2019), प्रसंस्करण प्रगति, वर्ष 3, अंक 1 अर्धवार्षिक राजभाषा पत्रिका (जनवरी–जून) कुल पृष्ठ 86.

आर. के. सिंह, मृदुला डी. एवं दीपिका गोस्वामी (2019), प्रसंस्करण प्रगति, दृ वर्ष 3, अंक 2 अर्धवार्षिक राजभाषा पत्रिका (जुलाई–दिसम्बर) कुल पृष्ठ 82.

Bidyalakshmi Devi Th, Khwairakpam Bembem, and Yogesh B Kalnar (2020) Post-harvest processing technologies of paddy. Training manual on Post-Harvest Management of paddy and value addition of rice. 16-18 Jan, 2020 under SCSP. pp.8-17.

Devi, T.B., Kalnar, Y.B., & Ghodki, B.M. (2020). Machinery for paddy processing. In Bembem, K., Devi, T.B., Muzaddadi A.U., Singh

A.K.C., & Devi, Y.P. (Eds). Training Manual on Post-Harvest Management of Paddy and Value Addition of Rice, pp. 45-55. (Nov 16-18, 2020). Ludhiana: ICAR-CIPHET.

Kaur S, Samota M K, Rani H. 2020. World Environment Day 2020: Celebrate biodiversity-The more variety, the better society. Food and Scientific Reports, 1(6): 10-12

Kaur S, Samota M K. 2020. Current scenario of health care professionals headed for attaining victory against deadlier COVID 19. Food and Scientific Reports, 1:60-62

Kaur S, Samota M K. 2020. Sustainability and precision in Indian agriculture: a need of the day. Biotech express, 8(85): 18-20

Khwairakpam Bembem., Devi T.B., Muzaddadi AU, Singh AK.C. and Devi Y.P. (2020). Training manual on Post-harvest management of paddy and value addition of rice, SCSP of ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana-141004, (Jan 16-18, 2020).

Manju Bala (2020). Maize based gluten free bakery products. In Training manual on Post-Harvest Processing and Value Addition of Cereals, pp 37-42.

Pankaj Kumar, Harpreet Kaur Jambh and Achhardeep Dhiman (2020). Is cryo-grinding of spices better than conventional grinding? Food and Scientific Reports, Volume: 1, Issue: 7, Page 6-9.

Pankaj Kumar, Harpreet Kaur Jambh and Achhardeep Dhiman (2020). Is cryo-grinding of spices better than conventional grinding? Food and Scientific Reports, Volume: 1, Issue: 7, Page 6-9.

Rani H, Kaur S, Samota M K. 2020. CRISPR/CAS9 system: A revolution in the era of genome editing and beyond. Food and Scientific Reports, 1(6): 34-38

Rani H, Samota M K, Kaur S. 2020. Sucrose-starch metabolism in plants under drought stress. Agriculture & food: E-newsletter, 2 (7): 793-795

S Korouhanba, W. Nupendra, Th. Bidyalakshmi Devi and Khwairakpam Bembem. By-product utilization of Paddy. Training manual on Post-Harvest Management of paddy and value addition of rice. 16-18 Jan, 2020 under SCSP.

Sethi S., Mridula D., and Singh, R. (2020). Training Manual for Skill Development Training on 'Processing and Value Addition of Cereals' under Schedule Caste Sub Plan (SCSP) scheme, GoI, ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana-141004, Punjab.

Sharma A, Nath P, Kale S J. 2020. Ultrasonic Processing of Foods- An Overview. Indian Food Industry. 2(5): 33-43.

Th. Bidyalakshmi Devi, and Sandeep P Dawange Packaging and storage of paddy and rice. Training manual on Post-Harvest Management of paddy and value addition of rice. 16-18 Jan, 2020 under SCSP.

Th. Bidyalakshmi Devi, Khwairakpam Bembem and Yogesh B Kalnar (2020) Post-harvest processing technologies of paddy. Training manual on Post-Harvest Management of paddy and value addition of rice. 16-18 Jan, 2020 Under SCSP.

Th. Bidyalakshmi Devi, Yogesh B Kalnar and Bhupendra M Godhki. Machinery for paddy processing. Training manual on Post-Harvest Management of paddy and value addition of rice. 16-18 Jan, 2020 under SCSP.

पंकज कन्नौजिया, सखाराम काले, अजिनाथ डुकरे, नवनाथ इंदोरे, आर के सिंह. (2020). मल्चिंग आधारित सब्जी वर्गीय फसलों की खेती. तकनीकी बुलेटिन (भाकृअनुप– कें. क. उ. अभि. एवं प्रौ. सं/पब्लि./2020–21/01), अखिल भारतीय समन्वित अनुसन्धान परियोजना, प्लास्टिकल्चर अभियांत्रिकी एवं प्रौद्योगिकी, भाकृअनुप– केंद्रीय कटाई–उपरान्त अभियांत्रिकी एवं प्रौद्योगिकी संस्थान, अबोहर।

Participation in Conferences/Symposia/ Workshops/Meetings

- Ajinath Dukare attended 3 days online "International Workshop on Application of Statistics in Science and Technology using SPSS" organized by world food preservation center, USA from 8-10 August, 2020.
- Ajinath Dukare attended a webinar lecture on "Entrepreneurial Opportunities in Food Processing Sector" delivered by Dr. R.T. Patil, Former director, ICAR-CIPHET, Ludhiana Under webinar series on "Education for Agriculture- Making a Difference". Organized by NMIMS-School of Agricultural Sciences and Technology, Mumbai (MH) on 13 August, 2020.
- Ajinath Dukare attended one day national Webinar on "Recent Advances in Soil Microbiological Research with a Special Thrust to Biofertilizer Technology" organized by BAU, Sabour on 25 August, 2020.
- Ajinath Dukare participated in in one day workshop on the occasion of "world soil day" on 5 December, 2020 organized KVK at ICAR-CIPHET, Abohar.
- Akhoon Asrar attended Online session on 'Automation in Farming System' on 6 October, 2020.
- B.M. Ghodki attended Horticulture Group AGM of Chemical Industry (SCI), London on 04 September, 2020.
- B.M. Ghodki attended online seminar on "Basics of Rheology for Food Applications" organized by Anton Paar GmbH on 06 April, 2020.
- B.M. Ghodki attended online seminar on Fluid-Structure Interaction with the COMSOL® Software' on 30 April, 2020.
- B.M. Ghodki attended webinar on Sustaining Agriculture through Collectives, Cooperatives and Farmer Producer Organization Post COVID-19 on 08 September, 2020 organized by VAMNICOM Pune.
- B.M. Ghodki attended webinar with Director General, ICAR on Rapid Rural Community Response to COVID-19 RCRC on 3 July, 2020.
- B.M. Ghodki attended workshop on computational tools for drug discovery organized By SCI's Fine Chemicals Group and RSC's Chemical Information and Computer Applications Group UK on 06 May, 2020.
- B.M. Ghodki completed a six-week online course on "Life Skills for Engineers (Level 1)" with *Distinction* grade. The course was offered jointly by Commonwealth Education and Media Centre for Asia (CEMCA) and University of Hyderabad (UOH) from 1 January- 13 February, 2020.

