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CENTRAL INSTITUTE OF POST HARVEST ENGINEERING & TECHNOLOGY

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PREFACE

The institute continued with the good progress shown during previous years in research and extension activities, which got further momentum through in-house and externally funded projects. The research projects covered value addition to food grains, oilseeds, spices, fruits and vegetables, storage of fruits and vegetables, environment control of cattle and poultry houses, development of tools and equipments, non-destructive techniques for quality determination, value added products from meat and micro-encapsulation of micro-organisms. Dissemination of technologies were done through licensing, publications, presentations, training of entrepreneurs/farmers, exhibitions, video-conferencing, and pilot plants etc.

The research output included development of non-destructive systems, micro-organisms based ripening/ anti-ripening agent, use of moisture absorbers and anti-microbial agents in packaging, production of cellulases, ethanol & feed supplements, value added product from rice straw and bagasse, pelletization, dewatering process for onion, comfort of poultry birds and dairy cows, extraction of dietry fibre from peel, flaxseed as food and feed, flour from de-oiled sesame and peanut de-skinning machine etc.

Foam mat dried tamarind pulp & powder, dairy analogues farm peanut kernels, process and technology for dry degerming of maize, berseem chicory seed separator are the new developments during the period. The dehuller for dehulling guar gum with 92% efficiency has been developed. A ber destoner, ber fruit grader, fruit harvester for jamun and aonla has also been developed. The 500kg/h ber fruit grader has 90-92% efficiency. Mixed fruit anola cheese was prepared using pulp/juice from aonla, papaya, pineapple and guava.The shelf life of guava was enhanced using coating made from cassava starch, chitosan, rice/ turmeric and carnauba wax. A hand held litchi peeler from wood has been designed and is very effective for peeling litchis.

For effective communication of agricultural technologies to the end users the media and scientists interacted on common platform. News clippings, television and radio programs and documentaries of agricultural technologies were prepared, published and broadcasted. An exhibition on showcasing of technologies of CIPHET, other institutes and SHGs and a media meet to unveil technologies of CIPHET was held.

Taking a unique initiative, an agro processing training program for jail inmates was started by CIPHET for Ludhiana Central jail inmates. The training on production of peanut milk, RTS beverage from guava and processing of tomatoes was given to inmates for creating self employment opportunities after completion of their sentences. Various training programs sponsored by ATMA and other government agencies were conducted for the farmers and officials from different states in the areas of post harvest technologies and establishment of APCs in rural catchments. The AICRP on Post Harvest Technology and AICRP on Application of Plastics in Agriculture have also developed many useful technologies.

We thankfully acknowledge constant encouragement of Dr. S. Ayyappan, Secretary DARE and DG, ICAR, Sh. Rajiv Mehrishi, Additional Secretary DARE and Secretary ICAR for the cause of post harvest technology and value addition. I acknowledge with thanks the support and cooperation extended by Dr. M. M. Pandey, DDG (Engg), Dr. K.K. Singh ADG (PE), Dr. N.P.S. Sirohi, ADG (Engg), Dr. S. Ganesan, Principal Scientist (Engg.), ICAR, New Delhi and Dr. R.T. Patil, Ex Director, CIPHET. The help rendered by Dr. S.K.Nanda, PC(PHT), Dr.P.R. Bhatnagar, PC (APA), Dr. S.N. Jha, Dr. D.R.Rai, Dr. D. Dhingra, Dr. Sangeeta Chopra, Ms. Aruna Sharma, Sh. Manni Lal and all scientific, administrative, technical and supporting staff of CIPHET Ludhiana and Abohar, in institute activities and preparation of this report is highly appreciated.

R. K. Gupta
Director (Acting) CIPHET

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कार्यकारी सारांश

कार्यकारी सारांश

संस्थान ने सत्र 2010–11 में अनुसंधान और विकास गतिविधियों में अच्छी प्रगति की हैं। अनुसंधान और विस्तार गतिविधियां को आंतरिक और बाह्य वित्त पोषित परियोजनाओं से सक्रिय किया गया। अनुसंधान परियोजन के तहत अनाज, तिलहन, मसाले, फल और सब्जियाँ एवं उनका भण्डारण, मवेशियों और कुक्कुट ग्रहों के पर्यावरण नियंत्रण और केला, आम और अन्य फलों के लिए उपकरणों का विकास किया गया। नॉनडिस्ट्रक्टिव तकनीकों से मांस के उत्पादों की गुणवत्ता का विविध प्रकार से मूल्यांकन किया गया है। प्रोद्योगिकियों के हस्तांतरण को प्रकाशन, प्रस्तुतियों, उद्यमियों/किसानों के प्रशिक्षण के माध्यम से किया गया था।

आम की गुणवत्ता के अध्ययन के लिये नौ किस्म के ताजा और संग्रहित फलों की भौतिक, रसायनिक और सूक्ष्मजीवी गुणवत्ता का मूल्यांकन किया गया। आमों की परिपक्वता को जानने के लिये एक सामूहिक परिपक्वता सूचकांक तैयार किया गया। आम की ऊपरी सतह से 123 जीवाणु और 29 फंफूदी अलग किये गये। आम के रस में मिलावट की प्रागुक्ति करने के लिए एक तरीका विकसित किया गया हैं। अनार के छिलके के एक्सट्रेक्ट में रोगाणुरोधी एजेन्ट के गुण ज्यादा मात्रा में पाये जाते है। राइस सट्रौ और पीपौड एन्जाइम उत्पादन के लिये इस्तेमाल किये एवं इनका उपयोग पशुचारा के लिये सम्भावित है। एक पैलेटाइजर, (क्षमता 10–15 kg / घण्टा), का परीक्षण चावल के डट्ठल, खोई, कपास एवं ज्वार से पशु आहार गोली बनाने के लिए किया गया। फसल के अवशेषों के हाइड्रोलिसिस और किण्वन के लिये एकीकृत प्रायोगिक संयंत्र लगाया गया है। प्याज के निर्जलीकरण से पहले आंशिक यांत्रिक डीवॉटरिंग की प्रकिया से न्यूनतम ऊर्जा की खपत और अधिकतम तीखापन प्राप्त किया गया। 59.43% डीवॉटरिंग 68.29° तापमान पर करने निर्जलित प्याज प्राप्त किया गया।

पशुओं के समूह नियंत्रण में पाया गया कि पंखे–पैड और पंख–फौगर शीतलन प्रणाली, ब्रायलर मुर्गे के उत्पादन को बढ़ाने के लिये बेहतर हैं। इन शीतलन प्रणाली से 6 सप्ताह बाद ब्रायलर मुर्गे के औसत शरीर का बजन 16% और 10.4% से भी अधिक एवं उनमें मृत्यु दर काफी कम हो जाती है। सामान्य वातावरण की तुलना में पाया गया कि पशुओं में दूध उत्पादन बढ़ाने के लिये पंखे–पैड और पंखे–फौगर शीतलन प्रणाली बेहतर है।

अलसी, अनाज और दालों के साथ मिठास के विभिन्न स्तर पर तैयार की गई उर्जा पट्टी में ओमेगा 3 फैटी एसिड ज्यादा मात्रा में पाया गया जो कि स्वीकार्य है। क्रायोजेनिक चक्की का इस्तेमाल काली मिर्च, धनियाँ, हल्दी, मेथी और दालचीनी बीज को कम तापमान पर पीसने में

किया गया। मोती बाजरा और जौ के मूल्यवर्धन उत्पादन (दलिया, सूजी, आटा, इस्टेन्ट हलवा, त्वरित लड्डू, पास्ता) के लिए, प्रक्रिया प्रोटोकॉल विकसित किये गये। मूंगफली का छिलका उतारने वाली मशीन (क्षमता 60–75 किलो प्रति घण्टा) विकसित की गई जिसकी दक्षता 60–70 % है और इस मशीन से 35–40 % पूरा दाना प्राप्त किया गया।

अरहर के छिलके को उतारने के लिए सूक्ष्मजीवी का विकास किया गया। ट्राइकोडर्मा के ट्रीटमेन्ट की तुलना में एस्परजिलस के उपयोग से ज्यादा छिलका निकालकर दाना उत्पादन किया गया। इमली के गूदे को फोममेट के रुप में सुखाने के परिणामस्वरुप अच्छी गुणवत्ता का इमली पाउडर बनाया गया। 70:30 के अनुपात में मूँगफली का दूध और मानक दूध के मिश्रण से छेना मिठाई तैयार की गई, जिसकी गुणवत्ता को स्वीकार्य किया गया। लकड़ी से बना उपकरण लीची छीलने के लिये विकसित किया गया। ग्वार गम का छिलका निकालने वाली मशीन का विकास किया गया जिसकी क्षमता 70–80 किलो/घण्टा हैं एवं 92 प्रतिशत दक्षता है। जामुन–ऑवला की फसल काटने की मशीन और बेर ग्रेडर का विकास किया गया। बेर ग्रेडर की क्षमता 500 किलो प्रति घण्टा है एवं दक्षता 90–92 % तक की है। अमरुद का निधानी आयु बढ़ाने के लिये स्टार्च, चावल, हल्दी और मोम की कोटिंग का उपयोग फायदेमन्द पाया गया।

ए.पी.सी. और पशु संयंत्र के मशीनों में बदलते लोड की स्थिति में 0.2 से 0.76 तक का पावर–फेक्टर मापा गया अतः इनमें पावर–फेक्टर सुधार सिस्टम की जरुरत है। एक मछली डीस्केलिंग मशीन बनाई गई जिसमें विभिन्न प्रकार के बेलनाकार डीस्केलिंग हैड उपयोग किये गये। कच्चे आलू, अनाज, खरी, भूसी और गुड़ के मिश्रण से एक्सट्रूडिड पशु आहार तैयार किया गया। एन्जाइमेटिक और रासायनिक प्रक्रिया से आलू के छिल्के से फाइबर निकालने की प्रक्रिया का मानवीयकरण किया गया और बिस्किट और चपाती बनाने में इस्तेमाल किया गया।

कृषि सूचना के प्रसार के लिए लगभग 210 खबरें छापी गई एवं 10 टेलीविजन कार्यक्रम और 15 रेडियों प्रोग्रामों का प्रसारण किया गया। कृषिकों एवं उद्यमियों की जानकारी हेतु एक प्रर्दशनी भी सीफेट में आयोजित की गई। सेन्ट्रल जेल, लुधियाना, के महिलाओं और पुरुषों के लिए प्रशिक्षण कार्यक्रम आयोजित किए गए जिसमें अदरक का पाउडर, लहसुन स्लाइस, मूल्य वर्धित मांस उत्पादों, एक्ट्रूडिड स्नैक्स, मिश्रित अचार, गाजर की कैंडी और जैम जैली बनाने की विधि बताई गई। इससे उन्हें रोजगार के अवसरों के बारे में जानकारी प्राप्त हुई।

विभिन्न राज्यों के किसानों के लिए फसलोपरांत प्रौद्योकियों से संबंधित कई तरह के प्रशिक्षण कार्यक्रम आयोजित किये गए। AICRP (PHT) एवं AICRP (APA) ने कई उपयोगी तकनीकों को विकसित किया है। लगभग 35 प्रोद्योगिकी उद्यमियों/किसानों को लाइसेंस किये गये। इन प्रौद्योगिकियों में मूँगफली और सोयाबीन आधारित स्वाद पेय,

दही और पनीर बनाना, हरी मिर्च और हरी मिर्च पाउडर तैयार करना, मांस और पौल्ट्री प्रसंस्करण और मूल्यवर्धन उत्पाद बनाना, वाष्पीकरणी ठण्ड़ा कमरा (2 टन), सीफेट वाष्पीकरणीय ठंडी सरंचना (5 टन), खाद्य पदार्थों के इनकेप्सुलेसन के लिये माइक्रोइनकेवसुलेटर, अमरूद से चमड़ा/बार बनाना, प्याज के गुच्छे और प्याज का पाउडर बनाना, मखाना खीर मिश्रण एवं प्रोटीन समृद्ध एकसटूटिड उत्पाद शामिल है। संस्थान के वैज्ञानिकों ने अच्छी संख्या में शोध पत्र प्रकाशित किये एवं विभिन्न सम्मेलनों में भाग लिया।

EXECUTIVE SUMMARY

The institute made significant progress in research and extension activities during the reported period of 2010-11. These activities were accelerated through in house and externally funded projects. The research projects covered the areas of value addition of food grains, oilseeds, spices, fruits and vegetables, storage of fruits and vegetables, environment control of cattle and poultry houses, development of tools and equipments for banana, mango and other crops, non-destructive techniques for quality determination and diversified value added products from meat. Dissemination of technologies were done through licensing of technologies, publications, presentations and training of entrepreneurs and farmers.

Physicochemical and microbiological quality of nine varieties of fresh & stored mangoes was evaluated for nondestructive study of quality of mango. A common maturity index was formulated for prediction of maturity of mangoes. One hundred and twenty seven bacterial and 20 fungal strains were isolated from mango surfaces. A rapid method for prediction of adulteration of mango juice was developed. Pomegranate peel extract showed potential application as antimicrobial agent. A pelletizer of 10-15 kg/h capacity has been tested for making pellets from rice straw, bagasse, cotton stalk and sweet sorghum without use of binder. An integrated pilot plant has been installed for hydrolysis and fermentation of crop residues. The process of partial mechanical dewatering prior to dehydration was optimized to get minimum energy consumption and maximum pungency retention in drying of onions. The best combination was 59.43 % dewatering and drying at 68.29 ^{0}C for Agrifound dark red onion.

The effect of fan-pad and fan-fogger cooling systems was observed to be significantly better for broiler production than control. The average body weight of broiler chicks after 6th week was 16 % and 10.4 % more in fan-pad and fan-fogger cooling systems than that in control and the mortality of chicks kept in shelters cooled by the cooling systems was significantly low. The effect of fan-pad and fan-fogger cooling systems was found to be better for increasing milk production in cattle as compared to control group.

Energy bar samples rich in Omega-3 fatty acid have been prepared from mixture of flaxseed, cereals, and pulses with varying levels of sweeteners and were found to be acceptable. Cryogenic grinder was used to prepare ground spices from black pepper, coriander, turmeric, fenugreek and cinnamon seed at low temperature. Process protocols were developed for value added products from pearl millet and barley including *daliya, suji, atta*, insant *halwa*, instant *ladoo*, pasta etc. A peanut deskinning machine of capacity 60-75 kg/h has been developed with the deskinning efficiency of 60-70 % and over 35-40 % whole kernels were obtained from the machine.

Dehulling of pigeonpea was done by microbial growth and *Asperigillus* pretreatment produced more dehulled kernels in pigeonpea than *Trichoderma*. Foam mat drying of tamarind pulp resulted in better quality of tamarind powder. *Channa* sweet was prepared from 70:30 blends of peanut milk and standard milk and found to be of acceptable quality. A hand tool made from wood has been developed for litchi peeling. A dehuller with throughput capacity of 70-80 kg/h has been developed for dehulling guar gum with maximum efficiency of 92 %. A fruit harvester cum saver for harvesting of jamun/aonla and a ber grader of 500 kg/h capacity with efficiency of 90-92 % has been developed. The shelf life of

guava was assessed by using coating from cassava starch, chitosan, rice/turmeric, carnauba wax and enhanced shelf life was achieved.

The power factor of machines in APC and cattle pilot plant under no load conditions varied from 0.2 to 0.76 and need automatic power factor correction systems. A fish descaling machine has been designed with different cylindrical descaling heads. Extruded feed has been made from mixture of potato wastes, cereals, oil cake, husk and molasses. The enzymatic-chemical process for extracting of dietary fibre from potato peel was standardized, and was used to make biscuits and chapattis.

Around 210 news clippings, 11 television programs, 15 radio programmes were published/broadcasted for effective dissemination of agro-information and an exhibition on showcasing of technologies was also organized at CIPHET. The trainings have been conducted for women and men inmates of Central Jail, Ludhiana, for preparation of ginger powder, garlic slices, value-added meat products, extruded snack products, mixed pickle and carrot candy and jam/jelly in order to create awareness among them regarding self employment opportunities.

Various training programs sponsored by ATMA and other government agencies were conducted for the farmers and officials from different states in the areas of post harvest technologies and establishment of APCs in rural catchments. The AICRP on post harvest technology and application of plastics in agriculture have also developed many useful technologies.

As many as 35 technologies were licensed to entrepreneurs/farmers. These technologies included groundnut and soybean based flavored beverage, curd and paneer, technology for preparing green chilli powder and green chilli, paste/puree, meat and poultry processing and value addition technologies, evaporative cooled room (2 tons), CIPHET evaporative cooled structure (5 tons), microencapsulator for encapsulation of food ingredients, manufacturing guava leather/bar, onion flakes and onion powdering technology, ready to constitute makhana kheer mix, protein enriched ready to eat extruded products. A good number of research papers were published. The scientists of the institute participated in various conferences.

CIPHET - AN OVERVIEW

CIPHET - AN OVERVIEW

The Central Institute of Post-Harvest Engineering and Technology (CIPHET) was established on 29 December 1989 at the PAU Campus, Ludhiana, Punjab, India as a nodal institute to undertake lead researches in the area of the post-harvest engineering and technology appropriate to agricultural production catchments and agro-industries. The institute's second campus was established on 19 March 1993 at Abohar, Punjab, India and is primarily responsible for conducting research and development activities on fruits and vegetables. CIPHET is also headquarter for two All India Coordinated Research Projects (AICRPs) viz. AICRP on Post-Harvest Technology (PHT) with 38 Centres and AICRP on Application of Plastics in Agriculture (APA) with 11 Centres.

Mandate

To undertake basic, applied, strategic and adaptive engineering and technology research in post production sector of produce of plant origin, livestock and aquaculture produce including agricultural structures and environmental control, quality and safety.

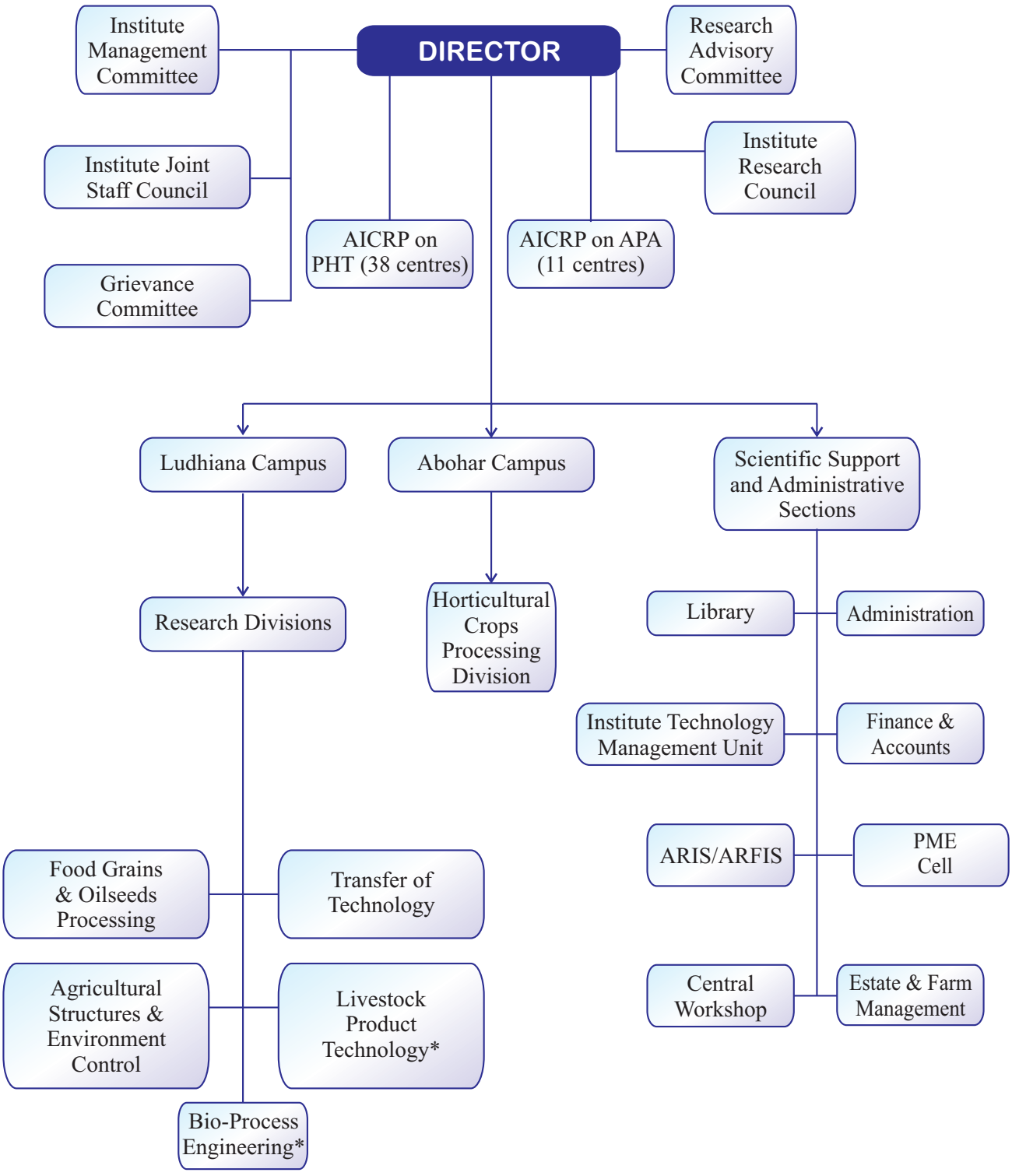
To act as national institute for research, education/teaching and training in post harvest engineering and technology.

To act as national repository of information on processes, equipment, products and technologies on post harvest engineering and technology.

To transfer technology and provide advisory and consultancy services and promote entrepreneurship.

To develop and strengthen linkages with the growers/farmers, private and public sector food processing enterprises in the mandated areas.

ORGANIZATIONAL STRUCTURE



** Proposed to be established*

RESEARCH DIVISIONS

Ludhiana Campus

1. Agricultural Structures and Environment Control
2. Food Grains and Oilseeds Processing
3. Livestock Product Technology*
4. Bio-Process Engineering*
5. Transfer of Technology

Abohar Campus

6. Horticultural Crops Processing

** Proposed to be established*

INFRASTRUCTURE

LIBRARY

The library of CIPHET has good collection of books and journals in the area of post-harvest engineering, biotechnology, food engineering, food microbiology and attracts many researchers / visitors from all over the nation to review the literature in post-harvest technology and food engineering.

The library has current stock of books as 4609 gratis publications, 908 annual reports, research highlight etc as on 31 March 2011. Library subscribed thirteen international journals and twenty two national local journals, during this year.

The breakup of books and journals purchased in the year 2010-11

Particular	Number
Books	262
Indian Journals	21
Foreign Journals	5

Library provides the current list of journals and new arrivals regularly to all the CIPHET staff. Apart from the routine work of library, it serves in the following manner to the visitors :

Sale of publications: Library puts on sale institute publications, technical bulletins and conference proceedings.

Reference service: The library provides the photocopy facilities to the readers on payment basis. Library also arranges references and abstracts of research papers and articles.

AKMU/ARIS Cell

The Institute has an Agricultural Knowledge Management Unit (AKMU) earlier known as Agricultural Research Information System (ARIS) for scientists to support data analysis and electronic communication. The unit has fifteen desktops alongwith three servers. More than 100 desktops of the Institute are well connected through Local Area Network and Internet. Internet connectivity is available through 2Mbps leased line provided by BSNL. AKMU houses a number of analysis and design software such as Front Page 2003, Corel Draw Graphics Suite, Adobe Professional, Pro-Engineer, SAS, Design Expert Software, Ansys CFX, Leap Office 2000 (Hindi Software). The facilities in the cell were strengthened through more number of analysis and general software. Institute Website www.ciphet.in available both in Hindi and English is maintained by AKMU.

Services provided by AKMU are as follows:

Data analysis facility.

Data browsing on www.indiastat.com

Assistance in software application in different research works.

Internet browsing.

Software and computer hardware support.

Assistance in online patent search through various database.

Institute Technology Management Unit (ITMU)

ITMU plays a crucial role in management of

technologies. It provides :

1. Advisory & Consultancy: For general information regarding CIPHET developed technologies, any one can enroll as a member of institute by paying fees of Rs1000/- only for one year. In return institute provides all the general information for one year.

2. Training and Licensing: For practical training on a particular technology and hands on experience for 3-5 days, fees is charged. In this case, training certificate and license of technology is issued to the contracting party after successful completion of training.

3. Signing of MOU: Institute signs MOU with firms and NGO's interested in trainings (paid), general information, guidance, establishment of food processing industries and various activities related to postharvest technologies, value addition etc.

Prioritization, Monitoring & Evaluation (PME) Cell

Prioritization Monitoring & Evaluation concept is a management tool in R&D system to enhance scientific productivity and is the requirement of most of the funding agencies. It helps in setting a unified priority and monitoring of externally funded and in-house projects. PME cell at CIPHET conducts Institute Research Council Meeting and maintains all research project files. The monthly, quarterly and six monthly reports of individual scientists are collated and compiled into Progress Reports, Results Framework Document, quarterly and half yearly performance review reports. PME cell also acts as a link between the various regional committee meetings, directors conferences etc. and the institute scientists. The exchange of information acts through PME Cell. The database of parliament questions and their answers, action taken reports, and issues related to scientific activities of the institute are dealt by PME Cell. In addition to this, the research information related to ongoing and completed research projects is uploaded through Project Information and Management System (PIMS) software to avoid duplication in research.

CIVIL WORKS

I. Completed

Sewerage system (One set completed)

Agro-processing cluster building, Ludhiana.

Chilli processing plant, Ludhiana.

II. Under Progress

Quarters (Type V) 2 Nos. at CIPHET, Ludhiana

Quarter (Type V) 01 No. at CIPHET, Abohar

Quarter (Type IV) 6 Nos. at CIPHET, Ludhiana

III. New works awarded for construction

Conversion of KVK Building into Guest House at CIPHET, Abohar

Replacement of LT cable in Guest House at CIPHET, Ludhiana.

STAFF POSITION (AS ON 31.03.2011)

Category	Sanctioned strength	Filled		Total Filled
		Ludhiana	Abohar	
Scientific	77*	31*	09	40
Administrative	22#	17#	04	21
Technical	30	23	07	30
Supporting	05	03	01	04
Total	134	74	21	95

* including Director
# Including Administrative Officer

AICRP on Post Harvest Technology, CIPHET, Ludhiana

Category	Sanctioned Posts	Posts in Position
Scientific	3*	2
Administrative	2	0
Technical	4	0
Supporting	1	0
Total	10	3

* including PC (PHT)

AICRP on Application of Plastics in Agriculture, CIPHET, Ludhiana

Category	Sanctioned Posts	Posts in Position
Scientific	2	1
Administrative	3	1
Technical	2	2
Supporting	2	0
Total	9	4

STATEMENT OF BUDGET ESTIMATES AND EXPENDITURE (2010-2011)

PLAN

(Rs. in lakhs)

S.No.	Head of Account	Revised Budget Estimates	Expenditure up to 31.03.2011
1.	Establishment Charges (TS/OTA)	-	-
2.	Travelling Allowance	13.00	12.84
3.	Other charges including equipment	292.13	291.60
4.	Revenue Resources	-	-
5.	Works (Major)		
	a. Office building	66.87	66.87
	b. Residential building	-	-
6.	Information Technology	14.00	13.99
7.	Other items (HRD)	5.00	4.71
	Total	**391.01**	**390.01**

NON - PLAN

(Rs. in lakhs)

S.No.	Head of Account	Revised Budget Estimates	Expenditure
1.	Establishment Charges (TS/OTA)	480.16	425.98
2.	Travelling Allowance	2.50	2.50
3.	Other charges including equipment	73.87	57.91
4.	Revenue Resources	-	-
5.	Works		
	a. Office building	8.47	8.31
	b. Residential building	2.00	1.34
6.	Other items (HRD)	-	-
	Total	**567.00**	**496.04**

RESEARCH ACHIEVEMENTS

RESEARCH ACHIEVEMENTS

AGRICULTURAL STRUCTURES AND ENVIRONMENT CONTROL

Development of microorganisms based ripening/anti-ripening agent for mango and banana

Pranita Jaiswal, S N Jha

Three bacterial strains with desired biochemical activity, procured from IARI New Delhi, were evaluated for their role as ripening agent. One of them showed potential to delay the ripening of mango and banana as compared to control as evident from lower total soluble solids (TSS) and dry matter content, and higher titrable acidity. The force required to puncture the fruits was also found to be higher in case of treated fruits as compared to control.

Potential of spectroscopy in the wavelength range of 299-1100 nm for nondestructive prediction of dry matter (DM) content, pH, sweetness, total soluble solids (TSS), and acid Brix ratio (ABR) for banana was studied for estimation of maturity and ripening stage of banana. Partial least square (PLS) and multiple linear regression (MLR) tests were carried out. PLS models were found to be the best with multiple correlation coefficients for calibration and validation as 0.88 and 0.81 º Brix for TSS, 0.85 and 0.78 for ABR, 0.88 and 0.83 for pH and 0.90 and 0.87% for DM respectively. The standard errors of calibration, prediction, biases and differences in them were low, which indicated that NIRS has potential to predict maturity and ripening of banana nondestructively.

Development of nondestructive systems for evaluation of microbial and physiochemical quality parameters of mango

S N Jha, K Narsaiah, Pranita Jaiswal, Ramesh Kumar

a) *Mango orchards of* ***nine states*** *(Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Orissa, Punjab, Tamil Nadu, and Uttar Pradesh)* for sampling of **nine mango cultivars** (*Banganpally, Maldah, Keshar, Mallika, Alphonso, Neelum,Langara Dusheri,* and *Chausa*) were selected. A total of **380 microbes** belonging to different genera of bacteria and fungi were isolated from surface of 1520 mangoes. Total microbial population was found to be in the range of 10^4 to 10^7 cfu. Bacterial diversity on nine different mango cultivars included **127 species belonging to 22 genera.** Highest bacterial diversity was recorded from Neelam variety collected from Tamil Nadu, whereon 15 bacterial species were detected belonging to 10 genera, while lowest diversity was observed on Dashehari from Punjab showing presence of only four bacterial species. The most dominant bacterial genera, on the surface of mango cultivars were found to be *Bacillus,* followed by *Staphylococcus, Enterobacter and Pseudomonas. A*mong them the predominant bacterial species, was found to be *Bacillus subtillis, which* was detected from majority of mango cultivars*, e*xcept Dashehari from *Punjab and Uttar Pradesh* and Langra from *Uttar Pradesh. Bacillus pumilis,* causative agent of die back disease of mango, has been detected from eight mango cultivars (*Alphonso* from Karnataka and Maharashtra, *Banganpally* from AP, *Chausa* from Punjab, *Dashari* from Punjab and UP, *Keshar* from Maharstra and *Maldah* from Bihar). **Neelam variety from Tamil Nadu showed presence of a bacterial strain (*Stenotrophomonas maltophilia)*, which has been reported to be *opportunistic* pathogen.**

Twenty fungal strains belonging to the genera of *Aspergillus, Fusarium, Alternaria, Cladosporium, Penicillium, Heminthosporium, Trichoderma,Rhizopus,Paecilomyces, Acremonium, Colletotrichum* were detected from mango surface. *Aspergillus niger* was found to

be predominant fungal species, detected from majority of the mango cultivars except *Kesar* from Gujarat; *Chausa* from Punjab and UP and *Maldah* from Bihar. **Maximum fungal diversity was recorded on *Alphanso from* Maharashtra,** where 8 different fungal species belonging to 5 genera were detected and lowest fungal diversity was recorded on *Kesar* from Maharashtra.

b) *A simple and common **"maturity index"** based on biochemical properties for nine varieties of mangoes was developed.* Level of maturity **of each variety** now can be computed quantitatively, which hitherto was being done subjectively**.** NIR spectra in the wavelength ranges of about 400 – 1100 nm, 900–1700 nm and 1200–2200 nm of 3064 mangoes have been acquired and NIR models for nondestructive prediction of maturity, sweetness and sourness of all varieties have been developed. The best MLR models are in the wavelength range of 1600 -1800 nm for maturity index, TSS, DM and pH with multiple correlation coefficients for calibration of 0.89, 0.92, 0.81 and 0.91 respectively. Acidity however could be better predicted in the spectral range of 475 – 925 nm using PLS model having multiple correlation coefficients for calibration and validations of 0.77 and 0.67 respectively.

c) *A Rapid method for qualitative and quantitative prediction of **adulteration of mango juice** by outside sugar was developed using ATR-FTIR in conjunction with chemometric analysis of spectral data.* The detection limits at 5 % significance level were 1 % for samples having no mango juice at all, 3 % for samples with low natural TSS, 5 % for samples having natural TSS more than 10^0 Brix, and 3.6 % in commercial mango juice. Added sugar content, total soluble solids content and real juice content were predicted very reliably with multiple correlation coefficient of 0.99 and 0.98 in the wave number range of 1476 to 912 cm^{-1} using partial least squares regression and three wave numbers (1088, 1050, 991 cm^{-1}) (Eqn 1) using multiple linear regression, respectively;

$$TSS = 3.4 - 272.6A_{1088} + 821.2A_{1050} - 576.2A_{991} \quad (1)$$

where, $A_{1088,}$ $A_{1050,}$ A_{991} are absorbance values at wavenumbers 1088, 1050 and 991 cm^{-1}, respectively.

d) *ProteOn XPR36 Protein Interaction Array System was used to show the power parallel measurements of analyte–ligand (small molecule-protein) interactions.* ProteOn XPR36 Protein Interaction Array System (BIO-RAD Laboratories, Hercules, CA, USA) was used to show the power parallel measurements of analyte–ligand (small molecule-protein) interactions. Well-characterized model of CAII binding to the (CBS) analyte was selected. Repetitive injections were performed using the One-shot Kinetic approach to demonstrate the reproducibility of the binding signals. The CAII ligand was immobilized on five different channels using exactly the same immobilization conditions. Each channel was immobilized with ligand (10,000 RU) and binding of six different concentrations of CBS inhibitor was studied and the data for kinetic analysis is shown in (Fig.1) while results are summarized in (Table 1). Six concentrations of CBS analyte allowed the determination of association (k_a) and dissociation (k_d) rate constants. (Fig.1) shows the data obtained from 30 independent CBS injections over the five CA II channels. No regeneration (removal of analyte) was required between injection panels, as dissociation was rapid and the signal returned to baseline. The binding curves of all interactions were ?tted using simple 1:1 binding Langmuir model. Each injection panel, consisting of six different CBS concentrations were analyzed independently, using the grouped mode for k_a, k_d, and R_{max} to determine the kinetic binding constants and inherent variation.

In total, 30 k_a and k_d constants were determined, based on 6 injections over five ligand channels. The calculated kinetic constants obtained from these 6 independent CBS injection steps are summarized in Table 1.

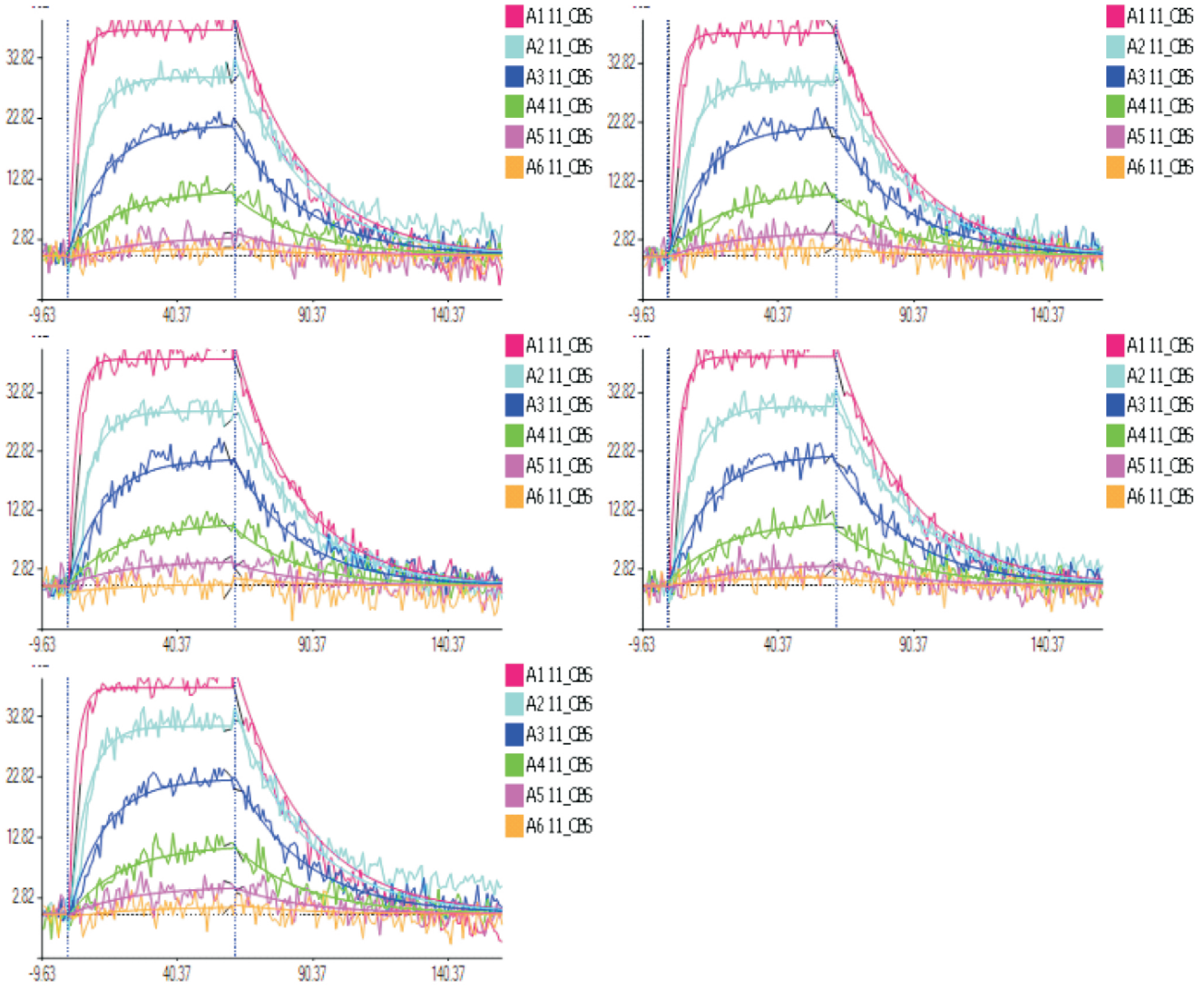


Fig. 1. An overview of data obtained from 6 independent CBS injection steps over five CAII channels

These results demonstrated a high reproducibility of the binding signals measured. Additionally, the activity of the immobilized CAII ligand was high which was important for the measurements of small molecules that generate low signals upon binding. The ability to interpret low signals with high reproducibility is crucial for many applications like pathogen or toxin detection and secondary screening in drug discovery. Langmuir model yielded the rate constants k_a and k_d which were of the order 1.58E+3 $M^{-1}s^{-1}$ and 0.04 s^{-1}, respectively and equilibrium dissociation constant was 2.45E-7 M.

Table1: Kinetic binding constants calculated using data obtained from 36 independent CBS injection steps over five different CAII ligand channels on GLM chips

Channel	Ligand Density (RU)	K_a ($M^{-1}s^{-1}$)	K_d (s^{-1})	K_D (M)	R_{max}
1	10342 ± 1.0%	1.53E+04	0.04	2.54E-06	45.75
2	10343 ± 0.9%	1.59E+04	0.04	2.37E-06	44.34
3	Reference channel	-		-	-
4	10482 ± 0.6%	1.60E+04	0.04	2.58E-06	46.38
5	10508 ± 0.4%	1.41E+04	0.04	2.62E-06	46.91
6	10512 ± 1.2%	1.78E+04	0.04	2.15E-06	45.77
Average	-	1.58E+04	0.04	2.45E-07	-
SD	-	1.34E+03	0	1.93E-07	-

Rapid identification and detection of microbes in poultry meat using IR spectroscopy and chemometrics

Manpreet Kaur Grewal, Pranita Jaiswal

Five organisms were identified as poultry meat specific microbes. Pure cultures of *Salmonella enteritidis, Pseudomonas ludensis, Listeria monocytogenes* and *Escherichia coli* were procured from IMTECH, Chandigarh. Spectral signatures of three actively growing cultures (*E. coli, L. monocytogenes and S.enteritidis*) were acquired using FTIR spectrometer with ZnSe crystal cell ATR in range of 600-4000 cm-1. The data were recorded at room temperature (24 ± 2°C) in the wave number range of 4000–600 cm^{-1}at 0.709 cm^{-1} interval. The preliminary inspection of spectra of three microbes showed three peaks with distinguishable difference in the regions of 1600–1201, 2400-2300 and 3600-2900 cm^{-1}.

Packaging and allied applications for bioactive components, antioxidants and microbiological safety of fruits and fresh cut fruits and vegetables

M. Manjunatha, Rahul K. Anurag

Studies were conducted on packaging and storage of cauliflower and green beans by using paddy husk and silica gel, mustard seed as moisture absorbents and antimicrobial agent. In both cauliflower and green beans, results showed that paddy husk powder, mustard flour and silica gel absorbed water vapor about 32, 30 and 70 %, respectively. Reduction in microbial load was more in mustard treated sample as compared to paddy husk and silica gel. More retention of vitamin-C, less browning and less off flavor was observed in the cauliflower samples packed with moisture absorbents (paddy husk, silica gel and mustard seed) and stored under refrigeration condition as compared to samples without moisture absorbents (paddy husk, silica gel and mustard seed) due to less microbial activity and low temperature. Sensory evaluation (9-point hedonic scale) showed that the both cauliflower and green beans packed with moisture absorbents (paddy husk, silica gel and mustard seed) and stored under refrigeration condition ranked best as compared to the samples stored under ambient condition without moisture absorbents.

Shelf-life extension of meat and meat products using natural extract and vacuum packaging as hurdles.

S K Devatkal, K Narasaiah

Evaluation of antibacterial activity of pomegranate peel extracts against Pseudomonas stutzeri bacteria:

In this study antibacterial activity of pomegranate peel (PPE) was evaluated against bacteria isolated from poultry meat. The bacteria from stored poultry meat were identified using 16S rRNA gene and DNA sequencing (Fig 2.) Results of molecular characterization showed that the bacteria isolated were having 100% homology with the *Pseudomonas stutzeri strain CTSP36* and further

analysis showed that bacteria isolated were P. *stutzeri* strain CTSP36. Antibacterial activity of PPE was demonstrated by clear zone of inhibition in plates inoculated with extract. The diameter of inhibition zones were significantly ($p<0.05$) higher in PPE as compared to standard antibiotic discs used (tetracycline, vancomycin and streptomycin). Results of broth dilution assay also revealed that PPE at 1%, 5% and 10% were effective in inhibiting bacterial growth in test plates (Table 2). Further, a decrease in the growth of bacterial cells and a gradual decline in protein content of bacterial cells were also observed when bacterial culture was grown with different concentration of PPE along with a control. These results showed the potential application of pomegranate peel extract as antibacterial agent against *P. stutzeri*.

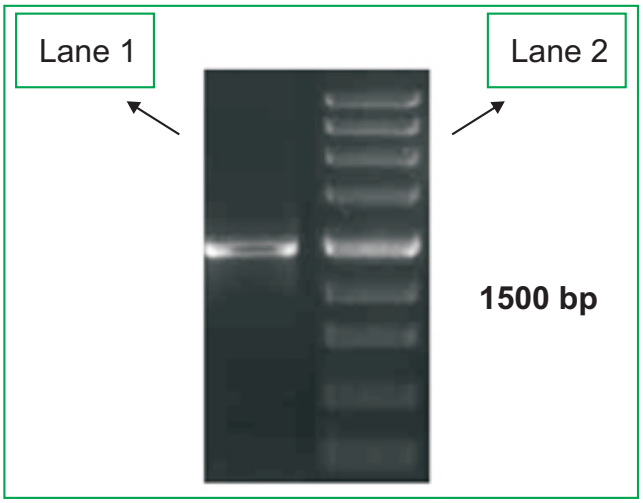


Fig. 2. Identification of the *Pseudomonas stutzeri* isolated from poultry meat. PCR amplification of 16s rDNA gene of the sample bacterial culture.
Lane 1. Amplified product of 16s rDNA;
Lane 2. DNA ladder.