- Bhushan Bibwe attended the webinar on 'This is how UV disinfection of surfaces and air succeeds', Expert speaker: Dawn Skinner & Kevin Khatta, Heraeus Noble light America on 09 June, 2020 organized by Wiley Expert.

- Bhushan Bibwe attended the webinar on "Food Processing: Current Status, Needs & Future" on 18 May 2020 organized by IIFPT webinar series.

- Bhushan Bibwe attended the webinar on Drying and dehydration of Onion, Garlic and Ginger into flakes and powder: An opportunity to establish industry, organized by ICAR-CIRCOT, Mumbai on 16 July, 2020.

- Bhushan Bibwe participated and attended the webinar on Potential and diverse application of atmospheric cold plasma for inactivation and mitigation of Corona virus (Covid-19) on 01 May 2020, organized by AFSTI, Mysore.

- Bhushan Bibwe participated in the webinar on"Business Opportunities in Fish Post-Harvest' on 05 June, 2020 , organized by ICAR-CIPHET, Ludhiana & ICAR- CIFT, Cochin.

- Deepika Goswami, Scientist attended 8th International Conference on 'Advancements in Engineering and Technology' (online mode) held at Bhai Gurdas Institute of Engineering and Technology, Sangrur (Punjab) during March 20-21, 2020 and gave Oral presentation on 'Non- nutritive bioactive components of pulses'.

- Deepika Goswami, Scientist attended one day Webinar on 'Importance of Rheology in the Development of Nanopackaging Materials' on August 28, 2020 organized by Department of Food Engineering, NIFTEM, Kundli (Haryana).

- Guru P. N. attended webinar on 'Science, Equity and Exponential Change: Re-imagining the Future' organised by Education Division of ICAR, New Delhi on 03 July, 2020.

- Guru P. N., attended 5 days online training programme on 'Pest management techniques for stored food commodities' organized by CSIR-CFTRI, Mysuru during 14-18 December 2020.

- Guru P. N., attended webinar on 'Locusts: Myths and Reality, How to tackle if we come across ?' organised by NAHEP-CAAST, MPKV, Rahuri (M.S) on 09 June 2020.

- Guru P. N., successfully completed a MOOC on 'Designing e-Learning Content' 01- 31 July 2020 organised by ICAR-NAARM, Hyderabad.

- Guru P. N., successfully completed an eight-week (21.04.2020 to 30.06.2020) MOOC on 'Integrated Pest Management' organised by AgMOOCs (UAS, Raichur and IIT, Kanpur).

- Mahesh Samota attended E-workshop on " Functional foods, Bioactive compounds and for better nutrition" organized by Department of Biochemistry, Uttar Banga Krishi Viswavidyalaya and Society for Plant Biochemistry and Biotechnology (SPBB) during 9-11 December, 2020.

- Manju Bala, Principal Scientist, ICAR-CIPHET, Ludhiana, attended Online Business Meet on Post-harvest Processing Technologies Developed at ICAR-CIAE, Bhopal, on 4 August 2020.

- Pankaj Kannaujia attended a webinar on 'How to be a successful hydroponics grower' on 25 July, 2020 organized by Agriplast Protected Cultivation Pvt Ltd.

- Poonam attended Video Lecture on NABL Accreditation of ICAR Laboratories on 22 July, 2020.

- Pragya Singh, Technical Assistant, attended training course on Post-Harvest Management of Agricultural Produce during Natural Calamities/Disaster during 19-21 October, 2020 convened by ICAR-CIPHET, Ludhiana in collaboration with NIDM, New Delhi through zoom meeting.

- Sakharam Kale participated in a webinar on 'How to be a successful hydroponics grower' on 25 July, 2020 organized by Agriplast Protected Cultivation Pvt Ltd.

- Sakharam Kale participated in the National webinar on "Setting a new normal in food processing sector in post COVID-19: opportunities and challenges" organized by Department of Processing and Food Engineering, College of Technology and Engineering on 10 June, 2020.

- Sandeep Dawange attended Web Clinic meeting on 'Agriculture production and innovation & Post-harvest technology" organized by ISTI portal on 5 November, 2020

- Sandeep Dawange participated in International online Faculty Development Programme on 'Green perspectives in food processing sector' organized by NIFTEM, Sonepat from 05-21 October, 2020.

- Sandeep Mann (PI, FFP) attended and presented progress of Farmer FIRST Project, ICAR-CIPHET, Ludhiana (2019-2020) in the FFP, Annual review workshop during 17-18 June, 2020 through online mode.

- Sandeep Mann, attended 10 days online certificate course on E-content Development Conducted by RCELL India from 07 - 17 July, 2020.

- Sandeep Mann, attended meeting on 5 June, 2020 under chairmanship of Shri Atul Saxena, Joint Secretary, MoFPI regarding fixation of Cost Norms for processing facilities related to cereals and grains.

- Scientists of ICAR-CIPHET attended Virtual Business Meet on "Post-harvest and value addition technologies developed at ICAR-CIPHET Ludhiana" organized by ICAR-CIPHET Ludhiana on 10 Dec 2020.

- Scientists of ICAR-CIPHET, attended ICAR- Industry Meet on "Maize Value Chain" organized by ICAR-IIMR, Ludhiana on 12 November, 2020 from 10.00 am to 2.00 pm through online mode.

- Scientists of ICAR-CIPHET, attended one day Web based workshop on "Challenges posed by COVID-19 pandemic on post-harvest food handling systems and the way forward during- and post-COVID-19 periods" on 11 June, 2020.

- Scientists of ICAR-CIPHET, attended training course on Post-Harvest Management of Agricultural Produce during Natural Calamities/Disaster during 19-21 October,2020 convened

by K. Narsaiah, Head (Act.), AS & EC Division, ICAR-CIPHET, Ludhiana in collaboration with Prof. Anil K. Gupta Head ECDRM, NIDM, New Delhi through zoom meeting.

- Scientists of ICAR-CIPHET, attended Webinar on "How to publish open access and succeed with your publication" on 05 October, 2020 by Victoria Babbit, Director Research Development & Outreach at Taylor & Francis Group.

- Scientists of ICAR-CIPHET, attended Webinar on 'FAO 75 years and world food Day celebration program on 16 October, 2020.

- Swati Sethi successfully completed 17 days International Online Faculty development program-2020 conducted by the Department of Food Engineering and Food Science and Technology of NIFTEM, Sonipat from 5-21st October 2020.

- Th Bidyalakshmi Devi attended and gave oral presentation on "Design of Sensor Based Solar Dryer with Phase Change Material as Thermal Storage" on 54th annual convention of ISAE and International symposium on "Artificial Intelligence Based Future Technologies in Agriculture" which was held at Hyatt Regency, Pune during January 07-09, 2020.

- Th. Bidyalakshmi Devi attended a webinar on "Developing Entrepreneurial Skills among Agri-Graduates" on 21 August 2020; conducted as a part of webinar series "Education for Agriculture- Making a Difference" by NMIMS-SAST, Shirpur.

- Th. Bidyalakshmi Devi attended a workshop on "ABC of scientific writing during 18th August to 2 September 2020 organized by Krishi Vigyan Kendra Cuttack, Santhapur, ICAR-NRRI, Cuttack.

- Th. Bidyalakshmi Devi attended one-day online workshop on 'Training Management Information System (TMIS)' on 08 May 2020 organized by ICAR HRM Unit in collaboration with IASRI, New Delhi.

- Th. Bidyalakshmi Devi attended one-week live online training on "Creativity & innovation management in research" for Women Scientists under Women Component DISHA From 26-30 October 2020 organized by ESCI, Hyderbad.

- Th. Bidyalakshmi Devi attended Online Training Programme on "COVID-19 and Its Impact on Small and Medium On Farm and Off Farm Agro-based and Cottage Enterprises", during 17-28 August 2020, organized by AARDO-RDA, Bogura, Bangladesh.

- Th. Bidyalakshmi Devi attended webinar series 2.0 "Automation in Agriculture" organized by ISAE during May-June, 2020.

- Vikas Kumar attended 'Laboratory System and Internal Audit as per ISO/IEC 17025:2017' organized by Quality Council of India from 13-14 June, 2020.

- Vikas Kumar attended a virtual training on 'Design Thinking in Research Project Formulation and Implementation organized by ICAR-NAARM from 25-29 August, 2020.

- Vikas Kumar attended a virtual workshop on 'ABC of Scientific Writing' organized by KVK, Cuttack and ICAR-NRRI, Cuttack from 18 August-23 September, 2020.

- Vikas Kumar attended E-conferences on 'Opportunities in Processing, Freezing and Exporting of Value Added Products for Seafood Industry' organized by Indian Chamber of Commerce and supported by MPEDA, SEAI and FRICK on 29 July, 2020.

- Vikas Kumar attended International Webinar on 'Innovative Mission in the Future of Fish Processing' organized by Department of Fish Processing Technology, Dr. MGR Fisheries College and Research Institute, TNJFU, Ponneri on 29 July 2020.

- Vikas Kumar attended Virtual International Seminar on 'New Normal in Fisheries Sector amidst and Post-COVID-19 in India' organized by TNJFU Business School (Fisheries), OMR Campus, Chennai from 31 July - 02 August, 2020.

Participation in Exhibitions/Mela

Sr. No.	Exhibition/Mela	Date/Duration	Venue
1.	Agri. Business Incubator's Conclave	6 Feb, 2020	PAU, Ludhiana
2.	CII Agritech South: PJTSAU	22-24 Feb, 2020	PJTSAU, Hyderabad
3.	Pusa Krishi Vigyan Mela	1-3 Mar, 2020	IARI, New Delhi
4.	India International Food and Agri Week 2020	16-22 Oct, 2020	CII Virtual Platform

Sri S.Niranjan Reddy, Hon'ble Minister of Agriculture, Marketing and Civil Supplies, Govt of Telangana keenly observing the technology brochures of ICAR-CIPHET, Ludhiana. Mr. Vikas Kumar, Scientist, ICAR-CIPHET giving brochures during 2nd Agritech South 2020 at PJTSAU, Hyderabad (22-24 February, 2020)