Table 2: Comparative Antibacterial activity of PPE and standard antibiotic discs using agar diffusion method

Test solution	PPE1	PPE2	PPE1 (Autoclaved)	PPE2 (Autoclaved)	Tetracycline (30mcg)	Vancomycin (30mcg)	Streptomycin (10mcg)	Sterile diluent
Diameter of inhibition zone (mm)	21.0 ^{c}	26.0 ^{d}	20.0 ^{c}	26 .0^{d}	13.0 ^{a}	15.0 ^{b}	12.0 ^{a}	-
Mean standard error	3.2	2.5	1.8	1.5	0.98	1.3	0.78	-

Means within a row with different superscripts are significantly different. $p<.0.05$. n=6
PPE1: Extract obtained from peels; PPE 2: Extract obtained from powder; - No inhibition

Optimization of parameters for utilization of paddy straw, kinnow pulp and pea pods for production of cellulases, ethanol and feed supplements

H S Oberoi, V K Bhargav

About twenty new isolates showing characteristic zones on CMC plates impregnated with congo red belonged to genera *Aspergillus*, *Trichoderma* and *Humicola*. They were assayed for filter paper cellulase and β-glucosidase activities. Four isolates belonging to the genus *Aspergillus* which showed filter paper cellulase activity of 1 FPU/ml or higher were further assayed for the total cellulase enzyme profile. On the basis of morphological and biochemical characterization, they were identified as isolates belonging to *Aspergillus niger* (1), *Aspergillus flavus* (2) and *Aspergillus fumigatus* (1).

Two yeast isolates and one bacterial isolate have been isolated using selective adaptation on xylose

medium and have shown the capability to assimilate and ferment pentose sugars such as xylose and arabinose. Simultaneous saccharification and fermentation of Kinnow waste with cellulase obtained from *Aspergillus niger* and fermentation by *Pichia kudriavzevii* resulted in ethanol concentration of 34 g/l and ethanol productivity of 2.8 g/l/h. Galactose adaptation of thermotolerant *Pichia kudriavzevii* cells helped in enhancing ethanol production from sugarcane juice at fermentation temperatures in the vicinity of 40 ºC and 45 ºC. Phylogenetic dendrogram for *Pichia kudriavzevii* is presented in Fig. 3.

Statistical optimization of concentration of cellulase, β-glucosidase, hydrolysis, temperature and time helped in obtaining 92% conversion of glucose from glucan in alkali pre-treated rice straw. Crude enzyme filtrate with filter paper cellulase (FP) activity of 1.50 FPU/ml could be concentrated to 8 FPU/ml in about 2h with protein getting concentrated from 0.17 mg/ml to 1.49 mg/ml.

Rice straw as well as pea pods used for enzyme production through solid-state fermentation showed a reduction in cellulose, hemicellulose and lignin concentrations and an increase in protein and ash concentrations in the biomass left after enzyme extraction indicating potential for use as cattle feed (Fig. 4).

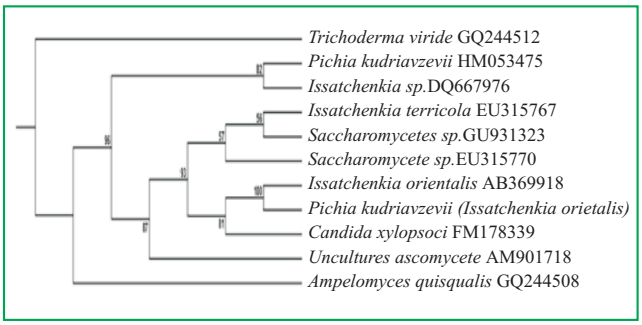
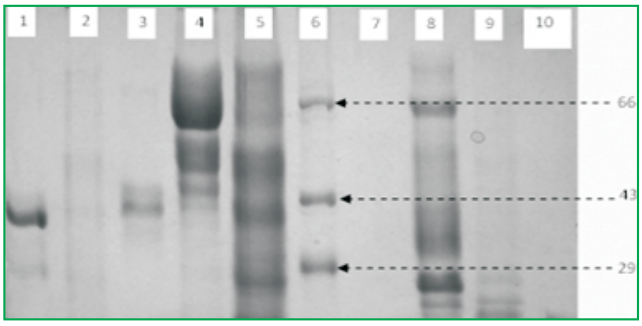


Fig. 3. Phylogenetic dendrogram for *Pichia kudriavzevii* (*Issatchenkia orientalis*) and related strains based on the ITS rDNA sequence. Numbers following the names of the isolates are accession numbers of published sequences.



1-Cellobiohydrolase, 2-crude enzyme, 3- Celluclast, 4- Novozyme-188, 5- retentate,6- ladder, 7- permeate, 8- pectinase, 9- xylanase, 10- second permeate

Fig. 4. Crude enzyme concentration using 10 kDa regenerated cellulose membranes

Novel Biotechnological process for production of value added product from rice straw and bagasse

H S Oberoi, V K Bhargav

Pretreatment using alkali has been optimized for both rice straw and bagasse. Alkali pretreatment with 1% alkali for rice straw and 3% bagasse resulted in enhanced hydrolysis. Scanning electron microscopy showing the disruption of rice straw structure after alkali pretreatment and SSF (Fig. 5 and Fig. 6).

Three thermotolerant cellulolytic *Aspergillus* isolates have been characterized for cellulase assay. Gene sequences for 28s rRNA gene for four novel *Aspergillus niger* isolates have been deposited with NCBI. Enzyme profile of crude filtrate extract of *Aspergillus niger* is shown in (Table 3). Hydrolysis of untreated bagasse using crude enzyme filtrate resulted in glucose and fructose concentrations of 28 g/l and 18 g/l respectively.

Table 3: Enzyme activities of *Aspergillus niger* on rice straw and wheat bran (4:1) as substrates in a solid-state fermentation process

Enzyme	Activity (IU/ g-ds)
CMCase	121.20
Xylanase	1700
FP cellulase	15.70
Cellobiohydrolase	12.30
β- glucosidase	282.60
α-L-arabinofuranosidase	87.60
β- xylosidase	137.70
Exo-polygalacturonase	212.70
Xylan esterase	157.45
Protein (g/l)	0.25

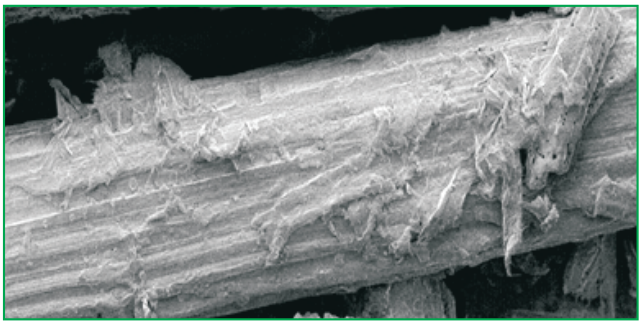


Fig. 5 .Scanning electron microscopy (SEM) of enzymatically hydrolyzed alkali-treated rice straw

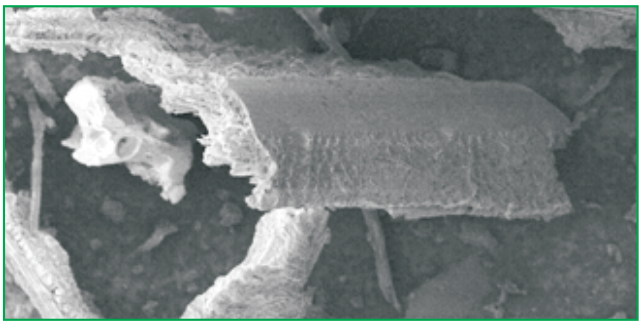


Fig. 6 .Scanning electron microscopy (SEM) rice straw structure after simultaneous saccharification and fermentation

Development of technologies for pelletization, delignification and saccharification of cellulosic biomass such as rice straw, cotton stalk, sweet sorghum, switchgrass, *Prosopis juliflora* and *Lantana camara*

H S Oberoi, V K Bhargav, K Narsaiah, R T Patil

A pelletizer (Fig. 7) of capacity 10-15 kg/h has been installed and tested for making pellets from rice straw, bagasse, cotton stalk and sweet sorghum bagasse without the use of any binder.

Pellets of size 12mm x 4mm diameter were produced using custom designed pelletizer by moisture equilibration without the use of any binders. The bulk density of ground rice straw and bagasse could be increased by 4-5 times through pelletization (Fig 8). An integrated pilot plant for pretreatment, hydrolysis and fermentation for production of value-added products from crop residues has been designed and installed (Fig. 9).

Fig. 7 .Custom designed pelletizer

Proximate composition analysis of rice straw, bagasse, sweet sorghum bagasse, cotton stalk, *Prosopis juliflora* and *Lantana camara* has been completed

Fig. 8 .Rice straw pellets

Fig. 9. Integrated pilot plant for pretreatment, hydrolysis and fermentation for production of value added products from crop residues

A value chain on novelty pork products under organized pig farming system

K Narsaiah, S K Devatkal

Many international regulations stipulate that all meat temperatures within the carcass must be reduced below 7 °C before the carcass is further processed or moved from the chillers. An insulated box with frozen gel bottles was tested for its suitability to distribute fresh pork carcasses by chilling. To simulate the heat load on the carrying boxes, the insulated box was kept in environmental control chamber and the temperature of environment surrounding the insulated box was set at 15, 20, 30 and 40 °C and them the system was evaluated with pork carcass.

At 15 °C the average inside temperature of the box after 6 h cooling was 1.8 °C and the coolant-2.4 °C (Fig. 10) and heat transfer rate at 15 °C was 0.304 W.

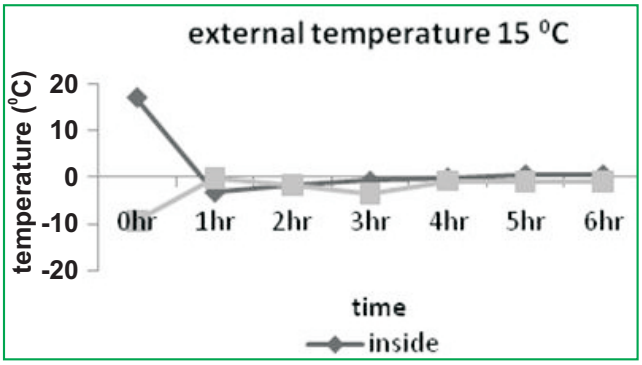


Fig. 10 .Temperature reduction graph of every hour at 15 °C

At 20 °C the average inside temperature of the box after 6 h cooling was 2.5 °C and the coolant-3.6 (Fig. 11) and heat transfer rate at 20 °C is 0.453 W.

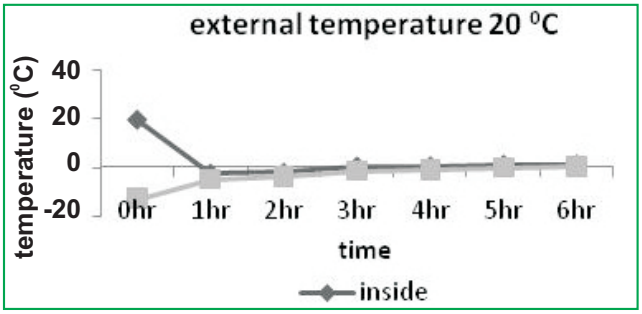


Fig. 11 .Temperature reduction graph of every hour at 20 °C

At 30 °C the average inside temperature of the box after 6 h cooling was 2.4 °C and the coolant-4.7 (Fig. 12) and the heat transfer rate at 30 °C was 0.510 W.

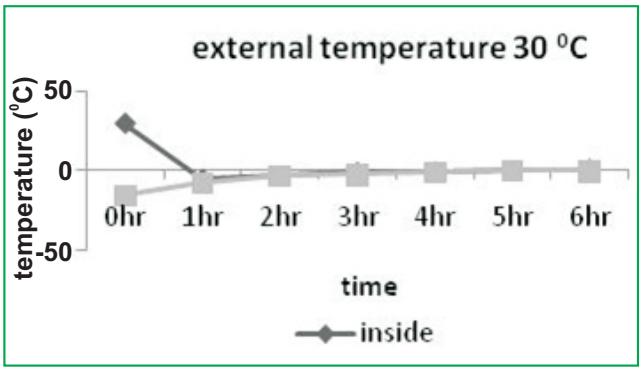


Fig. 12 .Temperature reduction graph of every hour at 30 °C

At 40 °C the average inside temperature of the box after 6 h cooling was 2.7 °C and the coolant -3.3 °C (Fig. 13) and heat transfer rate 40 °C was 1.215 W/s. The convective heat transfer coefficient of still air in an insulated box was 0.36 W $m^{-2}K^{-1}$.

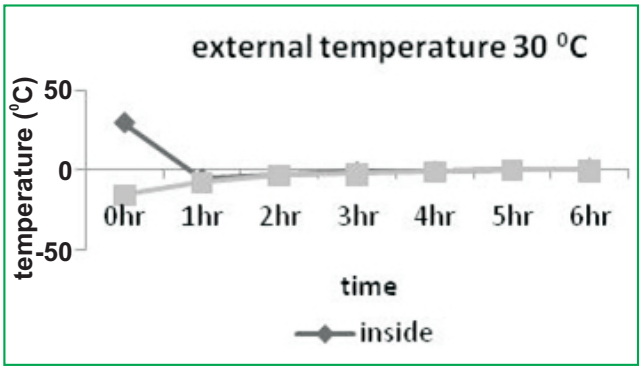


Fig. 13 .Temperature reduction graph of every hour at 40 °C

10 kg of pork meat was procured immediately after slaughtering from the local market of Ludhiana. The meat was washed with warm water to clean the surface of carcass and was then wrapped in unsealed plastic bag and was kept in the insulated box. The temperature of meat surface, deep muscles, frozen gel bottle and inside air was monitored at the external temperature 15°C for 8h and was plotted in graph (Fig. 14).

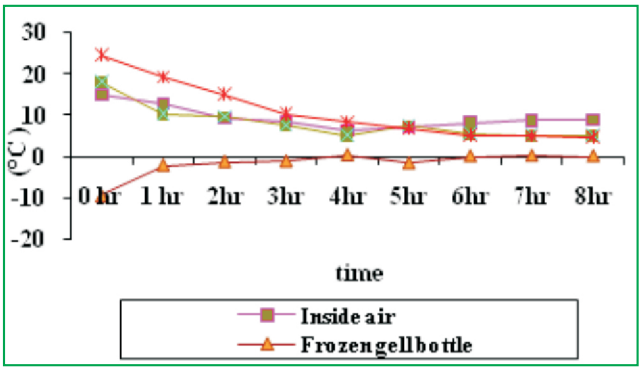
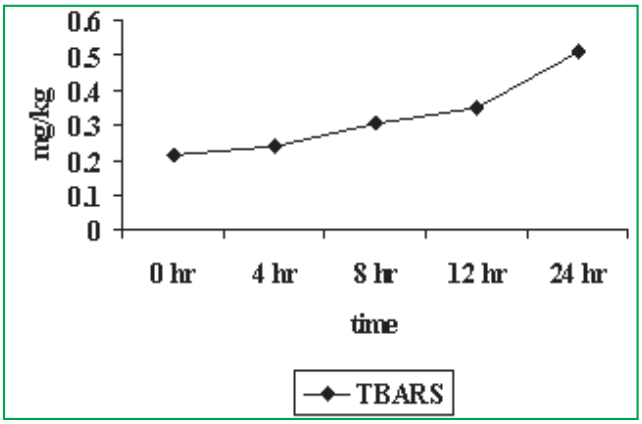


Fig. 14 .Temperature profile of an insulated empty box and with meat kept in a box

The chilling of meat extended to 24 hours and parameters like pH, cooking loss, colour, TBARS, water holding capacity were determined at 0, 4, 8, 12 and 24 hrs.

There was slight increase in TBARS after chilling within 24 h duration and decrease in pH of the meat after 24 h chilling. After every 4 h during chilling there was increase in pH of the meat. Springer *et. al.* reported that the pH of pork loin after 3.5 h was little higher in accelerated chilling of pork carcass.

The TBARS content in meat during chilling was increased after every 4 h interval in an insulated box with frozen gel bottles (Fig. 15).



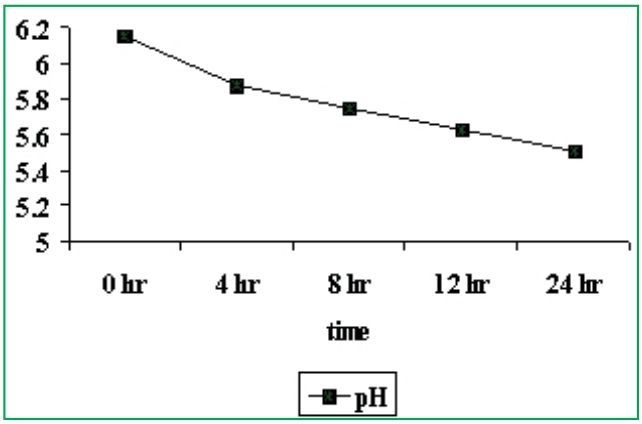
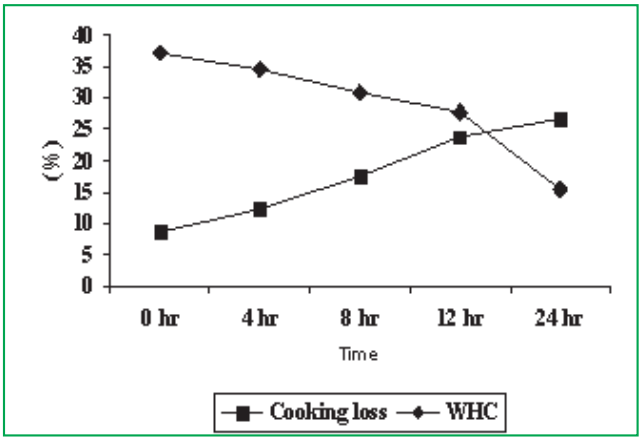


Fig. 15 .Chilling effect on Meat pH and TBARS



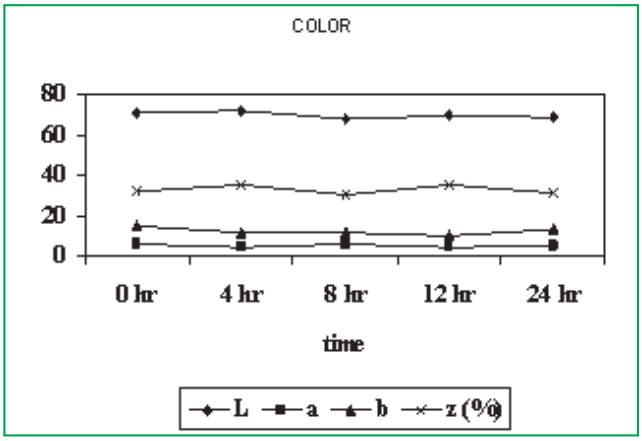


Fig. 16 .Effect of chilling on meat quality after 24 h

L, a and b had no effect in an insulate box kept with frozen gel bottles, there was no deterioration in colour of the meat sample and had not affected the quality (Fig. 16). At lower temperature of meat oxygen penetrated more deeply in the muscles compared to higher temperature which affected the red colour of meat.

Development of partial dewatering process for onion for value addition and safe storage

Manpreet Kaur Grewal, S N Jha

The process of partial mechanical dewatering prior to dehydration wasoptimized to get minimum energy consumption and maximum retention of pungency and other quality attributes. The process parameters i.e. onion variety, drying temperature (50, 60 and 70°C) and level of percent dewatering(0, 30 and 60%) were optimized using response surface methodology by targeting minimum energy requirement, loss in pungency, color change, non enzymatic browning and maximum ascorbic acid content. Three cultivars of onion were selected. The onions were dried in two stages in tray dryer. When the moisture content of product being dried in the dryer reached 7%, the temperature of the dryer was lowered to 40^{0}C. The product was then dried at lower temperature till it reached moisture content of 4-5%. This reduced the energy consumption and prevented discoloration of the end product. Onion powder was prepared by grinding the dehydrated onion slices and pulp in laboratory grinder. Temperature and percent dewatering were directly related to drying time, energy consumption and pyruvic acid content, while no clear influence could be found for colour degradation indicators, colour change and non-enzymatic browning. After optimization the best combinations were Agrifound dark Red : 59.43% dewatering and 68.29 °C temperature; 59.13% dewatering and 68.37 °C temperature; and 59.53% dewatering and 67.95°C temperature with desirability 0.813, 0.813 and 0.812 respectively. Considerable energy saving could be done by partial mechanical dewatering and subsequent drying with retention of pyruvic acid and ascorbic acid content comparable to conventional slice drying and without any undesirable colour degradation. The proximate composition of onion powder was moisture content 2.8-4.5%, protein 5.12-9.15%, ash 3.4-4.4%, crude fat 0.64-1.64%, fiber 2.7-4.9% and carbohydrate 75.4% -85.34%.

Effect of cooling systems on thermal comfort and production of poultry birds

Sangeeta Chopra, D R Rai, S S Nagra, Daljeet Kaur

The effect of the cooling systems was seen on the broilers kept in deep litter system. A total number of 480 one day-old broiler chicks with similar body weight range were used for conducting the experiment of six weeks duration. The three treatment groups were fan-fogger system (T_1) and fan –Pad system (T_2) and control. The broiler chicks were randomly divided into the three treatment groups each having 160 birds in 4 replications, of 40 numbers each.

Design considerations of the cooling systems

The size of the shed was 16 x 10 x 10 ft. In the deep litter system, hens need 2 ft^2 for comfort. Since the floor Area of shed = 160 ft^2 therefore 70 hens can be kept in the shed. The hen needs 30 cfm of air circulation for comfort therefore the air flow needed for comfort of 70 hens is 2100 ft^3/min i.e. 59.5 m^3/min. Hence a fan having air delivery 59.5 m^3/min i.e. 3570 m^3/h is needed. An exhaust fan of size 18" with air delivery 60 m^3/min i.e. 76.8 kg / min was selected. To take the condition of environment from 35 ^{0}C, 40% to 30 ^{0}C, 60%: 0.0025 kg moisture/ kg dry air. The rate at which moisture to be added was 76.8 x .0025 = 0.192 kg water/min = 11.5 l/h. Hence 5 nos. foggers each of discharge 2 l/h, 30 psi, 0.2 mm were fitted in front the fan in fan-fogger cooling system.

The fan / fogger system (Fig. 17) consisted of a blower with a copper ring placed in front of it. Fine foggers were placed on the ring, which was connected with a water tank through a high pressure pipe. The water was first filtered and then pumped to the foggers. The foggers on and off time were controlled through a timer. When the fan and the fogger were both in on condition a fine mist was created leading to the cooling of the shelter. During the off time of the fogger, the fan was in running condition so that the cooler temperature and the humidity were maintained. The on/off cycle of the foggers was repeated.

Fig. 17 .Fan-Fogger cooling system

The fan and pad system (Fig. 18) consisted of cellulose pads placed at one end of the shelter and the exhaust fan at the opposite end. The water was pumped to the pads through a pump and the pad was kept wet. The cross ventilation of the air in this system gave the coolness in the shelter. The pads were made of cellulose paper housed in a G.I casing with a water distributor through a P.V.C header. The intricately woven cellulose pads (Fig. 19) provided necessary water to air contact to achieve high efficiency in cooling.