Ongoing Research Projects

List of institute projects 2020-21 with their investigator

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
1.	Development of quality sensing system for mushroom and minimally processed pomegranate arils	Dr. Rahul Kumar Anurag (Co-PI) PI w.e.f. Dr. Shammi Kapoor, Sr. Mycologist, PAU Ludhiana (Co-PI) Dr. Th. Bidyalakshmi (Co-PI)	01.07.2015 20.06.2017 01.08.2015 01.10.2018	19.06.2017 31.12.2020 31.12.2020 31.12.2020	01/07/2015 30/06/2019
2.	Development of rapid spectro-scopic and molecular techniques for detection of animal species in meat products	Dr. Yogesh Kumar (PI) Sh. Vikas Kumar	01.04.2016 12.10.2018	31.03.2020 31.03.2020	01.04.2016 31.03.2020
3.	Design and development of hot air dryer for maize cob.	Er. Dhritiman Saha (Co-PI) Dr. Pankaj Kumar (PI w.e.f. 01.11.2017)	01.04.2016 01.11.2017	27.05.2019 31.12.2020	01/04/2016 31/03/2020
4.	Design and Development of Mechanized System for Fruit Bar Manufacturing	Dr. Kirti Jalgaonkar (PI) Mrs. Prerna Nath (Co-PI) Dr. Manoj Kumar Mahawar (Co-PI) Dr. Sakharam Kale (Co-PI w.e.f.)	01.04.2016 01.04.2016 01.04.2016 19.08.2020.	30/09/2019 Till date 30/09/2019 Till date	01/04/2016 30/09/2019
5.	Development of smart device for automatic detection and identification of insects in stored grains using machine vision technology	Dr. Ranjeet Singh (Co-PI) Dr. B.B. Ratnakar (Co-PI) Er. Yogesh Kalnar (Co-PI w.e.f.)	01.04.2016 18.07.2018 01.04.2016 01.04.2019.	17.07.2018 Till date 13.11.2020 Till date	01.04.2016 31.03.2019
6.	Development of hermetically sealed storage structure of 01 Tonne capacity for pulses	Er. Akhoon Asrar Bashir (PI) Dr V. Chandrasekar (Co-PI) Entomologist from PAU (Co-P-I)	01.04.2017 01.04.2017 01.04.2017	31.12.2020 02.09.2019 31.12.2020	01/04/2017 30/06/2020
7.	Development of process for color extraction from black carrot and its byproducts and its utilization in value added product	Dr. Prerna Nath Kale (PI) Dr. Sunil Kumar (Co-PI) Dr. Ajinath Dukare (Co-PI)	01.04.2017 01.04.2017 01.04.2017	31.03.2020 31.03.2020 31.03.2020	01/04/2017 31/03/2020
8.	Development of mechanized litchi de-stoner	Dr. Bibwe Bhusan Ratnakar (PI) Dr. Kirti Jalgaonkar (Co-PI) Dr. Pankaj Kumar Kannaujia (Co-PI)	01.04.2017 01.04.2017 01.04.2017	13.11.2020 30.11.2019 29.09.2018	01/04/2017 31/03/2020

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
9.	Designing Extension Strategies for Wider Adoption of Post-Harvest Technologies based on Adoption Behaviour of End Users	Dr. Renu Balakrishnan (PI)	01.04.2017	Till date	01/04/2017 31/03/2020
		Dr. Sandeep Mann (Co-PI)	01.04.2017	Till date	
		Dr Arvind Kumar (PS), ICAR-ATARI (Co-PI)	01.10.2018	Till date	
10.	Development of pigmented cereals based expanded/ extruded products and their nutritional evaluation	Dr. K. Bembem, (PI)	01.04.2017	31.12.2020	01/04/2017 31/03/2020
		Dr. Pankaj Kumar (Co-PI)	01.04.2017	31.12.2020	
11.	Development of automatic Sorter/Grader for Pomegranate and Tomato	Er. Yogesh Kalnar (PI)	01.04.2017	Till date	01/04/2017 31/03/2020
		Er. Sandeep Dawange Popatro (Co-PI)	01.10.2018	Till date	
12.	Development of collagen hydrolysate from buffalo (*Bubalus bubalis*) skin and its effect on osteoarthritis.	Dr. Tanbir Ahmad (PI)	01.10.2018	30.11.2019	01/10/2018 30/09/2020
		Dr A.U. Muzzadadi (Co-PI)	01.10.2018	Till Date	
		Dr. Yogesh Kumar (Co- PI & PI)	01.10.2018 01.12.2019	30.11.2019 Till Date	
13.	Development of process protocol for cryogenic grinding of selected medicinal herbs (Ashwagandha and Safed Musli)	Dr. Pankaj Kumar (PI)	01.10.2018	Till Date	01/10/2018 30/09/2021
		Dr. Manju Bala (Co-PI)	01.10.2018	Till Date	
14.	Production of bio-active ingredients from mango seed kernels	Dr. Poonam (PI)	01.10.2018	Till Date	01/10/2018 30/09/2021
		Dr. Th. Bidyalakshmi (Co-PI)	01.10.2018	Till Date	
		Dr. Sandeep Dawange Poputrao (Co-PI)	01.10.2018	Till Date	
15.	Development of ACE-Inhibitory Peptides from Fish and Livestock Processing Waste	Sh. Vikas Kumar (PI)	01.10.2018	Till Date	01/10/2018 30/09/2020
		Dr. Yogesh Kumar (Co-PI)	01.10.2018	Till Date	
		Dr. Tanbir Ahmad (Co-PI)	01.10.2018	30.11.2019	
		Dr.A.U.Muzadaddi (Co-PI)	15.01.2020	Till Date	
16.	Development of Lab-on-a-Chip method for detection of animal species in meat productS	Dr. Yogesh Kumar (PI)	01.04.2019	Till Date	01.04.2019 31.03.2022
		Dr. K Narsaiah (Co-PI)	01.04.2019	Till Date	
		Dr. Tanbir Ahmad (Co-PI)	01.04.2019	30.11.2019	
		Dr Poonam (Co-PI)	01.04.2019	Till Date	
17.	Development of Infra Red Spectroscopy Based Rapid Detection Methods for Adulterants in Chick pea flour (*Besan*)	Dr. Manju Bala (PI)	01.04.2019	Till Date	01.04.2019 31.03.2021
		Dr. Swati Sethi (Co-PI)	01.04.2019	Till Date	
		Mrs. P. Hemasankari (Co-PI)	01.04.2019	30.11.2019	

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
18.	Enhancing value of pigeon pea, black gram and their by-products through secondary agriculture	Dr. Deepika Goswami (PI)	01.01.2019	Till Date	01.01.2019 31.12.2021
		Dr. D. Mridula (Co-PI)	01.01.2019	Till Date	
		Dr. Manju Bala, (Co-PI)	01.01.2019	Till Date	
19.	Development of ripening delaying kit for enhancing the shelf-life of fresh fruits	Dr. Sunil Kumar (PI)	01.04.2019	18.08.2020	01.04.2019 31.03.2021
		Dr. Ramesh Kumar (Co-PI)	01.04.2019	Till Date	
20.	Postharvest Management and Value Addition of *Ker* and *Sangri* for their Commercial Exploration	Prerna Nath (Co-PI)	01.04.2019	Till Date	01.04.2019 31.03.2021
		Sakharam Kale (Co-PI)	01.04.2019	Till Date	
		Sunil Kumar (Co-PI)	01.04.2019	18.08.2020	
		Ramesh Kumar (Co-PI)	01.04.2019	Till Date	
21.	Development of mechanized system for deodorization and safe handling of dried fish	Dr A.U. Muzaddadi (PI)	01.04.2019	Till Date	01.04.2019 31.03.2022
		Dr. Sandeep Mann (Co-PI)	01.04.2019	Till Date	
		Dr. Khawairakpam Bembem (Co-PI)	01.04.2019	Till Date	
		Dr. Bipul Kakati (Co-PI)	01.04.2019	Till Date	
		Dr. Guru P.N (Co-PI)	27.02.2020	Till date	
		Dr. Kirti R. Jalgaonkar (Co-PI)	01.04.2019	30.11.2019	
22.	Upgradation and refinement of green pea depoding machine	Dr. B.B. Ratnakar (PI)	01.04.2019	31.03.2020	01.04.2019 31.03.2020
		Dr. Kirti Jalgaonkar (Co-PI)	01.04.2019	30.11.2019	
23.	Upgradation and commercial-ization of woman-friendly semi-automatic fish cleaning-cum dressing system"	Dr. A.U. Muzaddadi (PI)	01.04.2019	Till Date	01.04.2019 31.03.2020
		Mr. Vikas Kumar (Co-PI)	01.04.2019	Till Date	
24.	Development of enzyme assisted technology for enhancing protein extraction from de-oiled rice bran.	Ms. Surya (PI)	01.10.2020	Till Date	01.10.2020 30.09.2022
		Dr. D.N. Yadav (Co-PI)	01.10.2020	Till Date	
		Dr. Rajeev K. Kapoor (Co-PI), MDU, Rohtak, Haryana	01.10.2020	Till Date	
25.	Development of Photoreactor for Ethylene Degradation During Storage of Banana and Guava	Dr. Bhupendra M. Ghodki (PI)	01.10.2020	Till Date	01.10.2020 30.09.2023
		Er. Yogesh Kalnar (Co-PI)	01.10.2020	Till Date	
		One Food Technologist in place of Biochemist Dr. Poonam, may be associated in project team.	01.10.2020	Till Date	
26.	Development of Table Top Vaccum Frying System	Dr. Swati Sethi (PI)	01.10.2020	Till Date	01.10.2020 30.09.2022
		Dr. Pankaj Kumar (Co-PI)	01.10.2020	Till Date	

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
27.	Microbial production of Poly Hydroxy Butyrate (bioplastic) using mango by products	Dr. Ajinath Dukare (PI)	01.10.2020	02.03.2021	01.10.2020 30.09.2022
		Sh. Mahesh Kumar Samota (Co-PI)	01.10.2020	Till Date	
		Dr. Bibwe Bhushan Ratnagar (Co-PI)	01.10.2020	13.11.2020	
28.	Development of Solar Operated Low Cost Onion Storage Structure	Dr. Sakharam Kale (PI)	01.10.2020	Till Date	01.10.2020 30.09.2022
		Dr. Ajinath Dukare (Co-PI)	01.10.2020	02.03.2021	
		Sh. Mahesh Kumar Samota (Co-PI)	01.10.2020	Till Date	
29.	Development and Updating of Post-Harvest Machineries & Technologies Database	Dr Sandeep Mann (PI)	01.10.2020	Till Date	01.10.2020 30.09.2023
		Dr Sandeep P. Dawange (Co-PI)	01.10.2020	Till Date	
		PC PHET/Scientist (Co-PI)	01.10.2020	Till Date	
		PC PEASEM/ Scientist (Co-PI)	01.10.2020	Till Date	
30.	Development of android based mobile application (Mobile app) on post-harvest technology for skill development and employment security	Dr. Ranjeet Singh (PI)	01.10.2020	Till Date	01.10.2020 30.09.2023
		Er. Thongam. Sunita Devi (CoPI)	01.10.2020	Till Date	

List of Externally Funded Projects 2020-21 along with their investigator

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
1.	Development of food Bio-polymer based micro & nano scale delivery systems for bioactive ingredients in functional foods (Under Award of ICAR-National Fellow)	Dr. K. Narsaiah (PI)	02.01.2015	01.01.2020	02.01.2015 01.01.2020
2.	Establishment of modern fruits and vegetables Agro Processing Centre (APC)	Dr. Mridula D. (PI in place of Dr. R.K. Vishwakarma, PI & LCPC CRP on SA, ICAR-CIPHET, Ludhiana	1.04.2019	Till date	01/04/2015 31/03/2017
		Er. Akhoon Asrar Bashir (Co-PI)	22.12.2018	Till Date	
		Er. Indore Navnath Sakharam (Co-PI)	22.12.2018	Till Date	
		Dr. Deepika Goswami (Co-PI)	22.12.2018	Till Date	
3.	Value addition of Makhana and its by-products	Dr. R.K. Vishwakarma (PI)	01.04.2016	Till date	01.04/2016 31.03.2017
		Dr. Ranjit Singh (Co-PI)	01.04.2016	Till date	
		Dr. Khwairakpam Bembem (Co-PI)	16.08.2016	Till date	
		Dr. Mridula D. (Co-PI)	01.04.2018	Till date	
4.	Processing and Value Addition of Agricultural Produce for Enhancing Farmers income and Employment in Production Catchment under Farmer FIRST Programme (FFP)	Dr. Sandeep Mann (PI)	30.01.2017	Till date	30.01.2017 31.03.2017
		Dr. Rahul Kumar Anurag (Co-PI)	30.01.2017	Till date	
		Dr. Renu Balakrishnan (Co-PI)	30.01.2017	Till date	
		Er. Yogesh Kalnar (Co-PI)	30.01.2017	Till date	
		Dr. B.V.C Mahajan (Co-PI)Director & Prof., (PHPTC)	30.01.2017	Till date	
5.	Refinement of process protocol for preparation of traditional fermented fish products of Northeast India by using biotechnological tools and its process mechanization	Dr. A.U. Muzaddadi (PI)	23.03.2018	Till date	23.03.2018 22.03.2020
		Er. Dhritiman Saha (Co-PI)	23.03.2018	24.05.2019	
		Dr. Sandeep P. Dawange (Co-PI w.e.f)	23.03.2018	24.05.2019	
6.	Valorization of industrially produced soybean and ground-nut de-oiled meals/cakes by extraction, purification and production of protein isolateS	Dr. D.N. Yadav (PI)	01.08.2018	Till date	01.08.2018 31.07.2021
		Dr. R.K. Vishwakarma (Co-PI)	01.08.2018	31.07.2019	
		Ms. Surya (Co-PI)	01.08.2018	Till date	
		Dr. Swati Sethi (Co-PI)	01.08.2018	Till date	