Fig. 18 .Fan-Pad cooling system

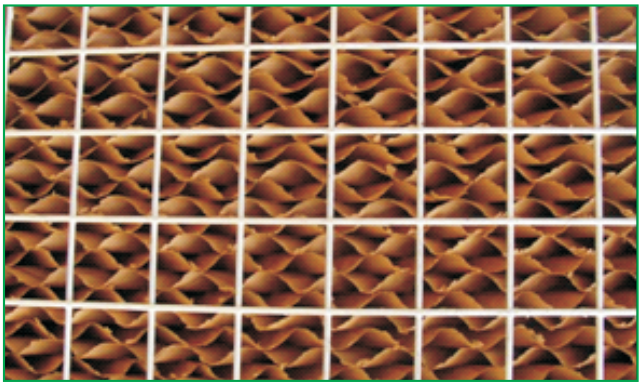


Fig. 19 .Cellulose pads

At the end of the 6th week the average body weight the broiler chicks was 16.31 and 10.4 % more in the fan-pad (T1) and fan-fogger (T2) system respectively than that in control (Fig. 20). Feed conversion ration (FCR) of fan-pad and fan-fogger was significantly better than control at 5% level of significance (Fig. 21). The mortality of the broiler chicks was significantly higher 8.12 % in control than in fan-fogger 5.62 % and in fan-pad system 3.12 %) (Fig. 22). The broiler chicks in the shelters equipped with the cooling system, took more feed and water, rested more often and walked around comfortably. Whereas the broiler chicks in the control chased each other, panted more often which was indicative of heat stress and took less feed and water and thus gained lesser weight.

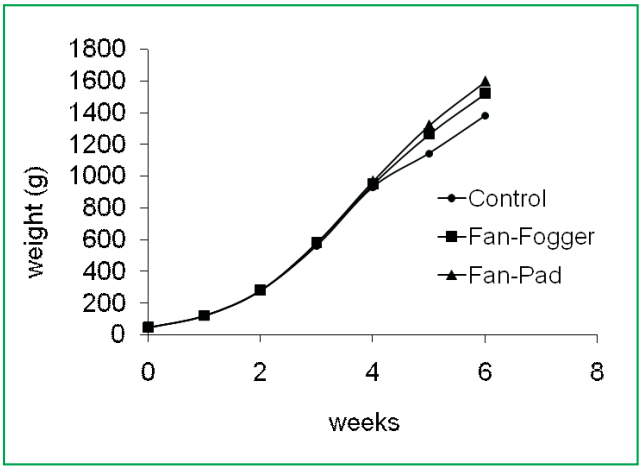


Fig. 20 .Average weight of broiler chicks under different treatments

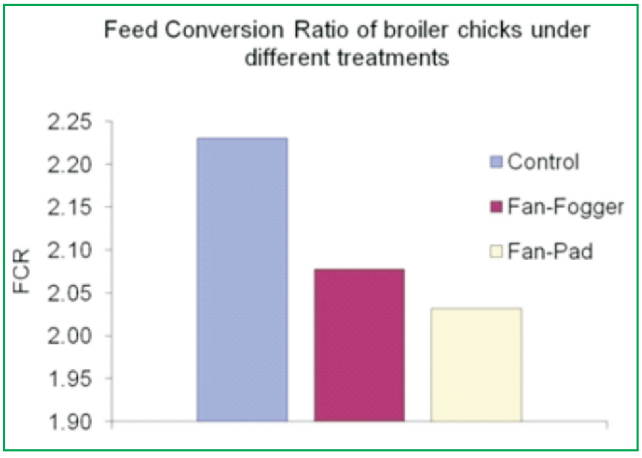


Fig. 21 .Feed Conversion Ratio of broiler chicks under different treatments

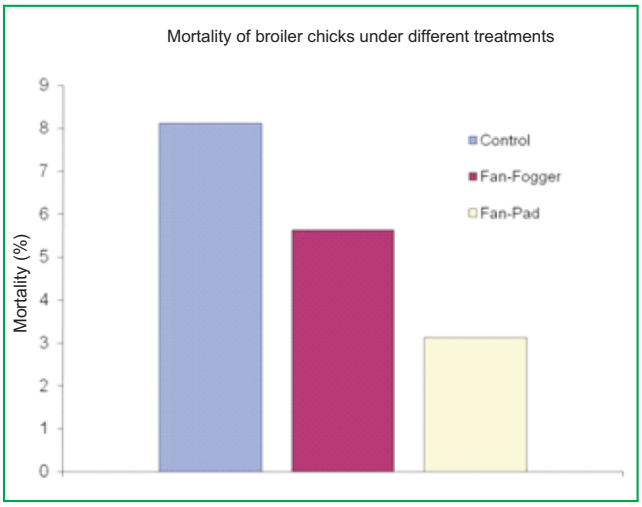


Fig. 22 .Mortality of broiler chicks under different treatments

Development of cooling systems for comfort and enhanced productivity of dairy cow

Sangeeta Chopra, S N Jha, M L Mehra, P Malhotra

The sheds in GADVASU were partially enclosed shelters in which the cows were kept loose. The size of the shed was 46.4 x 6.6 x 4.2 m (Fig. 23). The feeding area in on one side and the entrance to the sheds was on the other side. Since the sheds were partially open and could not be closed from either the feeding area side or the entrance side, the cooling systems were installed one on each side wall (along the width) and a third system at the middle of the shed. Three cooling systems were needed for each shed to improve the microclimate inside the sheds. Since the cows were kept loose and also needed cooling to reduce heat stress, they naturally positioned themselves near to the cooling systems which had a positive effect to reduce their heat stress.

a) Design considerations of cooling systems

The **c**ows (Holstein Friesian cross bred) were selected on random basis. These cows had the capacity to give 30-40 litres of milk per day in a favorable environment but due to heat stress there was a milk decline of 40-50 % normally in the summer season. They were in different lactations varying from 1st lactation to 4th lactation. A total 60 cows were selected with 20 in each treatment i.e. Fan-fogger, Fan-pad systems and as control. The cows were kept under loose housing system. The size of the cattle shed in GADVASU was 46.38 x 6.56 x 4.2 m and therefore the floor area was 304.25 m^2.

Fig. 23 .Partially enclosed shelter for cows in GADVASU

Each cow needed an area of 6 m^2 for comfortable position while sitting and standing, hence the total shed could accommodate 50 cows. Half a shed could accommodate 25 cows. Each cow needed 300 cfm of naural ventilation for comfort hence the air flow needed for comfort of 25 cows was 212.5 m^3/min. Therefore air circulator fans of size 36" with air delivery 200 m^3/min i.e. 258 kg/min were selected for installation in the sheds. In order the select the number and size of foggers was decided from psychrometer chart so that to achieve 30 C, 60 % from 35 C, 40 % in the air, around 0.0025 kg moisture wasadded per kg dry air. The rate at which moisture was added was 258 x .0025 = 0.645 kg water/min = 38.7 kg water/h = 38.7 l/h, therefore 5 nos. foggers each of discharge 7 l/h, 45 psi, 0.5 mm were selected. Three sheds were taken and two cooling systems of each type were installed in each shed. The third shed was control and had only two fans operating in it.

The Fan-fogger system (Fig. 24) consisted of air circulator fans of size 36" mounted on the side walls. These fans provide airflow of about 700 m^3/min and were tilted downward at an angle of 20-30°. The fogger nozzles (0.5 mm size, 45 psi, 50° spray angle) were mounted on a copper ring were placed in front of the fan. A high pressure pipe connected the water

tank to the fogging tank through a pump. The filtered water was pumped into the foggers. The foggers's on / off- timings were controlled through a timer.

Fig. 24 .Fogger and fan system

When switched on, the fogger created a fine mist which cooled the shelter by evaporation. During off - time of the fogger, the fan was in running condition. 60 sec. on and 60 sec off cycle was repeated. The entrances to the shelter were covered by tarpaulins to preserve the microclimate in the shelter. The Fan-pad cooling system (Fig. 25) was fitted to another cattle shelter. Two coolers containing two 36" / 700 rpm exhaust fans in each cooler and cellulose pads on the side walls of the shelters were fitted. The pads were made of cellulose paper housed in a G.I casing with a water distributor through a P.V.C header. The feeding side and the entrance side of the shelters were covered with net and tarpaulin to prevent solar radiation input and the cold air from escaping the shelter.

b) Effect of Fan-fogger and Fan-pad cooling systems on environment inside shelters:

In the shelter fitted with the Fan-fogger system the temperature in the shelter dropped by 4-5 ^{0}C and the mean relative humidity increased by 20 %. The Fan-pad cooling system lowered the temperature by 7-8 C and increased the mean RH by 40 % in the partially enclosed shelters.

Fig. 25 .Fan-pad system fitted in the GADVASU shelter

c) Effect of cooling systems on milk production and composition

The milk yield pattern under control and treatments used in the study during the experimental period is presented in (Fig. 26). It can be seen from the figure that the decrease in the milk yield was 18%, 25% and 35% for the cows kept in Fan-pad, Fan-fogger and conventional control systems respectively. This showed the efficacy of the mechanical treatments used during the study for the comfort of milch animals. There was no significant difference in percent fat, SNF, protein, lactose, milk density among the treatments and control.

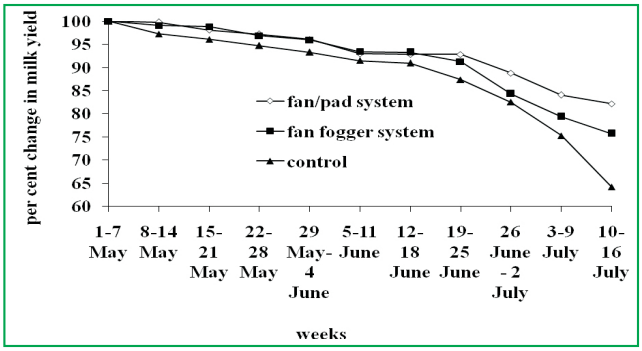


Fig. 26 .Milk yield pattern under control and treatment

d) Effect of cooling systems on comfort and welfare of cows

(Table 4) shows the changes in rectal temperature, pulse and respiration for the cows under different treatments. While among the treatments no significant diff was found between the mechanical treatments and control for rectal temperature, the pulse rate and respiration was found to be statistically significant at 95% level of confidence among all the mechanical and control treatments.

The number of animals showing clear oestrus were approximately 1.8 times and 1.5 times in Fan-pad and Fan-fogger systems respectively as compared to control group. The days open from parturition to first oestrus were less by about 22 and 16 % in Fan-pad and Fan-fogger systems respectively as compared to control group. Oestrus lasted 4.2 and 3.7 hours more in case of Fan-pad and Fan-fogger respectively as compared to control group. There was 118 and 78 % more conception in Fan-pad and Fan-fogger systems as compared to control group. The number of services per conception was 2.6, 3.3 and 4.2 in Fan-pad and Fan-fogger systems and control group respectively. These show better reproductive performance of Fan-pad and Fan-fogger systems as compared to control group. In Fan-pad and Fan-fogger systems animals were sitting in more comfortable position as compared to those in control which were panting. Dry matter intake in Fan-pad and Fan-fogger systems was comparatively higher than that in control. The body weight of cows was maintained in Fan-pad and Fan-fogger systems while there was a loss in body weight of cows kept in control during the same period. The cows in the Fan-pad and Fan-fogger systems had increased physiological comfort, maintained body weight and arrested decrease in milk yield to nearly 50% than the control animals.

Table 4: Rectal temperature, respiration and pulse rate of cows under different treatments

Parameter	Fan-pad System	Fan-fogger System	Control
Rectal Temperature (Deg.F)	102.1	102.4	103.2
Pulse (per min)	51	64	86
Respiration (per min)	48	57	78

Design construction and evaluation of bulk storage structure for food grains

D Dhingra, D R Rai, M Manjunatha

Grain storage is a practice which is followed worldwide. In India grain procurement, storage and distribution is done primarily by Food Corporation of India. At present only 30 % of the total food grain produced is handled by organized sector for storage management. The storage capacity available with FCI is around 28 million metric tonnes (which includes hired capacity from CWC and SWC's); in comparison to the present requirement of approximately 60 – 70 million metric tonnes. The storage infrastructure in India is not sufficient enough to tackle present production of food grains. India has to produce about 400 million tonnes of food grain by 2050 to feed its growing population. There is an urgent need to enhance the country's grain storage infrastructure through the involvement of private sector.

The quality of our existing storage infrastructure has also stagnated in terms of technology. The new concepts and materials in civil engineering have not been adopted. The bag storage system involves labour-intensive, time-consuming and quality compromising transport methods. Most of the operations in bag storage godowns are carried out by human labour. The bag storage structures do not have any facility for monitoring and evaluating the environment.

The specifications of conventional godowns were reviewed and on the basis of interactions with manufacturers, FCI and CWC, the use of Galvalume Sheet for roofing of 5000 tonne capacity godown was recommended. The Galvalume sheet can be formed into an arch and used as roofing without any truss. Alternatively it can also be used as cladding on pre-fabricated frame for godown roofing. The specifications of silos were also worked out. Storage of wheat and rice (5 quintals each) in bio polymer coated HDPE woven bags procured from M/s Everest Biotech, Bangalore has been initiated.

Characteristics of chicken nuggets as affected by added fat and variable salt contents

Yogesh Kumar

Chicken fat is edible, it is important to evolve production processes for gainful utilization of this part. So the main objective of this work was to study the effect of the addition of chicken fat and various salt contents on the physicochemical, proximate composition and sensory characteristics of chicken nuggets. Based on the results it is concluded that, even up to 5% level of chicken fat with 1.5-2% added salt there was no adverse effect in terms of physico-chemical, proximate composition and sensory qualities of cooked chicken nuggets. Even, at these fat and salt levels product was more preferred by panellist than no fat-no salt chicken nuggets.

FOOD GRAINS & OIL SEEDS PROCESSING

Development of technology for oil expelling of dehulled flaxseed (linseed) kernel and utilization of de-oiled cake

Mridula D, P Barnwal

a. Moisture dependent physico-mechanical properties of flaxseed (cv. *Garima*)

Flaxseed is one of the most important oilseed crops for industrial as well as food, feed and fibre purposes. The effect of moisture content on some physical properties of flaxseed *(cv. Garima)* seeds were evaluated at five levels of moisture content ranging from 3.24-17.09% (db). Length, width and thickness increased linearly from 4.94-5.02, 2.50-2.66 and 0.89-0.94 mm, respectively (Table 5). Sphericity, geometric mean diameter, surface area and unit volume of the seeds showed a linear increase with the increase in moisture content. True density increased from 1005.8-1111.7 kg/m^3 whereas bulk density decreased from 680.1-616.2 kg/m^3. A linear increase in porosity, thousand seed mass and angle of repose was observed while the rupture force, deformation and energy absorbed decreased linearly with increase in moisture content (Table 6).

Table 5: Physical properties of flaxseed (Cv. *Garima*) at different moisture content

Moisture content (%,d.b.)	Length, (mm)	Width, (mm)	Thickness, (mm)	Geometric Mean Diameter, (mm)	Sphericity (%)	Surface area (mm^2)	Unit Volume (mm^3)	True Density (kg/m^3)	Bulk Density (kg/m^3)	Porosity (%)	1000 seed mass (g)	Angle of repose (^{o})
3.24	4.94^b (0.221)	2.50^b (0.207)	0.89^b (0.124)	2.21^c (0.131)	44.84^b (2.889)	15.43^c (1.797)	5.75^c (0.985)	1005.8^c (5.10)	680.11^a (5.034)	32.38^e (0.629)	6.85^c (0.117)	24.16^d (0.363)
6.49	4.96^{ab} (0.220)	2.50^b (0.167)	0.89^b (0.126)	2.21^c (0.116)	44.68^b (2.469)	15.44^c (1.606)	5.75^c (0.892)	1040.43^b (8.767)	679.17^a (6.053)	34.72^d (0.958)	6.87^c (0.195)	24.36^d (0.620)
10.49	5.00^{ab} (0.266)	2.56^b (0.211)	0.93^a (0.128)	2.27^b (0.139)	45.58^{ab} (2.851)	16.25^b (1.931)	6.22^b (1.078)	1052.92^b (35.66)	665.15^b (4.727)	36.78^c (1.829)	7.21^b (0.155)	29.39^c (0.254)
14.57	5.02^a (0.218)	2.64^a (0.364)	0.93^a (0.115)	2.30^{ab} (0.134)	45.84^a (2.785)	16.65^{ab} (1.978)	6.44^{ab} (1.170)	1066.55^b (18.196)	641.90^c (4.613)	39.81^b (0.762)	7.33^b (0.062)	31.10^b (0.242)
17.09	5.02^a (0.193)	2.66^a (0.133)	0.94^a (0.112)	2.31^a (0.115)	46.18^a (1.967)	16.90^a (1.667)	6.58^a (0.966)	1111.65^a (32.180)	616.22^d (3.873)	44.53^a (1.414)	7.68^a (0.211)	34.73^a (0.585)

Figures in parenthesis are standard deviation. Values in the same columns followed by different letters (a-e) are significant (p<0.05).

Table 6: Mechanical properties of flaxseed (Cv. *Garima*) at different moisture content

Moisture content (%, d.b.)	Coefficient of friction				Rupture force(N)	Deformation (mm)	Energy absorbed (mJ)
	Plywood	Aluminium	Galvanized Iron	Mild Steel			
3.24	0.413^e (0.01)	0.381^e (0.01)	0.402^d (0.01)	0.499^e (0.01)	33.25^a (7.633)	0.309^a (0.03)	10.33^a (2.767)
6.49	0.483^d (0.01)	0.459^d (0.01)	0.426^c (0.01)	0.426^d (0.01)	33.18^a (4.524)	0.291^{ab} (0.04)	9.62^a (1.708)
10.49	0.633^c (0.01)	0.607^b (0.01)	0.447^b (0.01)	0.730^b (0.01)	32.98^a (9.249)	0.279^{bc} (0.04)	9.18^a (2.599)
14.57	0.702^b (0.01)	0.679^c (0.01)	0.645^a (0.01)	0.705^c (0.01)	31.66^a (7.545)	0.278^{bc} (0.05)	8.84^a (2.896)
17.09	0.727^a (0.01)	0.710^a (0.01)	0.657^a (0.01)	0.871^a (0.01)	26.03^b (4.726)	0.229^c (0.03)	6.72^b (1.306)

Figures in parenthesis are standard deviation. Values in the same columns followed by different letters (a-e) are significant (p<0.05).

b. Moisture dependent physico-mechanical properties of flaxseed (*cv. Neelam)*

The Physical, mechanical and bio-chemical properties of flaxseed *cv. Neelam* were studied as a function of moisture content in the range of 3.95% to 17.21% d.b. Geometrical properties namely average length, width, thickness, geometric mean diameter, sphericity, surface area and unit volume increased with increasing moisture content. The bulk density, rupture force, deformation and energy absorbed decreased linearly while true density, porosity, thousand seed mass, angle of repose and static coefficient of friction increased linearly with increasing moisture content (Table 7). The static coefficient of friction was maximum for mild steel surface and minimum for galvanized iron surface at 3.95% (d.b.) moisture content (Table 8).

c. Development of Omega-3 rich energy bar with flaxseed

Energy bar samples were prepared with different levels of flaxseed (0 to 20%) in addition to cereals and pulses with varying levels of sweeteners. Different levels of flaxseed and sweeteners significantly affected the hue and chroma values of the energy bar. The level of flaxseed in energy bar did not affect the hardness but it was decreased with

Table 7: Physical properties of flaxseed (Cv. *Neelam*) at different moisture content

Moisture content (%,d.b.)	Length, l (mm)	Width, w (mm)	Thickness, t (mm)	GMD, D_g (mm)	Spherecity (%)	Surface area (mm^2)	Unit Volume (mm^3)	True Density (kg/m^3)	Bulk Density (kg/m^3)	Porosity (%)	1000 seed mass (g)	Angle of repose (°)
3.95	5.75 (0.23)	2.85 (0.17)	0.92bc (0.13)	2.46 (0.14)	42.92 (2.53)	19.12 (2.17)	7.93bc (1.35)	1067.24d (4.43)	679.62a (2.93)	36.32e (0.32)	7.35c (0.02)	25.62d (0.63)
6.99	5.76 (0.25)	2.89 (0.24)	0.92c (0.16)	2.47 (0.22)	42.99 (3.78)	19.32 (2.95)	8.07c (1.67)	1083.89c (7.26)	675.76a (5.26)	37.65d (0.46)	7.58c (0.09)	26.04d (0.35)
10.68	5.76 (0.25)	2.91 (0.21)	0.95abc (0.13)	2.5 (0.15)	43.61 (2.23)	19.86 (2.36)	8.40abc (1.50)	1113.98b (3.74)	659.55b (10.44)	40.79c (1.07)	9.38b (0.51)	30.18c (0.32)
13.73	5.79 (0.27)	2.91 (0.15)	0.96ab (0.15)	2.51 (0.18)	43.50 (3.39)	19.94 (2.50)	8.46ab (1.44)	1142.43a (15.72)	659.45b (2.59)	42.27b (0.90)	9.91b (0.16)	37.5b (1.17)
17.21	5.80 (0.24)	2.92 (0.14)	0.97a (0.13)	2.54 (0.13)	43.71 (2.21)	20.25 (2.14)	8.64a 1.36)	1147.16a (5.39)	579.29c (3.24)	49.50a (0.44)	10.67a (0.46)	39.9a (0.55)

Figures in parenthesis are standard deviation. Values in the same columns followed by different letters (a-e) are significant ($p<0.05$).