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
7.	Design and Development of protective structures for high valued crops to reduce damage from hail and frost	Er. Indore Navnath S. (PI)	23.08.2018	06.01.2021	23.08.2018 31.03.2020
		Dr. R.K. Singh, Director (Acting) [Co-PI]	23.08.2018	Till date	
8.	Development of protocols for shelf life, safe storage, milling outturn and indicative norms for procurement of major pulses	Dr. R.K. Vishwakarma (PI)	27.03.2019	Till date	27.03.2019 26.03.2021
		Dr. Mridula D. (Co-PI)	27.03.2019	Till date	
		Dr. D.N. Yadav (Co-PI)	27.03.2019	Till date	
		Dr. Deepika Goswami (Co-PI)	27.03.2019	Till date	
		Er. Navnath Indore Sakharam	27.03.2019	06.01.2021	
9.	Development of rapid quality monitoring system for wheat flour and its primary milled products	Dr. D.N. Yadav (PI)	02.05.2018	Till date	02.05.2018 01.05.2021
		Dr. V.Chandrasekar (Co-PI)	02.05.2018	02.09.2019	
		Mrs. Surya (Co-PI)	02.05.2018	Till date	
		Dr. Bhupendra M. Ghodki (Co-PI)	01.08.2019	Till date	
		Dr. Rahul Kumar Anurag (Co-PI)	01.10.2019	Till date	
10.	Microwave Assisted Disinfestation of Selected Food Grains (Rice and Wheat) (Pradeep Metals Limited)	Dr. D.N. Yadav (PI)	01.03.2019	29.02.2020	01.03.2019 29.02.2020
		Dr. Swati Sethi (Co-PI)	01.03.2019	29.02.2020	
		Dr. Guru PN (Co-PI)	01.03.2019	29.02.2020	
		Dr. R.K. Singh (Co-PI)	01.03.2019	29.02.2020	
11.	Development of Hand-Held Instrument for Non-Destructive Quality Testing of Mango.	Dr. K.Narsaiah (PI)	01.10.2019	Till date	01.10.2019 30.09.2021
12.	Study on Determining Storage	Dr. R.K. Vishwakarma (LCPI)	20.11.2019	Till date	20.11.2019 19.05.2021
	Losses of Wheat and Paddy	Dr. Mridula D. (LCCo-PI)	04.03.2020	Till date	
	Stored in CAP System and to	Dr. Bhupendra M. Ghodki (LCCo-PI)	04.03.2020	Till date	
	Recommend Norms for Storage Losses.	Dr. Guru P.N. (LCCo-PI)	04.03.2020	Till date	
13.	Non-chemical management of stored-grain moths using flexible light-trap	Dr. Guru P.N. (PI)	01.10.2020	Till date	01.10.2020 30.09.2023
14.	Study for "Performance Evaluation of Hermetic Bags on selected commodities"	Dr. Sandeep Mann (PI)	01.10.2020	Till date	01.10.2020 30.09.2022
		Mrs. Surya (Co-PI)	01.10.2020	Till date	
		Dr. Guru P.N. (Co-PI)	01.10.2020	Till date	
		Dr. R.K. Singh, Director (Acting), ICAR-CIPHET (Co-PI)	01.10.2020	Till date	

List of Externally Funded Projects 2020-21 along with their investigator (AICRP on PET_HCP Division)

Sr. No.	Project Name	Project Leader & Associates	Period of Association From	To	Project period
1.	Revised Title: Development of phase change material based mobile cool chamber for transportation of fruits and vegetables	Dr. Sakharam Kale (PI)	01.04.2017	Till date	01.04.2017 31.03.2019
		Dr. Pankaj Kumar Kannaujia (Co-PI)	01.04.2017	Till date	
		Er. Indore Navnath (Co-PI)	01.04.2017	Till date	
2.	Assessment of soil microbial activities and post-harvest quality of tomato cultivated under plastic and organic mulches in arid regions	Dr. Ajinath Dukare (PI)	0.1.04.2018	Till date	01.04.2018\ 31.03.2020
		Dr. Pankaj Kannaujia (Co-PI)	0.1.04.2018	Till date	
3.	Strategies for maximum vertical space utilization in growing of selected vegetables inside polyhouse in hot and arid region	Dr. Pankaj Kumar Kannaujia (PI)	0.1.04.2018	Till date	01.04.2018 31.03.2020
		Dr. Sakharam Kale (Co-PI)	01.04.2018	Till date	
		Er. Indore Navnath Sakaram (Co-PI)	01.04.2018	Till date	

Research & Administrative Meetings

Research Advisory Committee (RAC)

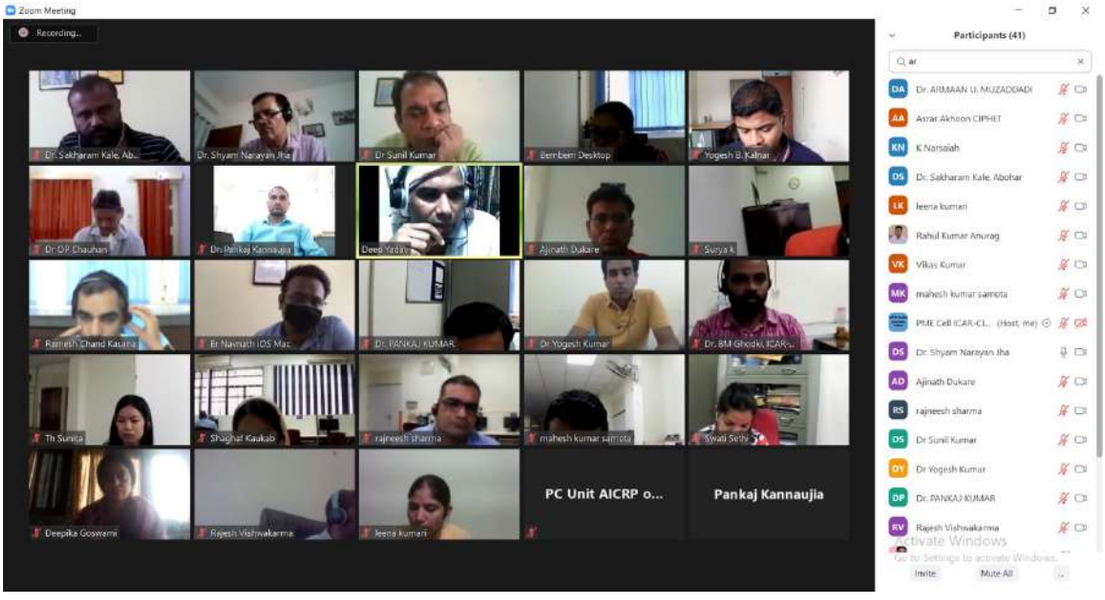
The Research Advisory Committee (RAC) of ICAR-CIPHET was held during 18-19 February 2020 at ICAR-CIPHET, Ludhiana. The Chairman & following members attended the meeting:

S. No.	Members
1.	Prof. Anwar Alam, Chairman, RAC; Former DDG (Engg.) and Former Vice Chancellor, SKUAST, Srinagar
2.	Dr. S.D. Kulkarni, Member; Former Project Director, SPU, ICAR-CIAE, Bhopal
3.	Dr. Nabarun Bhattacharya, Member; Director, C-DAC, Kolkata
4.	Dr. Vasudeva Singh, Member; Former Chief Scientist, CSIR-CFTRI, Mysore
5.	Dr. S. Ganapathy, Member; Professor & Head, Dept. of Food and Agricultural Process Engineering, CAE, TNAU, Coimbatore
6.	Dr. S. N. Jha, Ex-Officio Member; ADG (PE), Division of Agricultural Engineering, ICAR, KAB II, New Delhi
7.	Dr. R. K. Gupta, Member, ICAR-CIPHET, Ludhiana
8.	Dr. K. Narsaiah, Member Secretary; ICAR National Fellow and Pr. Scientist, AS&EC Division, ICAR-CIPHET, Ludhiana.

21st Research Advisory Committee (RAC) meeting

30th Institute Research Council (IRC) Meeting of ICAR-CIPHET, Ludhiana held through Video Conferencing during 08 – 10 July 2020

The 30th Institute Research Council Meeting was held through Video Conferencing during 08 - 10 July 2020 at ICAR-CIPHET, Ludhiana under the Chairmanship of Dr. R. K. Singh, Director (Acting), ICAR-CIPHET, Ludhiana. Dr. Ashok Kumar, Dean College of Agricultural Engineering, PAU, Ludhiana, Dr. O.P. Chauhan, Scientist-F, DFRL, Mysuru, and Dr. S.N. Jha, ADG (PE), ICAR, New Delhi were invited external experts. The invited external experts and scientists of ICAR-CIPHET, Ludhiana and Abohar participated in the meeting through online mode.



Personnel

Appointment/ Recruitment/ New Joining

Name of the officials	Date of Joining	Designation
Dr. Nachiket Kotwaliwale	12.10.2020	Director
Sh. Rajneesh Sharma	04.04.2020	Scientist
Sh. Mahesh Kumar Samota	04.04.2020	Scientist
Ms. Thongam Sunita Devi	04.04.2020	Scientist
Ms. Shaghaf Kaukab	04.04.2020	Scientist

Promotion (Scientists & Administrative)

Name of the officials	Date of Promotion (Under CAS)	Designation/RGP
Dr. Ranjeet Singh	21.10.2020 (w.e.f. 17.09.2018)	Principal Scientist
Sh. Chandan Solanki	01.01.2019	
Sh. Dhritiman Saha	01.01.2019	
Smt. Surya	05.01.2019	
Dr. Yogesh Kumar	06.11.2018	Sr. Scientist RGP
Sh. Kunwar Singh	09.11.2020	Assistant Administration Officer
Sh. Gurdial Singh	13.11.2020	Assistant
Smt. Sunita Rana	28.11.2020	UDC
Sh. B.C. Katoch	05.06.2020	Administration Officer

Clearance of Probation

Name & Designation	Date of appointment	Clearance of probation from the due date	Confirmation from the due date
Sh. Vikas Kumar, Scientist	01.01.2016	31.12.2018	01.01.2019
Dr. Poonam, Scientist	05.01.2017	04.01.2019	05.01.2019
Dr. Bhupendra M. Ghodki, Scientist	05.01.2017	04.01.2019	05.01.2019
Sh. Dawange Sandeep Popatrao, Scientist	05.07.2017	04.07.2019	05.07.2019
Dr. Thingujam Bidyalakshmi Devi, Scientist	05.07.2017	04.07.2019	05.07.2019
Dr. Guru P.N., Scientist	02.07.2018	01.07.2020	02.07.2020

Transfer

Name of the officials	Date of Transfer	Name of Place
Sh. B.C. Katoch, AAO	05.06.2020	ICAR-NDRI, Karnal
Sh. Rajneesh Sharma, Scientist	31.08.2020	ICAR-CAZRI, Jodhpur
Dr. Sunil Kumar, Pr. Scientist	18.08.2020	ICAR-IIWBR, Karnal
Sh. Bibwe Bhushan Ratnakar, Scientist	13.11.2020	ICAR-DOGR, Pune