Table 8: Mechanical properties of flaxseed (Cv. *Neelam*) at different moisture content

Moisture content (%, d.b.)	Coefficient of friction				Rupture force(N)	Deformation (mm)	Energy absorbed (mJ)
	Plywood	Aluminium	Galvanized Iron	Mild Steel			
3.95	0.416^{c}(0.01)	0.369^{e}(0.01)	0.363^{e}(0.01)	0.490^{e}(0.01)	42.27^{a}(7.44)	0.305^{a}(0.03)	12.85^{a}(2.62)
6.99	0.487^{bc}(0.01)	0.441^{d}(0.01)	0.530^{d}(0.01)	0.515^{d}(0.01)	41.71^{a}(6.92)	0.302^{a}(0.05)	12.57^{a}(2.68)
10.68	0.666^{a}(0.01)	0.633^{b}(0.01)	0.570^{c}(0.01)	0.732^{b}(0.01)	39.41^{ab}(3.72)	0.296^{ab}(0.02)	11.66^{ab}(1.14)
13.73	0.593^{ab}(0.01)	0.613^{c}(0.01)	0.656^{b}(0.01)	0.696^{c}(0.01)	38.56^{ab}(8.93)	0.278^{b}(0.04)	10.76^{bc}(3.17)
17.21	0.715^{a}(0.01)	0.739^{a}(0.01)	0.772^{a}(0.01)	0.803^{a}(0.01)	36.04^{b}(5.63)	0.276^{b}(0.04)	9.96^{c}(2.21)

Figures in parenthesis are standard deviation. Values in the same columns followed by different letters (a-e) are significant ($p<0.05$).

increasing level of sweeteners except in control sample (Table 9). The total calories obtained from the energy bar showed significant increase with the increasing levels of flaxseed, the maximum (397.95 kcal) being for bars with 20% flaxseed and 45% sweeteners (Table 10). The Overall mean sensory score for overall acceptability for samples with 10% flaxseed and 55% sweeteners and 15% flaxseed and 45% sweeteners were at par but the omega-3 and other nutrients in the later sample was higher than the former sample (Table 11). Hence, 15% flaxseed and 45% sweeteners along with other ingredients may be considered for production of acceptable quality omega-3 fatty acid rich energy bar at commercial scale.

d. Effect of pre-treatments on performance of screw pressing for flaxseed

The influence of different pretreatment conditions and moisture content of flaxseed prior to pressing was studied on the screw press performance. The pretreatments had significant effect on residual oil and press rate but non significant effect on oil recovery and sediment content. An inverse relationship between seed moisture content and oil recovery was observed in pressing flaxseed that means decreased moisture content in the range of 13.8-6.5 % resulted in increased oil recovery from 44.4- 73.3, 36.4-76.6 and 45.4-81% for the only moisture conditioned,

Table 9: Textural profile analysis of omega-3 rich energy bar

Energy Bar samples		Hardness (N)	Cohesiveness	Springiness (mm)	Chewiness (N/mm)	Gumminess (N)
Flaxseed (%)	Sweeteners (%)					
0	45	9.2^{defg}	0.333^{a}	0.511^{ab}	1.5^{cd}	3.1^{efg}
	50	14.3^{cd}	0.337^{a}	0.467^{bc}	2.2^{bc}	4.6^{cde}
	55	22.2^{b}	0.279^{bc}	0.349^{ef}	2.1^{bc}	6.2^{bc}
5	45	13.8^{cd}	0.347^{a}	0.480^{bc}	2.3^{bc}	4.8^{cde}
	50	12.6^{cdef}	0.291^{b}	0.410^{cde}	1.5^{cd}	3.7^{deh}
	55	6.0^{efgh}	0.258^{cde}	0.366^{def}	0.565^{ef}	1.5^{fg}
10	45	32.8^{a}	0.262^{cd}	0.411^{cde}	3.6^{a}	8.6^{a}
	50	14.4^{cd}	0.245^{def}	0.331^{f}	1.1^{de}	3.4^{def}
	55	4.4^{gh}	0.234^{efgh}	0.360^{def}	0.371^{ef}	1.0^{h}
15	45	19.6^{bc}	0.273^{bc}	0.428^{cd}	2.3^{bc}	5.4^{bcd}
	50	13.3^{cde}	0.233^{efgh}	0.323^{f}	1.0^{de}	3.1^{efg}
	55	1.9^{gh}	0.210^{h}	0.390^{def}	0.161^{f}	0.413^{h}
20	45	29.7^{a}	0.239^{defg}	0.371^{def}	2.7^{b}	7.2^{ab}
	50	5.4^{fgh}	0.217^{gh}	0.324^{f}	0.381^{ef}	1.2^{gh}
	55	0.95^{h}	0.221^{fgh}	0.581^{a}	0.119^{f}	0.21^{h}
F Value						
	F	3.2^{NS}	58.3^{***}	4.2^{*}	4.7^{*}	4.1^{*}
	S	36.2^{**}	39.1^{***}	8.4^{**}	49.4^{***}	39.9^{***}
	F S	12.3^{**}	3.8^{*}	9.7^{**}	7.7^{**}	10.4^{**}
CD(0.05)						
	F	4.3	0.015	0.044	0.477	1.1
	S	3.3	0.011	0.034	0.369	0.891
	F S	7.4	0.026	0.076	0.826	1.9

F-Flaxseed; S-Sweeteners; NS-non significant; *p <0.05, **p <0.01, ***p <0.001; n=5

Table 10: Nutritional composition of omega-3 rich energy bar

Flax Seed (%)	Sweeteners (%)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Calcium (mg/100g)	Iron (mg/100g)	Crude Fibre (%)	Total Carbohyrates (%)	Omega-3 fatty acid (%, fat basis)	Calories (kcal)
0	45	11.7	10.3	4.6	1.3	28.9	3.2	0.9	71.2	12.4	367.4
	50	12.6	9.5	4.4	1.2	28.2	3.1	0.8	71.5	11.5	363.6
	55	13.2	9.1	4.3	1.2	27.4	3.0	0.8	71.4	10.7	360.6
5	45	11.7	10.9	6.4	1.4	28.8	3.4	1.2	68.5	15.0	374.9
	50	12.4	10.2	6.2	1.3	28.1	3.2	1.2	68.8	14.1	371.5
	55	13.1	9.9	6.1	1.1	27.4	3.2	1.1	68.7	13.2	369.1
10	45	11.4	11.3	8.3	1.5	28.8	3.6	1.5	65.9	17.5	383.3
	50	12.2	10.8	8.0	1.4	28.1	3.4	1.5	66.2	16.6	379.6
	55	13.1	10.2	7.9	1.3	27.3	3.3	1.4	66.2	15.7	376.2
15	45	11.4	11.8	9.9	1.5	28.7	3.7	1.9	63.4	20.0	390.5
	50	12.3	11.3	9.9	1.4	27.1	3.6	1.8	63.3	19.1	387.2
	55	13.1	10.8	9.6	1.3	27.3	3.5	1.7	63.5	18.3	383.9
20	45	11.5	12.4	11.9	1.7	28.7	3.8	2.2	60.4	22.5	397.9
	50	12.4	11.9	11.6	1.5	27.9	3.7	2.1	60.5	21.7	393.7
	55	13.1	11.4	11.4	1.4	27.1	3.6	2.1	60.6	20.8	390.5
F Value											
	F	2.5^{NS}	170.2^{***}	9934.54^{***}	18.5^{**}	0.12^{NS}	10.5^{**}	162.1^{**}	1281.1^{**}	23303.9^{**}	909.8^{**}
	S	249.9^{***}	101.2^{***}	67.6^{***}	19.9^{**}	10.7^{**}	3.2^{NS}	6.3^{*}	1.1^{NS}	1781.2^{**}	120.5^{**}
	F S	0.436^{NS}	0.42^{NS}	1.1^{NS}	0.78^{NS}	0.001^{NS}	0.06^{NS}	0.08^{NS}	0.20^{NS}	0.14^{NS}	0.25^{NS}
CD(0.05)											
	F	0.187	0.20	0.082	0.08	0.84	0.21	0.115	0.345	0.076	1.2
	S	0.145	0.15	0.067	0.06	0.65	0.16	0.09	0.27	0.059	0.89
	FS	0.323	0.34	0.142	0.14	1.5	0.36	0.20	0.60	0.131	1.9

F-Flaxseed; S-Sweeteners; NS-non significant; *p <0.05, **p <0.01, ***p <0.001; n=3

Table 11: Sensory Characteristics of omega-3 rich energy bar

Energy bar samples		Appearance and colour	Texture	Odour	Flavor & Taste	Overall acceptability
Flaxseed (%)	Sweeteners (%)					
0	45	7.5	7.2^{de}	7.1	7.2^{efg}	7.3^{cd}
	50	7.2	7.2^{de}	7.1	7.3^{ef}	7.3^{c}
	55	7.4	7.5^{cd}	7.0	7.1^{fgh}	7.4^{c}
5	45	7.8	7.7^{bc}	7.3	7.9^{a}	7.8^{b}
	50	7.8	7.5^{c}	7.3	7.5^{cd}	7.7^{b}
	55	8.1	8.0^{a}	7.4	7.9^{a}	8.2^{a}
10	45	7.3	7.6^{c}	7.4	7.4^{de}	7.3^{cd}
	50	7.1	7.0^{ef}	7.2	6.9^{gh}	7.3^{c}
	55	7.6	7.9^{ab}	7.7	7.8^{abc}	7.9^{b}
15	45	7.2	7.5^{c}	7.4	7.8^{ab}	7.7^{b}
	50	7.4	7.5^{cd}	7.4	7.3^{ef}	7.8^{b}
	55	7.6	7.6^{c}	7.4	7.6^{bcd}	7.8^{b}
20	45	7.0	7.0^{ef}	7.0	6.9^{h}	7.0^{de}
	50	6.6	7.0^{ef}	7.1	7.2^{ef}	7.2^{cd}
	55	6.8	6.9^{f}	7.3	7.1^{fgh}	6.9^{e}
F Value						
	F	6.7^{**}	29.6^{**}	6.9^{**}	28.8^{**}	43.0^{**}
	S	1.4^{NS}	18.4^{**}	2.6^{NS}	11.8^{**}	10.7^{**}
	F S	0.34^{NS}	4.6^{*}	2.0^{NS}	6.6^{**}	5.0^{*}
CD(0.05)						
	F	0.42	0.151	0.171	0.150	0.145
	S	0.32	0.117	0.133	0.116	0.112
	F S	0.73	0.261	0.296	0.260	0.250

F-Flaxseed; S-Sweeteners; NS-non significant; *p <0.05, **p <0.01, ***p <0.001; n=9

steam- and enzyme-treated seeds, respectively (Fig. 27). The residual oil decreased significantly with decrease in moisture content from 13.8-6.5% while the press rate and sediment content were not affected significantly with decreased moisture content. Therefore, pressing of flaxseed at lower moisture content offers more benefits rather than steam and enzyme treatments.

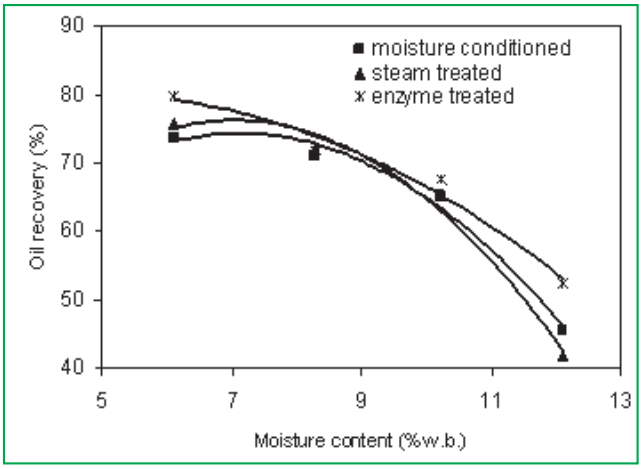


Fig. 27. Moisture content vs. oil recovery

Development of nutritive functional flour and food products

Mridula D, M R Manikantan, Anita Kochhar, Monika Sharma

Cereal based probiotic beverages:

Probiotic culture was added to a water solution containing 10% of formulation mixture consisting cereals and incubated at 37°C for 8h. Control (without formulation mixture) was also prepared from the same probiotic culture. The pH, acidity and probiotic count of the control and experimental sample, prepared with probiotic culture of *strain 1* were 7.78 and 5.54, 0.0018 and 0.0348% and 2×10^5 and 10×10^8 cfu/ml, respectively. pH, acidity and probiotic count of the control and experimental sample, prepared with probiotic culture of *strain 2* were 8.3 and 6.25, 0.0004 and 0.0257% and 2×10^5 and 7×10^6 cfu/ml, respectively.

Probiotic culture was added to a water solution containing 10% of formulation mixture consisting of food additive and cereals and incubated at 37°C for 8h. Control was also prepared from the same probiotic culture. Samples, thus prepared (in duplicate) were analyzed for pH, acidity and probiotic counts. pH, acidity and probiotic count of the control and experimental sample, prepared with probiotic culture of *strain 1* were 7.78 and 5.08, 0.0018 and 0.0352% and 3×10^5 and 5×10^8 cfu/ml, respectively. pH, acidity and probiotic count of the control and experimental sample, prepared with probiotic culture of *strain 2* were 8.3 and 5.21, 0.0004 and 0.0285% and 2×10^5 and 6×10^6 cfu/ml, respectively.

Based on these experiments and probiotic counts, *strain 1* was found better for development of probiotic beverages using sprouted wheat flour and wheat bran, oat meal and guar gum.

Studies on cryogenic grinding for retention of flavour and properties of some important Indian spices

S Balasubramanium

The cultivars of specific spices were collected from IISR, Calicut, NRCSS, Ajmer and subjected to ambient and cryogenic grinding. Cryogenic grinding using liquid nitrogen at low temperature (-50ºC) with different feeder screw and grinder speed were studied. Grinding of spices at ambient condition using swing type hammer mill at different moisture content (5-15% moisture content (w.b.), feed rate (8, 16 and 24 kg/h) and screen opening (0.5, 1.0 and 1.5 mm) with constant hammer speed 3000 rpm were studied. Black pepper, coriander, turmeric, fenugreek and cinnamon seeds were ground using cryogenic grinder (Fig. 28) at mill speed of 12000 rpm and feed rate of 1 kg/h. The specific energy consumption was significantly decreased from 374-31.1 kJ/kg using liquid nitrogen. The ground spice was subjected to three grades according to sieve size, the average particle size was found to be significantly decreased from 492 to 64 micron. About 30% volatile oil was retained in cryoground powder of black pepper. The Bond's work index and

Kick's constant were also calculated at both conditions and varied from 1.678-2.307, 0.298 to 0.367kWh/kg, respectively. The glass transition temperature decreased with the increase of moisture content (Fig. 29) and specific heat increased with increase in moisture content as well as size. The grinding temperature at ambient conditions of coriander, black pepper and for fenugreek were found to be in the range of 80-85^{0}C and 70-75^{0}C respectively. A pre-cooling unit with the specifications; length of screw conveyor, 450 mm; screw diameter, 41 mm; length of shaft, 500 mm; diameter, 25 mm and pitch of screw conveyor, 14 mm was designed

Fig. 28. View of cryogenic grinder (Imported)

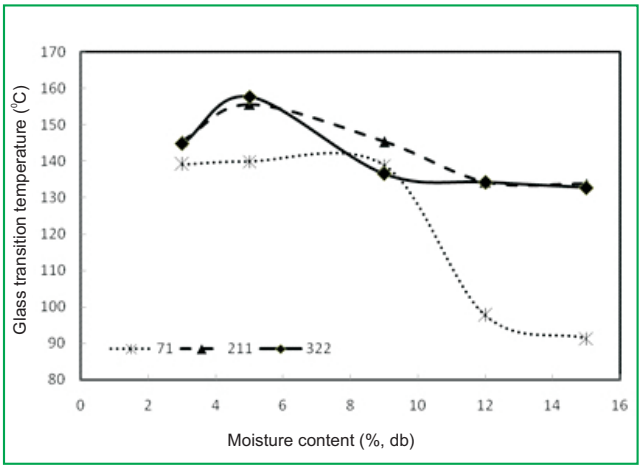


Fig. 29. Variation of glass transition with moisture content

Development of composite dairy foods with enhanced health attributes for commercialization

S Balasubramanian, D N Yadav

Process protocols for different value added products of pearl millet and barley were developed viz., dehulled pearl millet kernel, *daliya*/*suji*, *atta* with increased storage life, instant *halwa* mix, instant *upma* mix, instant *ladoo* mix, pasta, extrudates, and millet pillow. Composite pasta (Fig. 30) was prepared with improved physical properties such as colour, firmness and stickiness, improved nutritional and sensory properties. Pearl millet (kernel, grit and flour) with low lipase activity with enhanced shelf-life and better product quality by microwave treatment was prepared. Pasting properties in terms peak viscosity and final viscosity increased with microwave treatment. The increase in peroxide value and free fatty acid values was significantly lower with storage after microwave treatment. Lipase activity decreased with increased exposure to microwaves and was lowest at 18% level for conditioning at 100s exposure (Fig.31).

Fig. 30. Composite pasta

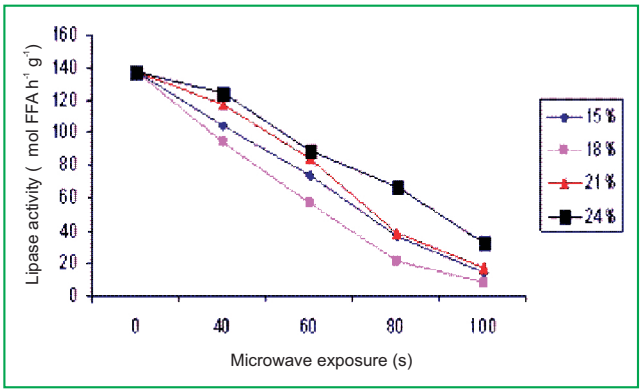


Fig. 31. Lipase activity vs. moisture exposure of pearl millet

Fig. 32. Pearl millet weaning food

The microwave treated samples were acceptable up to 30 days of storage. Pearl millet and barley grains were malted by steeping the clean, uniform grains in water for 8 h with intermittent changes of water after every 2 h. Thereafter, grains were kept for germination (3-5 days, 22°C in a near saturated condition). During germination, amylase activity was found increased and starch hydrolysed into simple sugars. Mineral contents also enhanced in terms of iron and calcium. The germinated grains were dried and kilned in a hot air oven at 50°C for 24 h. The de-rooted germinated grains (malt), were subjected to grits and blended with raw pearl millet/barley grits. These composite grits were extruded in a collet extruder and pulverized to make a base for weaning foods. With this base material, dry milk solids, whey protein concentrate, sugar, vegetable oil etc. were added to produce the desired weaning food. The weaning food (Fig. 32) prepared containing 15% protein, 5% fat and 2.3% mineral content was produced and tested.

Development of pilot level process and technology for the production of protein rich flour from de-oiled sesame and sunflower seeds

M R Manikantan, and D N Yadav

The proximate composition such as moisture, fat, protein, carbohydrates, ash and anti-nutritional compounds of sesame and sunflower seeds were determined and are presented in (Table 12).

Table 12: Proximate composition of sesame seed and sunflower seed fractions

Parameters	Whole Sesame	Dehulled Sesame	Deoiled Cake	Flour
Moisture content, % (w.b)	4.76	4.92	4.46	5.65
Protein, %	22.27	25.54	47.35	50.48
Fat, %	52.70	54.20	9.85	9.28
Ash content, %	4.44	4.45	5.46	7.06
Crude fiber, %	6.46	3.20	1.53	0.69
Carbohydrates, %	9.38	8.90	31.35	26.84
Oxalic acid, %	2.25	0.95	0.51	0.33
Parameters	**Whole Sunflower**	**Dehulled Sunflower**	**Deoiled Cake**	**Flour**
Moisture content, % (w.b)	4.76	4.10	3.32	5.626
Protein, %	17.50	26.77	45.92	47.74
Fat, %	39.33	50.43	10.12	9.65
Ash content, %	3.93	3.99	6.75	6.94
Crude fiber, %	18.64	12.58	9.73	8.46
Carbohydrates, %	15.84	2.13	24.16	21.58
Chlorogenic Acid, %	4.07	1.76	1.27	0.73

Development of peanut de-skinning machine

M R Manikantan, D N Yadav

Groundnut kernel contains 92-94% cotyledon and 3-4% each testa/skin and germ. The skin is rich in carbohydrates, crude fibre with little or no oil and tannin compounds which contributes to darkening of oil and cake. This leads to the increase of the refining cost in oil processing and hence additional treatments are required to nullify the effect of this skin component in cake for edible purpose. Deskinning of groundnut is also required in the processing of other value added dairy analogue products like groundnut milk, groundnut butter, groundnut curd, groundnut paneer etc.,

The peeling of groundnut skin is presently done manually by soaking in water mixed with certain chemicals and rubbing with hand, which is a inefficient and laborious process. A groundnut deskinning machine with simple and minimum pre-treatment of 15-20 min water soaking and 2-3 hr drying at 60°C was developed.

The machine operates on the principle of abrasion & friction using 1 hp motor, and has dimensions of 102x62x80 cm. The machine consists of 8-10° inclined central shaft attached with 28-30° inclined abrasive hard rubber belt for effective abrasive action and covered with 4mm size sieve. During operation, the groundnut kernels are passed through the clearance of 1.5 cm between the abrasive belt and outer concave sieve. The combined abrasive action of belt over groundnut skin and friction between kernel to kernel leads to the deskinning of groundnut. The capacity of the unit was found to be 60-75 kg/h. The deskinning efficiency was ranging from 60-70% and over 35-40% of whole kernels were obtained in this machine. The approximate cost of the machine is Rs.25, 000.

Effect of growth of *Trichoderma* and *Aspergillus* on dehulling efficiency of pigeonpea

Subrata Nath Bhowmik, M R Manikantan, Deepika Goswami

Pre-conditioning to loosen the gummy bond between the hull and cotyledon during milling is traditionally attained by water, oil or heat treatment. Pre-conditioning of pulse grains via microbial cellulolytic enzymes and organic acids is prospective method to improve the dehulling efficiency

Aseptically collected culture filtrates (wheat bran medium) of *Trichoderma reesei* and *Aspergillus oryzae* at various incubation period – 0, 3, 6, 9, 12 days through whatman no 1 filter paper were refrigerated (4°C, 8 h). Fifty grams of pigeonpea on autoclaving (0 psi, 10 min) in Erlenmeyer flask (150 ml ca.) was mixed immediately to the culture filtrate @ 1:1 (w/v) and incubated (40°C, 4h). Preliminary investigation of dehulling of kernels (moisture 10%) was carried out in rice polisher and fractions (dehulled, undehulled, hulls, fines) were separated to evaluate the dehulling efficiency.

The concentration of microbial population increased with advance of incubation period (Table 13). The population density ranged from 7.0-7.3 log cfu/ ml for *Trichoderma* and 7.1-7.9 log cfu/ ml for *Aspergillus*. The overall order of incubation treatments is 12 days> 9 days> 6 days> 3days > control. Maximum dehulling efficiency was attained by *Aspergillus* at 12 days (72.9%). Increment of cellulolytic enzymes, organic acids in culture filtrate with corresponding fungal population size is the plausible cause for this aspect. The cooking time of control pigeonpea is 20 min. No significant change in the cooking times and solid dispersion of dehulled splits was observed for control and culture filtrate pre-treated legume. This suggest that, the moisture gradient formed in the seed during enzyme reaction, 1:1 (w/v) may not have affected the quality of protein, starch, and perhaps other moisture sensitive components of the grain. Therefore, culture filtrate pre-treatments, which retain the cooking quality of dehulled splits and improve the yield of dehulled kernels, may be considered as effective pre-dehulling treatments for *dhal* milling industry.

The dehulling efficiency increased with the microbial growth. *Aspergillus* pre-treatment produced more dehulled kernels in pigeonpea than *Trichoderma*. Culture filtrate dehulling pre-treatments reduced the amount of fines and did not alter the cooking properties of dehulled grains. Use of culture filtrate of cellulolytic fungi has the potential to increase efficiency and quality output in grain processing operations.

Table 13: Comparative analysis of yield of milled fractions, dehulling properties, cooking properties of pigeonpea subjected to various culture filtrates pre-dehulling treatment. Results are mean value of three determinations

Dehulling treatment	Population density (log cfu/ml)	Moisture content (%)	Dehulled grains (%)	Undehulled grains (%)	Fines (%)	Hulls (%)	Dehulling Index	Degree of dehulling (%)	Dehulling efficiency (%)	Cooking time (min)	Dispersed solids (g/100g)
Control	0.0	5.7	61.8	17.7	9.5	10.9	0.45	82.3	61.9	20	17.32
Trichoderma reesei											
3 days	7.0	5.3	67.4	12.6	8.6	11.3	0.57	87.5	67.7	21	24.00
6 days	7.1	6.0	70.5	9.4	8.2	11.8	0.64	90.7	70.8	21	23.70
9 days	7.2	6.0	71.6	7.9	7.9	12.5	0.68	92.1	71.7	20	20.39
12 days	7.3	5.8	71.4	8.4	8.1	12.0	0.66	91.6	71.8	20	20.82
Aspergillus oryzae											
3 days	7.1	5.0	70.8	9.64	8.0	11.5	0.65	90.4	70.8	19	28.48
6 days	7.3	6.0	71.4	7.8	7.8	12.9	0.69	92.2	71.5	19	21.65
9 days	7.9	6.2	70.8	8.9	7.1	13.1	0.68	91.1	70.9	20	26.09
12 days	7.6	5.9	72.9	6.63	6.5	13.9	0.74	93.4	72.9	21	21.23

Design, development and evaluation of mini dhal mill

D M Kadam

In the commercially available dhal milling machines the grain remains inside the machine for 1-4 seconds only. So, complete dehulling of the grain is not achieved. The grain is passed through the machine again and again to dehull all grains and hence more broken and powder formation takes place. Based on preliminary trials conducted at CIPHET and optimization of oil treatment for dehulling pigeon pea, the residence time of 12 seconds was observed to be optimum.

Single feed composite pigeon pea mini Dhal Mill

The dhal milling machine was developed, based on abrasive dehulling of pigeon pea. The machine consists of feed hopper, cylindrical emery, and concave of perforated mild steel. This machine has two specific features (emery made of three different grades of carborundum and stoppers inside the concave to increase the residence time inside the machine).

The mini Dhal Mill (Fig. 33 and Fig. 34) has the dimensions 1x0.56x1.23 m and abrasive circle surface perimeter is 1100 mm. The capacity of the mini dhal mill with above roller was 100 kg/h. A trapezoidal feed hopper of capacity 15 kg is fitted at the top of the machine. A feed gate is provided at the outlet of the machine to control the feed rate of grain. The treated pigeon pea grain is filled in the hopper. After running the machine, the feed gate is opened to feed the material between emery roller and concave. The emery roller is fitted inside the machine. It is a mild steel cylinder of 75 cm length on which emery is pasted. At the feed section Grade A carborundum

followed by Grade B and at outlet section Grade C is pasted and screen is encircled for dehulling the pigeon pea. First 25 cm of the roller is pasted with 18-grade emery, middle 25 cm with 24-grade emery and last 25 cm with 32-grade emery. The material is fed at the start of the roller where 18-grade emery is pasted. The diameter of the emery roller is 30 cm. Emery rotates at 900 rpm with a 3 hp three-phase motor. The power is transmitted from motor to roller through v-belt drive pulley. A dehusking roller with three different grades of carborundum has been fabricated. The grades of carborundum are:

I 24 (0.3-0.5 mm)

II 30 (0.22-0.49 mm)

III 36 (0.16-0.25 mm)

Note: All dimensions are in cm.

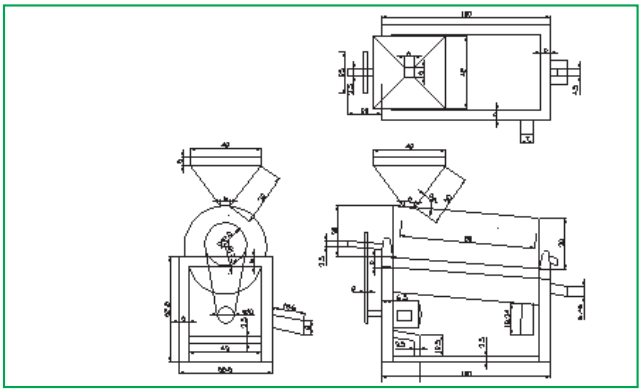


Fig. 33. Schematic view of CIPHET Developed Single Feed Composite Pigeon Pea Mini Dhal Mill

Fig. 34. CIPHET Developed Single Feed Composite Pigeon Pea Mini Dhal Mill

Design and development of foam mat dryer for selected liquid foods

D M Kadam, S Balasubramanian, D R Rai, Monika Sharma

Foam mat drying is a profitable process for drying of tomato, mango, kinnow, pineapple and tamarind pulp to powdered form. The increase in drying air temperature decreased the drying time and increase of foaming agent level enhances the drying process followed with a decreasing trend. The drying time varied depending up on type of fruit juice dried and foaming agent with its concentration levels used. As the original yellow colour of the mango is retained the powder it can be used as a natural colourant. The sugar content of the tamarind powder is high. Various value added foods products such as chutneys, sauces, ice cream, sherbet, sambar and beverages can be prepared using tamarind pulp powders (Fig.35).

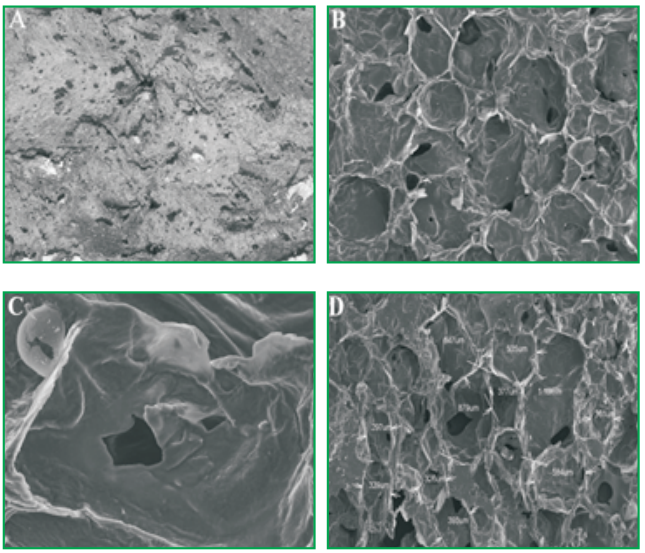


Fig. 35. (A) Tomato foam mats, (B) Scanning electron micrograph of Tomato foam mats showing honeycomb like compartmental structure, (C) Perforation in the wall in one of the compartment, (D) Size of different compartments.

Structural studies of foam mat dried tomato foam mats using SEM

Development of foam mat dried tamarind pulp and powder

Foam mat drying could be an appropriate process for tamarind pulp preservation and increasing the degree of convenience by converting it, in the form of powder. Investigations were carried out to see the impact of foaming agent in different concentration levels on the chemical properties of foam-mat dried tamarind pulp powder (Fig 36). Microbial load was not detected in foam-mat dried tamarind pulp powder. The foam-mat dried tamarind powder has a better nutritional quality, increased food safety and higher degree of convenience.

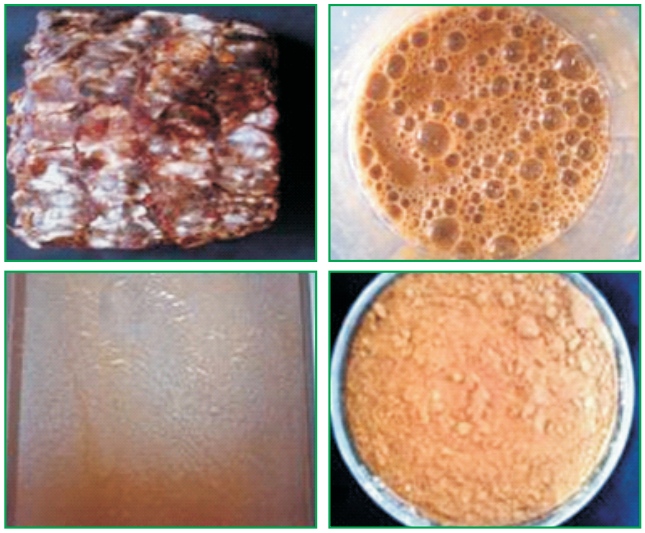


Fig. 36. Method for preparation of tamarind pulp powder

Roller based chapati making machine

D M Kadam

A chapati making machines was designed and developed using Nylon rollers and dc motor and tested for preparation of chapatti (Fig 37). The roller speed can be adjusted based on the hydration characteristics of the wheat flour. The rolling sheet thickness can also be adjusted. The machines can be used for preparing chapatti, puri, parathanan, papad etc. The machine can roll about 250 to 325 nos of chapattis per hour. The machine has numbers of rollers to form a round ball dough in to 1.5 to 2 mm thick circular sheet that can be baked on hot plate to get puffed chapati for consumption. Diameter of the 65 g dough ball varied from 41.36 to 49.10 mm which was passed through different rollers and found that sheet formation increased length in both dimensions with decreasing the thickness. Dimension of wheat dough passing through different rollers (1st, 2nd, 3rd, 4th and 5th) to form a chapati in terms of length, width and thickness are significant at P>0.05 in all three parameters (Table 14).

Table 14: Effect of roller arrangement on Physical Dimensions of Chapatti during Preparation

Roller No	Length, mm	Width, mm	Thickness, mm
1	66.84 ^{d}	71.41 ^{b}	13.93 ^{e}
2	93.22 ^{c}	61.51 ^{b}	7.83 ^{d}
3	101.91 ^{b}	62.77 ^{b}	6.94 ^{c}
4	139.25 ^{a}	67.28 ^{b}	4.59 ^{b}
5	142.75 ^{a}	135.69 ^{a}	1.77 ^{a}
SEd	4.7200	11.0977	0.1985
CD (0.05)	9.3204	21.9343	0.3924
CD (0.01)	12.3096	28.9689	0.5182
CV%	16.91	53.92	10.97

Fig. 37. Roller based chapati making machine

Development of dairy analogues from peanut kernel and utilization of deoiled cake for food purposes

D N Yadav, S N Bhowmik

Different peanut varieties (GG7, GG 20, Girnar and TG37) were procured from NRC on Groundnut Junagarh, Gujarat and evaluated for its physico-chemical properties. Peanut variety TG-37 was found best for peanut milk as it contained more protein (1.93%) and total solids (7.4 %) as compared to other varieties under study and variety GG-20 was found best for peanut paneer on the basis of yield, texture and sensory quality.

Peanut milk beverage (Sterilized in glass bottles at 121 ^{0}C for 15 min) was evaluated for physico-chemically, microbiologically and sensory qualities during storage at room temperature. The beverage was found acceptable up to 3 months at ambient conditions. Developed paneer was evaluated for bio-chemical, physical and microbiological changes during storage at 4 and -20 °C under normal and vacuum packaging conditions. Results showed that initially paneer had peroxide value, 6.24 meq O_2 /kg fat, free fatty acids (% oleic acid) 2.83, lightness 81.55, Total plate count $2x10^2$ cfu/ml, yeast and mould $0.6x10^2$ cfu/ml, Hardness 1.04 N, cohesiveness 0.70 and springiness 0.92 mm. Peroxide value, free fatty acids, total plate count, yeast and mould count and hardness values increased during storage whereas, lightness and springiness decreased. Paneer samples packed under vacuum and stored at -20 °C had peroxide value 7.98 meq O_2 /Kg fat, free fatty acids (% oleic acid) 3.15, lightness 80.63, Total plate count $3.9x10^2$ cfu/ml, yeast and mould $0.8x10^2$ cfu/ml, hardness 1.82 N, springiness 0.82 mm after 20 days of storage and found acceptable with 8.2 overall acceptability score. However above changes for samples packed without vacuum were acceptable up to 15 days at -20 °C while at refrigeration conditions (4 °C) samples stored under vacuum had 12 days shelf-life, whereas without vacuum samples had only 8 days shelf-life.

Different microbial culture i.e Lactic, yoghurt and desi culture were evaluated for peanut curd preparation and found that all cultures were able to ferment peanut milk, however addition of some fermentable sugars was required. Addition of 2% glucose was found suitable for fermentation of peanut milk. Fermentation capacity of desi culture was best compared to lactic and yoghurt because it contained several different kind of bacteria.

Chhana sweet from the blends of peanut milk and standard milk was prepared in different ratio i.e 0:100, 90:10, 80:20, 70:30. The ingredients were as follows: Baking powder 2g, Aluminium 0.5g, Meetha soda 0.20g, Semolina 3-4g, Arrowroot 5g, Reetha 3-4g per 100 g of coagulated protein. It was found that an acceptable chhanna like sweet from peanut milk and standard milk was possible in the ratio of 70:30.

Development of process and technology for dry degerming of maize at small scale

P Barnwal, D M Kadam

Development of small capacity maize degermer

A power operated small capacity maize degermer was fabricated at CIPHET. Different parts of degermer included machine frame, feed hopper, degerming rotor, spikes, and sieving system etc. The hopper was mounted on the upper half lid over the feed section. Feed screw was fabricated and the spikes were fixed on the conical rotor through welding. The rotor along with driven shaft was fitted on the frame with the help of bearings with brackets

Fig. 38. A small capacity maize degermer, fabricated at CIPHET, Ludhiana

at both ends. An electric motor (1.0 HP, three phase, 1370 rpm) was fitted to the drive shaft (rotor) using three step v-pulley fitted on drive and driven shafts of effective diameter 7.62 cm, 10.16 cm and 12.70 cm, which facilitated to test / evaluate the performance of the maize degermer at three different speeds. A provision of the safety measures/ gadgets such as belt guards etc. was also made (Fig.38).

Performance evaluation of small capacity maize degermer

Experiments for degerming (detaching germ physically) of maize were carried out using the developed maize degermer for four moisture levels (16.3 %, 17.7 %, 19.5% and 22.2 % w.b.) and three rotor speeds (822 rpm, 1370 rpm, 2283 rpm). The various fractions like maize germ, maize grit, maize germ-grit mixture, maize powder and husk etc. were obtained in the process (Fig 39). The higher recovery of maize germ and maize grit were obtained at 19.5 % w.b. moisture content and 1370 rpm with 35 kg/h capacity (feed rate). It was observed that various fractions of maize degerming process such as maize germ, degermed maize grit and maize powder etc., varied with moisture content as well as with rotor speed. A dry degerming process was standardized for mechanical fractionation of maize (whole maize) into germ, grits and powder etc. using developed maize degermer and for mechanical separation of maize germ and grits from maize degermer fractions using other agro-processing machines.

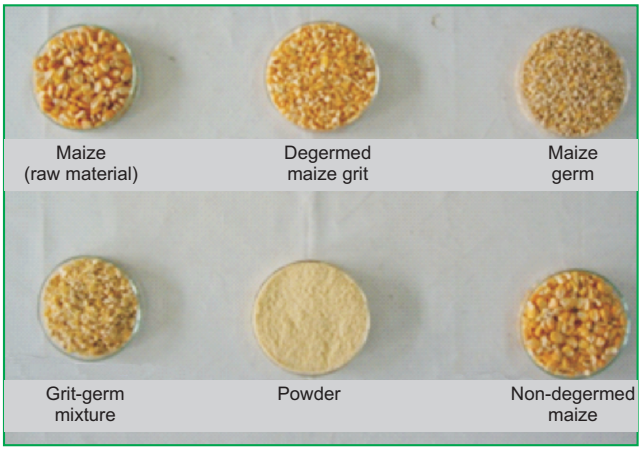


Fig. 39. Maize and its fractions after degermination

Storability of whole and degermed maize flours

Maize procured from local market was divided into two parts. The first part of whole maize was ground to make powder using burr mill whereas second part of maize was passed through the developed maize degermer to separate the maize grit and maize germ by dry degerming process. Degermed maize grits obtained were ground to make powder using burr mill and sieved for uniform particle size using ordinary household sieve. The flours of whole maize and degermed maize grits were packed in triplicate in three different packaging materials viz. aluminium laminated foil (ALF), high density polyethylene (HDPE) and low density polyethylene (LDPE) for 70 days storage period with 10 days storage interval to study the effect of packaging materials and storage periods on biochemical properties of whole and degermed maize flours during storage. The various biochemical properties viz. moisture content, protein, fat, FFA, total acid and ash of flours and textural properties of the flour dough were determined at storage interval of ten days for seventy days of storage period. The moisture, fat and FFA were increased whereas protein, total acid and ash contents decreased with increasing storage interval. The minimum changes in biochemical properties were found in aluminium laminated foil packed flours (both whole maize and degermed maize flours) during storage. Maize flour stored in aluminium foil found best followed by HDPE. The textural properties of the dough increased with increasing storage period and rehydration time of 10 to 20 minute gave the best dough for cutting and puncture properties which are more suitable for making *chapati*. It was found that degermed maize flour is better in terms of moisture, protein, fat, FFA, total acidity, ash and textural properties as compared to the whole maize flour. The degermed maize flour can be stored for longer period as compared to whole maize flour.

Utilization of maize germ

Maize germ, obtained from degerming process,

was utilized for oil extraction using laboratory oil expeller (Komet oil expeller) with die size 5 mm at Department of Processing and Food Engineering, PAU, Ludhiana and germ oil and de-oiled germ cake were obtained. Oil obtained from Komet oil expeller was filtered through filter paper for obtaining filtered oil (Fig.40). De-oiled maize germ cake was dried in tray dryer and then ground in laboratory grinder cum mixer to obtain de-oiled maize germ cake flour (DMGCF).

Fig. 40. De-oiled maize germ cake, crude germ oil and filtered germ oil

For utilization of maize germ for value added product for human consumption, the DMGCF incorporated biscuits were prepared at different levels of DMGCF (5%, 10%, 20%, 30%, 40% and 50%) by blending with wheat flour and standard ingredients to investigate the influence of DMGCF on quality of biscuits. It was found that protein, fat, ash, and crude fiber content of biscuits samples increased whereas carbohydrate content was significantly decreased with increasing the percentage of DMGCF. It was also observed that DMGCF can be used for protein enrichment of various types of biscuits. The biscuits from 10% and 20% DMGCF were at par and accepted with higher acceptability as compared to other biscuit samples.

Development and testing of berseem-chicory seed separator

(Inter-institutional Collaborative Research Project)

(IGFRI, Jhansi: **PK Pathak and CS Sahay;** ***CIPHET, Ludhiana:*** **VK Bhargava and P Barnwal)**

Determination of physical properties of berseem and chicory seeds

The average length, width, thickness, arithmetic and geometric mean diameters of berseem seed was 1.88 mm, 1.22 mm, 1.18 mm, 1.43 mm and 1.39 mm, respectively at 6.1% w.b. moisture content. In case of chicory seed, the average length, width, thickness, arithmetic and geometric mean diameters was 1.93, 1.07 and 0.98 mm, 1.33 mm and 1.26 mm, respectively at 6.1% w.b. moisture content.

For berseem seed in moisture range of 6.1 to 18.5% w.b, the seed size (arithmetic mean diameter) increased linearly from 1.43 to 1.58 mm with increasing moisture content. One thousand berseem seed mass were increased linearly from 2.41 to 2.63g with moisture increase. In the moisture range from 6.1% to 18.5% w.b, the seed size (arithmetic mean diameter) of chicory seed increased linearly from 1.26 to 1.56 mm with increasing moisture content. One thousand chicory seed mass increased linearly from 1.41 to 1.51g with the moisture increase.

For berseem seed in moisture range of 6.1 to 18.5% w.b, the true density decreased from 1089.2 to 808.3 kg/m^3 (1 kg/m^3=1 kg/cum) whereas bulk density decreased from 785.36 to 724.87 kg/m^3 with increasing moisture content from 6.1 and 18.5% w.b. (Fig.41). In case of chicory seed, the true density increased from 801.2 to 889.7 kg/m^3 whereas bulk density decreased from 588.71 to 529.21 kg/m^3 with increasing moisture content in the range of 6.1 and 18.5% w.b.

Development of berseem-chicory seed separator

Chicory *(Chicorium intybus L.)* is an objectionable weed crop. Thus, it is necessary to separate chicory seed from berseem-chicory seed mixture for achieving / maintaining the purity of berseem seed. The chicory seed is separated at farmers' level using salt solution while sowing the crop. This increases the moisture and discolours the seed causing reduction in market value. This method is beneficial only at time of sowing. Traditionally, series of air blasts using blowers/fans are applied to separate both the seeds which results in low recovery due to mixing with chicory seed in last step. There is very minute difference in size of both the seeds and it was visually observed that the berseem seed has round shape and smooth texture whereas chicory seed is of triangular shape and rough texture.

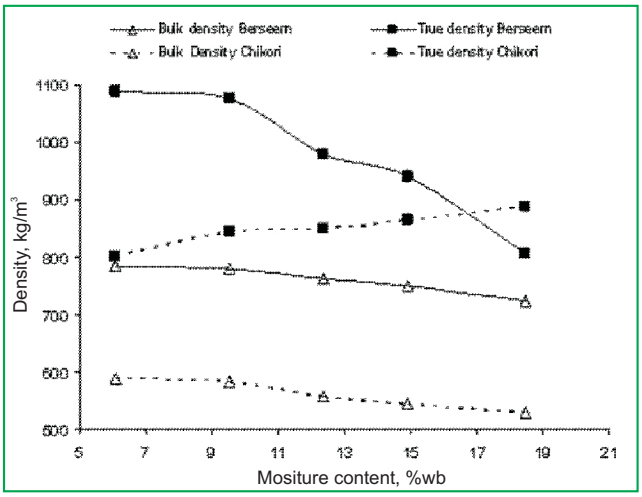


Fig. 41. Influence of moisture content on true and bulk densities of berseem and chicory seeds

The physical properties related to surface property and aero dynamics behaviour of both seeds could serve the purpose for separating chicory and berseem seeds. An aspirator grader (berseem-chicory seed separator), based on aerodynamic behavior of both seeds, was designed and fabricated at CIPHET, (Fig. 42).