Institutional Staff

At Ludhiana Campus

Name	Designation	Discipline
Scientific Staff		
Dr. Nachiket Kotwaliwale	Director	Agricultural Process Engineering
Dr. R. K. Singh AICRP	Project Coordinator, (PEASEM)	Soil Water Conservation Engineering
Dr. S. K. Tyagi	Principal Scientist	Chemical Engineering
Dr. K. Narsaiah	Principal Scientist	Agricultural Structures & Process Engineering
Dr. Mridula D.	Principal Scientist	Food & Nutrition
Dr. D. N. Yadav	Principal Scientist	Food Technology
Dr. Sandeep Mann	Principal Scientist	Agricultural Process Engineering
Dr. R. K. Vishwakarma	Principal Scientist	Agricultural Structures & Process Engineering
Dr. Manju Bala	Principal Scientist	Plant Biochemistry
Dr. A. U. Muzaddadi	Principal Scientist	Fish Processing Technology
Dr. Ramesh Chand Kasana	Principal Scientist	Microbiology
Dr. Ranjeet Singh	Principal Scientist	Agricultural Process Engineering
Dr. Yogesh Kumar	Senior Scientist	Livestock Product Technology
Dr. R. K. Anurag	Scientist	Food Technology
Dr. Deepika Goswami	Scientist	Food Technology
Smt. Leena Kumari**	Scientist	Electronics & Instrumentation
Smt. Surya	Scientist	Agricultural Microbiology
Dr. Swati Sethi	Scientist	Food Technology
Er. Chandan Solanki**	Scientist	Agricultural Process Engineering
Er. Dhritiman Saha**	Scientist	Agricultural Process Engineering
Er. A. A. Bashir	Scientist	Agricultural Structures & Environment Management
Er. Navnath Indore	Scientist	Agricultural Structures & Environment Management
Sh. Vikas Kumar	Scientist	Fish Processing Technology
Dr. Khwairakpam Bembem	Scientist	Home Science

Name	Designation	Discipline
Dr. Renu Balakrishnan	Scientist	Agricultural Extension
Er. Kalnar Yogesh	Scientist	Agricultural Process Engineering
Dr. Pankaj Kumar	Scientist	Agricultural Process Engineering
Dr. Poonam	Scientist	Plant Biochemistry
Er. Sandeep Dawange	Scientist	Agricultural Structures & Process Engineering
Dr. Thingujam Bidyalakshmi	Scientist	Agricultural Structures & Process Engineering
Dr. Guru P. N.	Scientist	Agricultural Entomology
Dr. B. M. Ghodki	Scientist	Agricultural Structures & Process Engineering
Ms. Shaghaf Kaukab	Scientist	Agricultural Structures & Process Engineering
Ms. Thongam Sunita Devi	Scientist	Agricultural Structures & Process Engineering

** On study leave

Name	Designation
Administrative Staff	
Sh. H.L. Meena	Senior Administrative Officer
Sh. Manni Lal	Finance and Accounts Officer
Sh. Kunwar Singh	Assistant Administrative Officer
Sh. S. S. Verm	Personal Secretary
Sh. Avtar Singh	Assistant
Sh. Tarsem Singh Purba	Assistant
Smt. Jasvir Kaur	Assistant
Sh. Gurdial Singh	Assistant
Sh. Ashwani Kumar	Upper Division Clerk
Sh. R. K. Raheja	Upper Division Clerk
Sh. Iqbal Singh	Upper Division Clerk
Smt. Sunita Rana	Upper Division Clerk
Sh. R. K. Yadav	Lower Division Clerk
Sh. S. K. Gaur	Lower Division Clerk
Technical Staff	
Dr. Mukund Narayan	Senior Technical Officer
Sh. Gurdeep Singh	Technical Officer
Sh. H. S. Sekhon (Driver)	Technical Officer
Sh. Vishal Kumar	Technical Officer
Sh. Beant Singh (Driver)	Technical Officer
Sh. Lakhwinder Singh	Senior Technical Assistant
Sh. Bhajan Singh	Senior Technical Assistant
Sh. Jaswant Singh	Senior Technical Assistant
Sh. Rajiv Sharma	Senior Technical Assistant

Name	Designation
Sh. Hardeep Singh	Senior Technical Assistant
Smt. Sonia Rani	Senior Technical Assistant
Sh. Pradip Kumar	Senior Technical Assistant
Smt. Pragya Singh	Technical Assistant
Sh. Jaswinder Singh	Technical Assistant
Sh. Jagtar Singh	Technical Assistant
Sh. Yashpal Singh	Technical Assistant
Sh. Satwinder Singh	Senior Technician
Sh. Sarup Singh	Senior Technician
Supporting Staff	
Sh. Sukhbir	Skilled Support Staff
Sh. Manoj Kumar	Skilled Support Staff

At Abohar Campus

Name	Designation	Discipline
Scientific Staff		
Dr. Ramesh Kumar	Principal Scientist	Horticulture
Dr. Prerna Nath	Scientist	Food Technology
Dr. Kale Sakharam	Scientist	Agricultural Structures & Process Engineering
Dr. Dukare Ajinath	Scientist	Agricultural Microbiology
Dr. P. K. Kannaujia	Scientist	Horticultural & Vegetable Science
Dr. Mahesh Kumar Samota	Scientist	Agricultural Structures & Process Engineering

Name	Designation
Administrative Staff	
Sh. Pawan Kumar	Assistant Administrative Officer
Sh. Mohan Lal	Assistant
Sh. Ajay Kumar	Lower Division Clerk
Technical Staff	
Sh. V. K. Saharan	Chief Technical Officer
Sh. Prithvi Raj	Assistant Chief Technical Officer
Sh. Rajesh Kumar	Assistant Chief Technical Officer
Sh. Ganpat Ram (Driver)	Senior Technical Assistant
Sh. Devinder Kumar	Senior Technical Assistant
Sh. Pawan Kumar	Senior Technical Assistant
Sh. Dalu Ram	Senior Technical Assistant
Supporting Staff	
Sh. Surinder Kumar	Skilled Support Staff

भाकृअनुप
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