Fig. 42. Aspirator grader (*berseem-chicory seed separator*)

HORTICULTURAL CROPS PROCESSING

Development of Litchi peeler and pulper

R K Vishwakarma, V E Nambi, R K Gupta

The initial moisture content of the fruit was 80.23%. The physical properties of litchi fruit were determined and are presented in (Table 15).

Table 15: Physical properties of Litchi fruit and seed

S. No.	Parameter	Fruit	Seed
1	Mass (g)	24.55	2.95
2	Pulp (%)	68.84	
3	Peel (%)	15.89	
4	Seed (%)	11.98	
5	TSS (°B)	16.40	
6	Acidity (%)	0.25	
7	Length (mm)	36.32	27.80
8	Width (mm)	34.20	12.40
9	Thickness (mm)	33.60	11.10
10	Sphericity	0.96	0.56
11	Bulk density (kg/m^3)	811.0	655.0
12	True density (kg/m^3)	1030.0	1010.0
13	Coefficient of friction	0.20	0.19
14	Moisture content (%)	80.23	

The bulk densities of the fruit and seed are less than that of water which indicates that the fruits and seeds will float when submerged in water. Low value of coefficient and sphericity of 0.96 show that the fruits are nearly round in shape.

Fabrication of Litchi Peeler

Litchi is a delicate fruit containing the skin which covers the fruit, flesh and hard seed. In order to use the fruit, it is necessary to remove the skin and seed. Peeling is the operation in which skin of the fruit is removed. Three different mechanisms based on impact, cutting, shear and compression were tested for peeling the litchi. In impact, the skin was removed but the flesh was also damaged during the process.

Compression with friction, which ultimately led to the tearing action, was found suitable for peeling of litchi. Based on this concept, a hand tool for litchi peeling was designed (Fig. 43).

Fig. 43. Front view of litchi peeling hand tool

The hand tool is made of wood. This consists of a plunger to apply the compressive force to the fruits, which is fitted with spring to take it to its original position after peeling. A cylindrical peeling chamber is attached with it. A knife is fitted in the peeling chamber of the tool. The fruit is placed at the top of the peeling chamber. As plunger comes down, the knife makes a small incision on the skin of the fruit. The inner walls of the chamber hold the skin at its place due to friction. The indented surface of the litchi skin also helps in holding the skin. Increase in compressive force causes the tearing of the skin and the fruit comes out leaving skin in the peeling chamber.

Studies on processing of guar (*Cyamopsis tetragonoloba*) for production of guar gum

R K Vishwakarma, S K Nanda, U S Shivhare

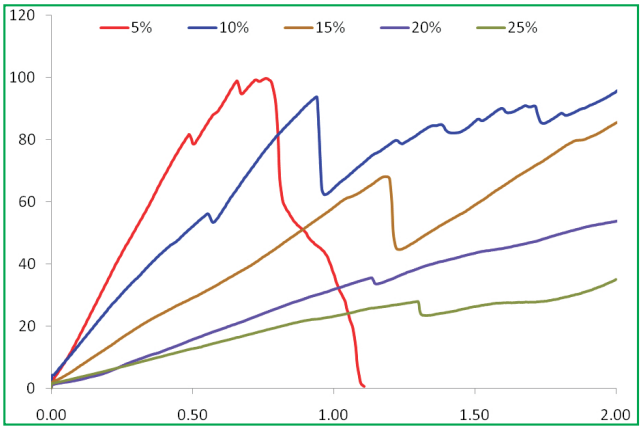
A dehuller (Fig. 44) was developed for dehulling guar seeds with a pre-treatment, which has been patented by CIPHET. It consists of two plates made of wire mesh of 60 cm diameter. The upper plate is fixed whereas the lower plate rotates at a speed of 150-200 rpm. The treated material is fed in the centre of the machine. The friction and abrasion causes dehulling of the guar seeds. The dehulled material is fed to the hull separator, where hull is blown away.

The maximum dehulling efficiency of 92% was observed. The hull separation efficiency was 98.5%. The machine was operated by 3-phase 2 hp motor with throughput capacity of 75-80 kg/h. The dehulled seeds were dried to about 10% moisture content and then split into two halves in horizontal burr mill.

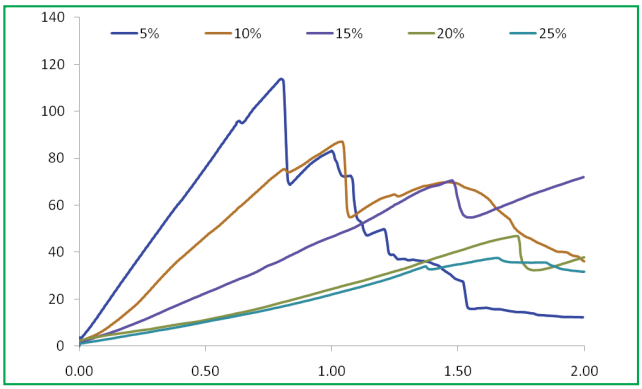
Fig. 44. Guar seed dehuller with hull separator

The dehulled seeds were separated using any conventional grader. Dehulled seeds were then dried to bring moisture content to 10% (dry basis) or as per the requirement and also to remove the traces of chemical used in pre-treatment. The horizontal burr milldehulled seed satisfactorily into two halves. Polishing of the splits further removed traces of germ from cotyledon. The refined guar gum splits thus obtained were separated using conventional grader.

The force deformation behavior of guar seeds were studied and analyzed. The guar seed was considered as elastic body and the modulus of elasticity were calculated using Hertz law of contact stress. Poisson's ratio was taken as 0.4. The two bodies were considered as elliptical bodies and surface of contact was considered as elliptical contact. The stress strain curves of the guar seeds at different moisture content were as shown in (Fig.45).



(a) Loading in width direction



(b) Loading along length direction

Fig. 45. Force deformation behavior of guar seeds

The effect of moisture content on modulus of elasticity of guar is shown in (Fig. 46). It can be observed that up to 10% moisture content, no appreciable change in modulus of elasticity was observed for loading in all directions. Beyond this point, the modulus of elasticity decreased sharply. This may be due to the fact that at moisture content of 15% and above, the grain behavior changed from elastic body to visco-elastic body behavior. It was also seen that the grain may not be splitted into two halves properly using uniaxial force. The grain showed the viscous flow, which is the characteristic of the gum present in the seed.

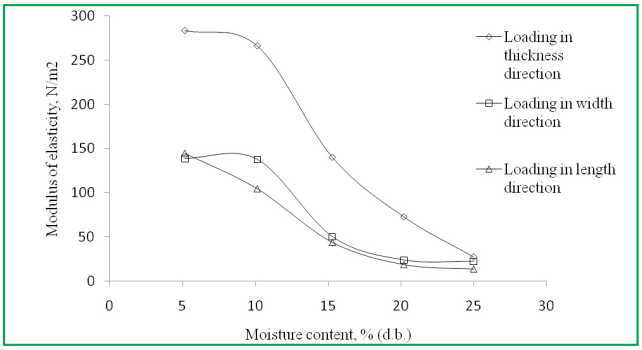


Fig. 46. Effect of moisture content on modulus of elasticity of guar seeds

A Value Chain on Commercial Exploitation of Underutilized Fruits of Tribal Zones of Rajasthan

R K Gupta, V E Nambi, R K Vishwakarma, and Ramesh Kumar

a) Development of Ber destoner

A destoning machine has been developed to remove the stone from Ber (*Ziziphus mauritiana L*) fruit. The machine has six plungers with feeding, holding & collecting mechanism. The capacity of the machine was observed to be 70-80kg/h. (Fig. 47).

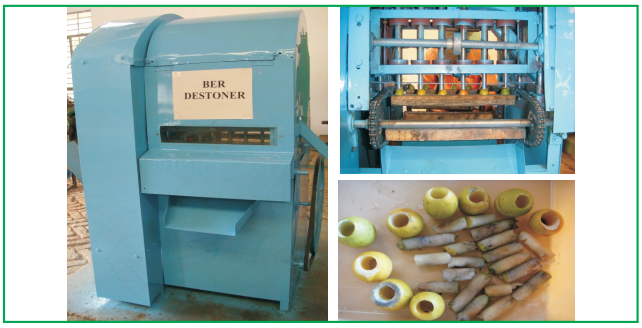


Fig. 47. Ber destoner

b) Fruit Harvester cum Saver

Fruit harvester was developed for safe harvesting of Jamun/Aonla. It was fabricated using a MS pipe 20 feet long. A hook was provided at top of the harvester to pull the fruit from its stem and fruit was detached from the branch. The collecting nylon net was fixed in a revolving frame for collecting fruits without damage. The frame was made with the MS pipe in a circular manner. The height of collecting net was 5 feet and collection area was 25 m^2 .Two pipes were fixed in concentric to reduce the size of machine during transportation. About 3-4 trees per hour without any damage/injury to the fruits could be harvested. The harvester (Fig. 48) is suitable for harvesting Jamun, Aonla, lemon, litchi, date palm, oil palm, areca nut etc.

Fig. 48. Harvesting of Jamun fruit using harvester cum Saver

c) Development of Ber fruit grader

Ber is one of the important fruits owing to its hardy nature and commercial yield potential on marginal land. Graded Ber fruits can fetch better price to the farmers/entrepreneurs. A Ber fruit grader (Fig. 49) has been developed which can sort the Ber fruits in three grades depending upon the size of fruits. The prototype could grade the fruits in three sizes (>30mm, 30-50mm and<50 mm of radial diameter of fruit).

The capacity of machine was 500 kg/hr with efficiency of 90-92 %. The percentage of fruit damage was about 2 %.

Fig. 49. Ber fruit grader

d) Preparation of mixed fruit Aonla cheese

Fruit cheese was prepared using fruit pulp, sugar, butter, citric acid, salt and appropriate amount of color. It has a shelf life of 3-6 months. Mature and ripe fruits (guava, papaya, pineapple) were washed under tap water to remove dirt or any foreign particle and the stems and blossom ends were removed manually. The manual peeling was done using sharp stainless steel knife. The pulp was passed through plastic sieve for uniform consistency and to remove the fibrous matter present in the pulp. Mixed fruit aonla cheese (Fig. 50) was prepared using pulp/juice in the proportions as aonla (50-70%), papaya (10-15%), pineapple juice (10-15%) and guava (10-20%) as per the proportions obtained by D-optimal mixture design.

The mixture was poured in a stainless steel vessel and mixed thoroughly and cooked at 70°C just to make the homogeneous pulp mixture. Sugar (1.25 kg/kg fruit pulp) was then added and stirred to make the mixture consistent. Then the butter (70g/kg fruit pulp) was added and cooking continued with stirring to mix the butter in pulp and sugar mixture. Citric acid (3g/kg fruit pulp) was added to the cooked mixture and cooked till the mixture became sufficiently thick approximately one hour for 250g fruit pulp. Salt (2g/kg fruit pulp) was added and cooked again until the mass started leaving the sides of pan. The hot cheese was poured in 0.6 cm thick layer on a tray, in which butter coating was applied at the bottom, to avoid the stickiness after setting. Then it was allowed to cool, set and cut into the square shape with the help of knife and packed in polythene pouches and kept under refrigerated conditions.

Fig. 50. Optimized mixed fruit aonla cheese

The optimized values of the ingredients for mixed fruit protein enriched mixed fruit aonla cheese were aonla, pineapple, papaya and guava at 63.59%, 14.03%, 12.38% and 10% respectively (Fig. 51). The prepared mixed fruit aonla cheese is a good source of vitamin C and minerals and can be considered as a nutritious supplement for children as well as adults.

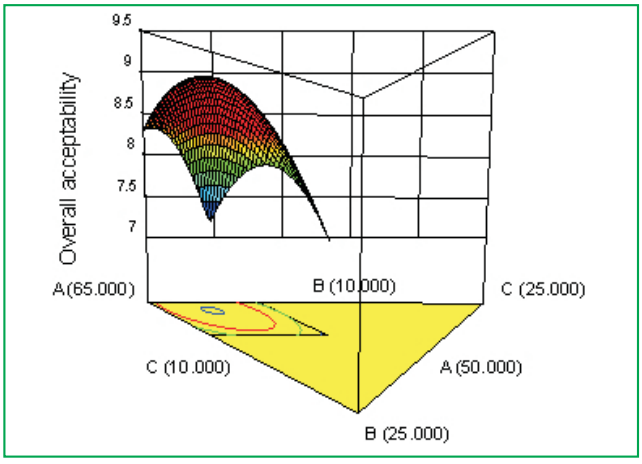


Fig. 51. 3D surface curve of overall acceptability of mixed fruit aonla cheese

Development of bio-coating and improved packaging technique for enhancing shelf life of mango and guava

Ramesh Kumar, R K Gupta

a) Effect of cassava starch based coating on storage life of guava

Shelf life of guava was assessed with application of polysaccharide based coating prepared from 1, 2 and 3% of cassava starch. Lower concentration of cassava (1 or 2 %) did not produce any significant effect on post harvest conservation of guava while of 3 % cassava starch significantly reduced the respiration rate of fruit and can be an alternative to extend the shelf life of guava under ambient condition. The fruits treated with this coating improved gloss of the fruit and maintained its firmness. However, coated fruits were slightly lower in TSS content as compared to uncoated fruits. Control fruit lasted only for 5 days under ambient condition while those treated with cassava starch based coating had shelf life to 2-3 days more.

b) Post-harvest conservation of guava with chitosan coating

Quality and shelf life of guava was studied by applying chitosan coating in different concentrations under ambient condition. Skin colour of guava was most effectively preserved by this coating. Sensory quality of both coated and uncoated fruits decreased during storage but the coated fruits were quite acceptable even after 9 days under ambient conditions. The study revealed the superiority of 3 % chitosan coating in extending the shelf life of guava fruit as compared to its control. Chitosan coating at this concentration significantly reduced the spoilage of guava to 8.33 % as against their untreated fruit which lost around double the quantity of treated fruits after 9 days of storage (Fig 52).

c) Edible coating from rice and turmeric for improving post harvest life of guava:

Edible coatings produced from rice (2.5 and 5.0 %) and turmeric starch (2.5 %) were applied alone and in combination to prolong the storage life of guava under ambient condition. The results showed that rice starch considerably arrested the weight loss and slowed down the ripening changes. However, it was not effective in checking the decay loss. Use of turmeric starch delayed the onset of spoilage but did not exhibit much effect on physiological loss in weight. Ascorbic acid decreased in all the fruits but this decrease was slower in the fruits treated with edible coatings. Though individual coatings were found superior to their control fruits but a composite formulation of 2.5 % rice starch and 2.5% turmeric resulted in maximum shelf life of coated guavas. This coating formulation delayed the colour development and retained the fruit firmness (Fig. 53) and was well accepted by the consumer throughout the period of storage.

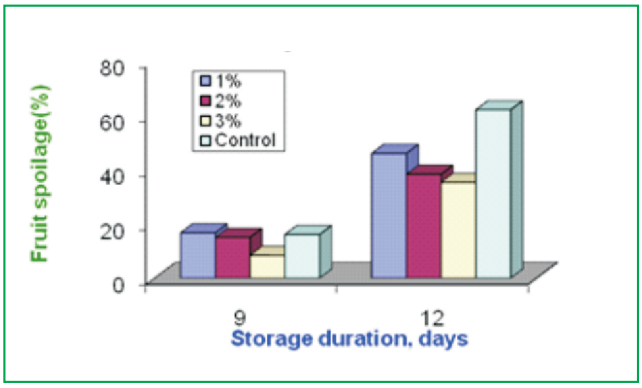


Fig. 52. Decay loss as affected by chitosan coating of guava

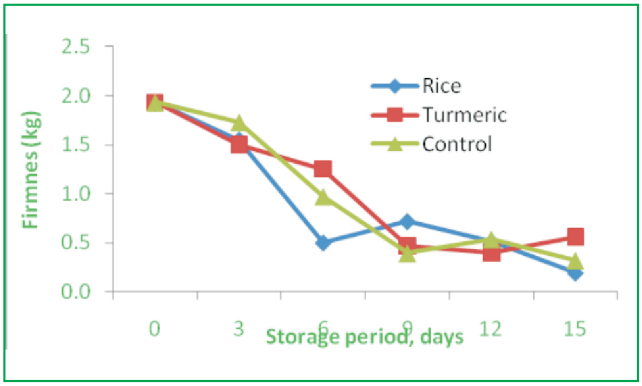


Fig. 53. Effect of edible coating on firmness of guava

d) Carnauba wax to extend shelf life of guava:

Carnauba wax was applied at the rate of 0, 5 and 10 % emulsion and the fruits were evaluated after

every three days during their storage. Waxing of fruit aggravatedchilling injury but did not develop as much colour. The fruits treated with 5 % wax emulsion had little effect on soluble solid, titrable acidity and ascorbic acid content. Whereas 10 % emulsion coating of carnauba wax was found quite effective in delaying fruit ripening and reducing mass loss. Though this formulation slowed down the fruit softening by 15-25 % but coated fruits were more prone to browning in storage than uncoated fruits. There was no decay in both coated and uncoated guava up to 6 days of storage. Control fruit had lost more than 9 % of its weight within 6 days of storage whereas wax coated fruit resulted in as much weight loss after 9 days of ambient storage and also had low acidity and soluble solids.

e) Response of guava to post-harvest application of 1-MCP:

Guava fruits were harvested at mature green stage and were treated with 0, 250,500 and 1000 nl L^{-1} of 1-MCP for 4, 8 and 16h followed by storage at ambient and low temperature conditions. The results showed 1-MCP treated fruits could be stored for 28 days under low temperature condition while non-treated fruit could be kept in acceptable condition only for 20 days under similar storage condition. 1-MCP concentrations of 250 or 500 l L^{-1} were not sufficient for 4 h exposure time.However, storage quality of fruit was significantly improved with the application of 1000 l L^{-1} MCP. The use of 1-MCP at 250 or 500 l L^{-1} for 16 hours showed the best results for desirable colour and textural property of the fruit which were at par with those treated to 1000 l L^{-1} for 4 hour treatment. Treatment with 1-MCP delayed the onset of guava fruit ripening by more than 7 days compared with untreated control fruits under low temperature condition. However, once the ripening was commenced, fruit softening rates were similar for treated and untreated fruits. The study inferred that 1-MCP efficiently inhibited ethylene action and could considerably delay the ripening of guava even at room temperature.

f) 1-MCP effect on post harvest ripening of guava:

Ripening changes in guava were assessed with different concentrations of 1-MCP (250, 500 and 1000 l L^{-1}). Fruits treated with 1-MCP maintained higher acidity levels during storage. Soluble solid and ascorbic acid were not affected by the 1-MCP treatment. At the end of storage period fruits treated with 1-MCP @ 1000 l L^{-1} had low respiratory rate when compared with the fruits treated with 250 or 500 l L^{-1}. Fruit colour was little influenced by 1-MCP treatment after the guava fruits were fully ripened. Fruits showed dark green colour at harvest which changed to intense yellow at the end of ripening. Non treated guavas were completely yellow after 5 days of storage. Fruits treated with 250 l L^{-1} showed little retention of colour compared to those treated with 1000 l L^{-1} (Fig. 54). However, fruits exposed to 8 or 16 h under same concentration showed significant retention of skin colour. The fruits become thoroughly yellow between 7th and 9th days after treatment. Fruits treated with 1000 l L^{-1} of 1-MCP for 4 or 8 h also turned yellow on the 8th day after the treatment while those exposed for 16 h did not ripen. The result showed that 1-MCP has potential for the commercial control of guava fruit ripening.

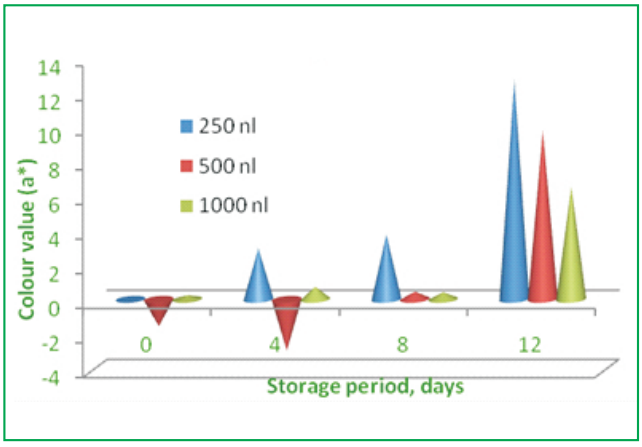


Fig. 54. Effect of 1-MCP conc. on colur value of guava

g) Effect of 1-MCP under different storage conditions of mango:

Shelf life of mango was evaluated with 1-MCP and the treatment consisted of 0, 250, 500 and 1000 $l\,L^{-1}$ MCP for 4 hfollowed by storage at ambient and low temperature storage with 90±5 % RH. The changes in the colour of the pulp were more evident than of the skin of mango variety chausa. The effect of 1-MCP was quite significant on the reduction of rot incidence at both storage temperatures (Fig 55). Non-treated fruits showed higher percentage of rot (40 %) on the 28th day of cold storage. Higher percentage of rot was observed from the 21st day of storage in fruits treated with 250 or 500 $l\,L^{-1}$. The application of 1000 $l\,L^{-1}$ of MCP for 4 h was efficient in delaying the loss of the skin colour and in maintaining fruit firmness at both storage temperature. However, 500 $l\,L^{-1}$ of 1-MCP was efficient in delaying the skin colour loss only when the fruits were stored at low temperature condition. Application of 250 $l\,L^{-1}$ had increasing impact while 1000 $l\,L^{-1}$ begin to approach response saturation. The respiratory rate was lower in fruits treated with 500 or 1000 $l\,L^{-1}$ of 1-MCP during their storage under both the conditions. Although 1-MCP is not a fungicide and does not have protective nor eradicating effect on pathogens, it showed indirect effect in decay control of fruits by delaying the ripening process. The study revealed that the product was effective in delaying the ripening of the fruit and the concentration of 1000 $l\,L^{-1}$ was found to be the optimum dose for prolonging the shelf life of mango.

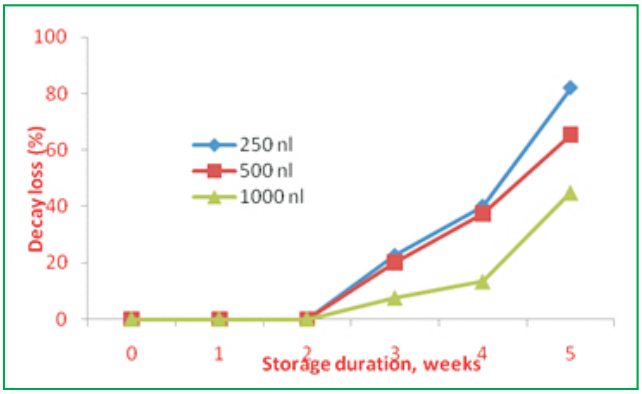


Fig. 55. Decay loss of mango as affected 1-MCP

h) Effect of Exposure time of 1-MCP on mango:

Fruits of mango variety Chausa were harvested and treated with three exposer duration of 1-MCP (4, 8 and 16 h) at two maturity stages. Slow rate of changes in soluble solid, titrable acidity and vitamin C contents with the increase in the treatment duration reflect the effectiveness of exposure time to 1-MCP. Generally the fruits harvested at more advanced stage of maturity were found less susceptible to 1-MCP application. Fruits coated with 250 $l\,L^{-1}$ for 16 h promoted the best retention of skin colour(Fig. 56). Exposure time of 8 or 16 h to 500 $l\,L^{-1}$ of 1-MCP showed equal colour retention but comparatively better results than 4 h treatment. Also 4 h exposure time to 1000 $l\,L^{-1}$ 1-MCP was as effective in skin colour retention as 8 or 16 h of exposure time to 500 or 250 $l\,L^{-1}$ 1-MCP. However, no differences were observed among different duration of exposure time in the fruits treated with the highest concentration of 1-MCP. Pulp softening was slower in 1-MCP treated mango with longest period of exposure. Lower concentration of 1-MCP (250 $l\,L^{-1}$) was as effective as the highest concentration of 1000 $l\,L^{-1}$ when the treatment time was extended to 16 h. This treatment combination was apparently more effective in surpassing ethylene induced effects on fruit ripening. The trend in response to 16 h suggests that no additional benefit would be obtained by further extending the duration of treatment and exposure time greater than 8 h appeared to reach saturation.

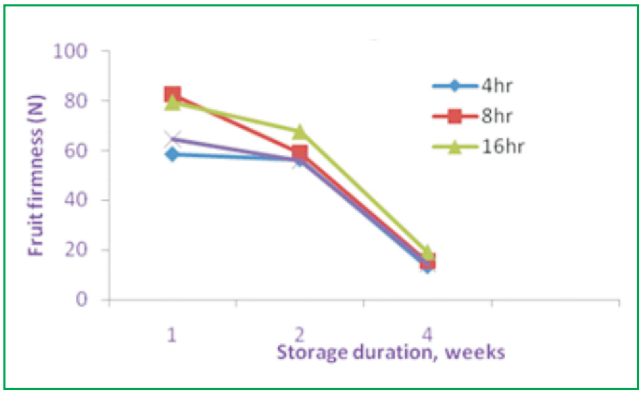


Fig. 56. Effect of exposer time to 1-MCP on firmness of mango

Impact of different mulching on soil microclimate in strawberry and okra fields

Jitendra Singh, Ramesh Kumar, R.K. Gupta

Transplantation of strawberry (*Fragaria* sp. variety: *Chandler*) was carried on raised beds with25 cm plant to plant and row to row distance of 1m. There were four rows of the plants on each bed and two lateral lines were installed between the two rows of plants. Unwoven jute (175g/m^2) mulch was laid, besides the white and black polythene of 7 and 25µ thickness. Mulching was done after one week of transplantation, when plants were fully settled. Jute mulching was done in three replicates of each single, double and triple layers (Fig. 57).

a) Weed growth in different mulched plots

Black plastic mulching of both thickness (7µ and 25) and jute mulch in single, double and triple layers have indicated a better plant growth and these were found to be effective in weed management. Comparatively jute single layer was found quite suitable for mulching purpose in terms of plant growth and water conservation. Minor soil born diseases were experienced in black mulched plots during early stage of the crop, while such type of disease attack was not been observed in jute mulched field. Although in terms of soil temperature enhancement during winter season, white transparent plastic mulching was found suitable to some extent. Comparatively, there were no significant differences in plant growth and yield during winter under black and white polythene. However, in terms of weed management white transparent polythene was not found suitable because a huge and unmanageable amount of weed growth. Only few plants of a weed *Cyperousrotundus* were found to penetrate all the mulching films of polythene as well as jute.

b) Extension of crop period

Around 25 days more flowering and fruiting period of the strawberry was achieved using black polytheneand jute mulches, whereas in white polythene mulched plots the crop was flooded with excessive weed density. Although, manual weeding was done in control plots, yet crop period was observed less than the mulched plots.

Fig. 57. Effect of different types of mulching on strawberry growth

Evaluation of insect net for insect dynamics and Microclimate inside net house for vegetable production.

Jitendra Singh, Ramesh Kumar, D D Nangare

Four Net-houses of 25, 40, 50 and 60 mesh size with double door were constructed (Fig. 58). Drip irrigation system was installed in the net house to avoid the entry of tiny adult insects, eggs and larvae of insects through surface irrigation. The water was pumped from water storage tank from more than one meter depth where egg and larval contamination was not possible. Entire net-house structures were protected to prevent the insect entry through secondary sources.

Fig. 58. Net houses of 25, 40, 50 and 60 mesh size

Transplantation of tomato (*cv. naveen*) was done with 45cm plant to plant and 1 meter row to row spacing. Similarly, capsicum (*cv. california wonder)* transplantation was carried out with 50 x 50 cm

spacing. Application of fertilizers such as DAP and urea were uniform in each treatment.Two yellow sticky bands (12 x 8" using mustered oil) (Fig 59) were installed in each net-house and outside to monitor the presence of aphid, whiteflies and other tiny insects. Not a single tiny insect was found inside 40, 50 and 60 mesh size net-houses. Whereas 50-60 aphids were observed inside the 25 mesh net house and 450-600 aphid in open field conditions counts were recorded on a single yellow sticky band (Fig. 60). Attack of flying aphid was noticed from first week of February while no attack of whiteflies was found till May 2011.

Fig. 59. Installation of yellow sticky bands to trap the tiny insects

Fig. 60. Yellow sticky band in open field conditions showing adhered aphids

During November average temperature of whole month was almost same inside and outide of the net-houses. It was 25.5 and 25.9°C in net-house 1 (25 mesh) and net-house 2 (40 mesh) respectively. Similarly, it was somewhat lower in open field conditions (Table 18). A decrease in average temperature was found during December and this trend was continued up to January. During January two remaining structures of 50 and 60 mesh size were also constructed and compared to net-house1, net-house 2 and open field conditions; considerably more temperature was recorded in these two structures (Table 16). There was very little difference in temperature between 50 and 60 mesh size net-houses. The average temperature during February increased considerably as compared to January in all the structures and open field conditions.Almost similar trend in relative humidity was recorded. A considerably low humidity was found in 50 and 60 mesh size net-houses as compared to other net-houses and open field conditions. But in February almost same humidity was observed in all the structures and open field (Table 16). Around 1-2°C less temperature and 5-8% more humidity was observed inside the 40, 50 and 60 mesh size net houses, while no considerable change was observed in 25 mesh size net house.

Aphid score counts was found as 550-600 and 330-400 on apical five leaves of capsicum and tomato, respectively, in open field conditions. Whereas, 40-50 aphid counts were found on capsicum and tomato leaves under 25 mesh size net-house conditions and no aphidinfestation was found inside 40, 50 and 60 mesh size net-houses. Similarly, whitefly infestation was not found inside 40, 50 and 60 mesh net-houses.

A standard spectrophotometric method was followed to analyze the chlorophyll content in tomato plants under different net-house and open field conditions. Around 30.5±2 chlorophyll a, 15.42±0.9 chlorophyll b and 2524.25±37 µg/g leaf carotene was found. No significant change in leaf chlorophyll contents was observed. A sever attack of early blight (*Alternariasolani*) disease was observed in tomato inside and outside of the shade net-houses, which was controlled by a fungicide carbendazim 50%EC.

Table 16: Comparison of temperature, humidity and light penetration in different net-houses and open field conditions

Months	Net house 1 (25 mesh)			Net house 2 (mesh40)			Net house 3 (50 mesh)			Net house 4 (60 mesh)			Open field		
	Tem °C	Hum %	Radiation x 100 lux	Tem°C	Hum %	Radiation x 100 lux	Tem°C	Hum %	Radiation x 100 lux	Tem°C	Hum %	Radiation x 100 lux	Tem °C	Hum %	Radiation x 100 lux
Nov	25.5	37.2	350.2	25.9	36.9	321.9							25.1	37.6	441.6
Dec.	19.1	50.2	355.7	20.6	49.7	332.5							18.7	50.4	499.1
Jan.	15.3	59.9	370.7	15.4	59.8	366.3	18.9	47.3	336.6	19.1	46.7	316.4	14.9	60.5	451.9
Feb.	21.4	54.9	490.8	21.6	56.1	457.8	21.8	55.5	410.6	21.8	55.7	407.1	21.1	56.5	696.4

Optimization of shade net design to create a suitable climate for cultivation of vegetable, cut flowers in semi-arid region

D D Nangare, J Singh, R K Gupta, Anil Dixit

Shade net houses with three different shading (35, 50 and 75%) and three different heights (2.5,3 and 3.5 m) were constructed (Fig 61). Nursery of Tomato (*Cv. Naveen*) and capsicum (*Cv California Wonder*) were sown in polyhouse. The field layout inside shade net (6x4 m) for tomato, capsicum andmarigold was prepared and drip system was installed. The transplanting of tomato capsicum and Marigold was done in all shade nets and in open field. In open field, polyethylene sheet was covered from north side to protect the tomato and capsicum plants from cold waves during winter. The polyethylene sheet was removed at the end of February. The soil at the experimental site was sandy loam. The irrigation was given through drip system for tomato, capsicum and marigold in nine shade net house as well as in open field.

The daily temperature, humidity and solar radiation were observed inside and outside shade net from November. The average monthly maximum temperature and humidity varied from 15 to 26 °C and humidity varied between 38 to 100 percent during November to March in day time. There was not much difference found in temperature and humidity in shade net as compared to open field. The maximum solar radiation was found in open field followed by 30, 50 and 75 % shading nets. (Fig. 62)

Fig. 61. Bamboo shade net houses covered with three shading 35, 50 and 75%

Growth parameter

The plant height was recorded at 15 days interval in each shade net and open field for tomato, capsicum and marigold**.** The variation in plant height of tomato, capsicum and marigold under different shade nets were as given in (Fig. 63). The maximum plant height was observed in 50 and 75 % shading net house compared to 35 % shading net house and open field. The rate of increase in height was observed higher after 60 days. In tomato, the flowering started

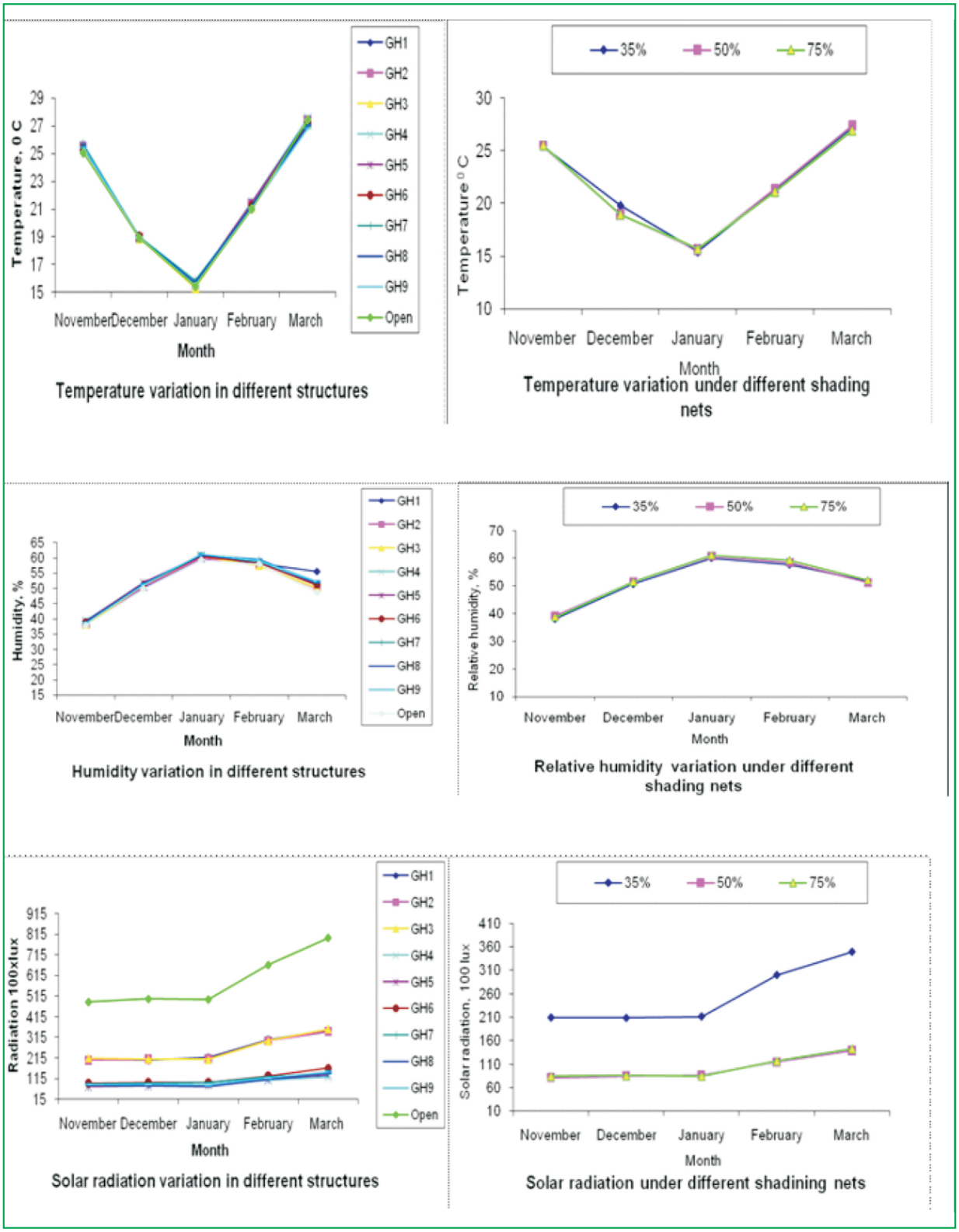
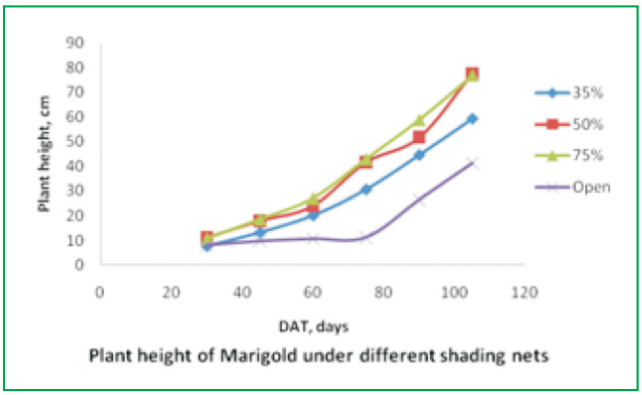


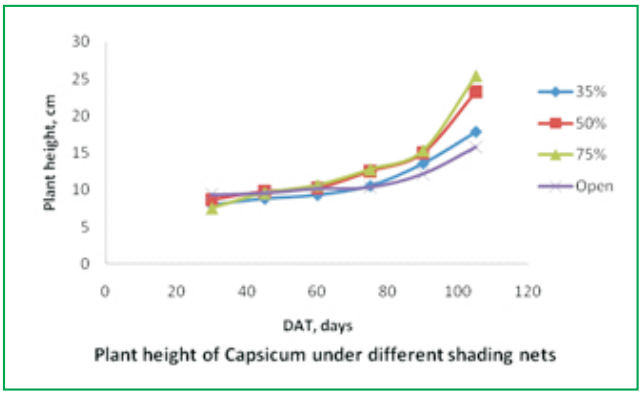
Fig. 62. Temperature, humidity and solar radiation variation during November to March inside and outside shade nets

in open field and 35 % shading net in the month of February. The flowering started in 50 and 75 % shading net house at the end of February also flowering was observed less as compared to open and 35 % shading net house.

Chlorophyll content

A standard spectrophotometric method was followed to analyze chlorophyll content in tomato plants under different green-house and open field conditions to optimize appropriate microclimatic conditions for better plant growth and yield. The three extraction solvents methanol, diethyl etherand acetone were compared for chlorophyll extraction efficiency.Among all these solvents acetone extraction was found efficient for higher recovery of chlorophyll from tomato leaves (Table 17). Chlorophyll a content was found highest in medium height (3m) shade net-houses of 50 and 75% shadings, such as 40.16 and 40.95 µg/g leaf, respectively, which was followed by 39.7 µg/g leaf in open field conditions.





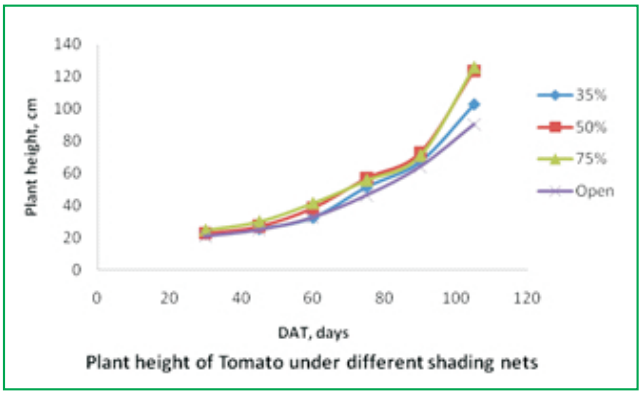


Fig. 63. Variation in plant height of tomato, capsicum and marigold under different shade nets

Pest and disease incidence

Aphid and white fly attacks observed during second week of March, were severe on capsicum and tomato in open field trials. On an average, highest aphid attack was found in open field conditions i.e. 48.2 aphids were observed on three apical leaves (Table 18). However, almost negligible number of aphids were found in shade houses of 50 and 75% shadings of all three different heights, whereas in shade net-houses of 35% shadings 28 aphid/plant were observed. No aphid attack was found on marigold plants.

Effect of micro-nutrient and NAA sprays on quality of freshly harvested Ber fruits

Vijay Singh Meena, Eyarkai Nambi

A field experiment was conducted to study the effect of Micro-Nutrient and NAA spray on quality of freshly harvested Ber fruits on loamy sand soil. The experiment comprising 16 combinations of four foliar spray levels of Ferrous Sulphate (Control, 0.2, 0.3 and 0.4 per cent) and four spray levels of NAA(Naphthalene acetic acid) viz.(Control, 50 ppm , 75 and 100 PPM) was laid out in randomized block design with four replications. Eight years old Ber (var. *Gola*) was used for testing the treatments. Foliar application of Ferrous Sulphate along with Naphthalene acetic acid with all possible combination was done during flowering stage and second spray was carried out 20 days after of first

Table 17: Chlorophyll content µg/ in per gram fresh tomato leaves under different green houses and open field conditions

Shade net houses	Methanol			Diethyl ether			Acetone		
	Cl_a	Cl_b	Carotene	Cl_a	Cl_b	Carotene	Cl_a	Cl_b	Carotene
GH_1	27.82	11.50	2287.37	7.18	2.19	199.27	34.70	12.48	3021.74
GH_2	32.48	14.67	2780.37	11.81	4.22	411.85	37.02	13.38	3352.16
GH_3	30.86	12.81	2710.00	8.48	2.79	270.46	35.29	15.64	3355.30
GH_4	25.47	10.59	2141.57	12.52	4.31	499.91	34.66	15.95	2761.60
GH_5	33.04	16.11	2851.02	7.20	2.38	287.20	40.16	17.00	3127.73
GH_6	31.50	14.24	2604.40	10.61	3.85	381.47	36.31	15.83	2842.91
GH_7	26.96	12.44	2313.34	8.43	2.75	308.53	27.30	16.15	2270.24
GH_8	26.91	11.11	2178.19	7.29	2.41	294.07	40.95	18.52	3526.40
GH_9	29.28	14.07	2477.84	8.15	3.02	321.83	35.05	10.71	2664.59
Open	27.65	10.88	2471.19	10.40	3.17	326.91	37.58	16.43	3433.80

Table 18: Score counting of aphids in capsicum under shade net and open field conditions

Tagged plants	35% shade net			50% shade net			75% shade net			Open field
	GH1	GH2	GH3	GH4	GH5	GH6	GH7	GH8	GH9	
1	26	19	24	0	0	12	0	0	0	75
2	33	22	27	0	0	11	0	11	0	63
3	27	32	30	0	0	0	0	0	0	32
4	28	27	37	0	0	0	0	0	0	67
5	34	38	24	0	0	22	0	0	0	54
Average	29.6	27.6	28.4	0	0	9	0	2.2	0	58.2

spray. The data in relation to fruit quality are depicted in following graphs.

Foliar spray of Ferrous Sulphate ferrous @ 0.3 per cent significantly increased the average fruit weight of ber over control and 0.2 % spray. The increase recorded due to 0.4 per cent Ferrous Sulphate was at par with 0.3 % level. It is presented in (Fig. 64) that NAA @ of 75 PPM increased the average fruit weight (31.10g) over control (27.04 g) and its preceding lower level 50ppm (29.43 g) spray. The percent increases in fruit weight were recorded with 75 PPM spray of NAA was to the tune of 7.84 and 14.02 over 50 ppm and control, respectively. The chlorophyll content might have increased due to higher level of Ferrous Sulphate and NAA application which ultimately increased the photosynthetic efficiency of ber leaves and greater production of assimilates.

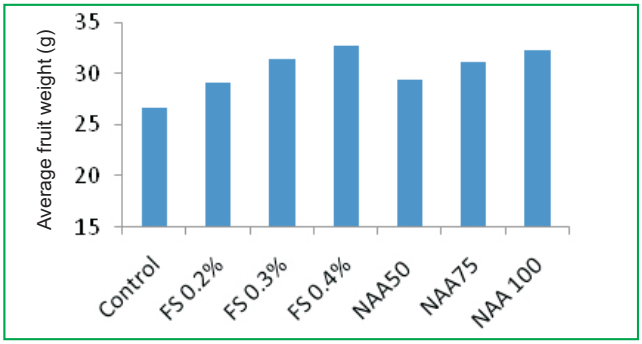


Fig. 64. Comparative performance of different treatments on fruit weight

The greater production of photosynthates and their translocation to economic sinks may be the reason of improved growth characters. Another reason may be due to foliar feeding of nutrient iron and consequent translocation to phloem tissue. It is evident from the data presented in (Fig. 65 and 66) that among bio chemical parameters Ferrous sulphate @ 0.3 per cent and NAA 75 PPM as foliar spray perceptibly improved the quality characters like TSS, ascorbic acid of ber fruits whereas fruit acidity was decreased with the increasing levels of Ferrous Sulphate (Fig. 67).

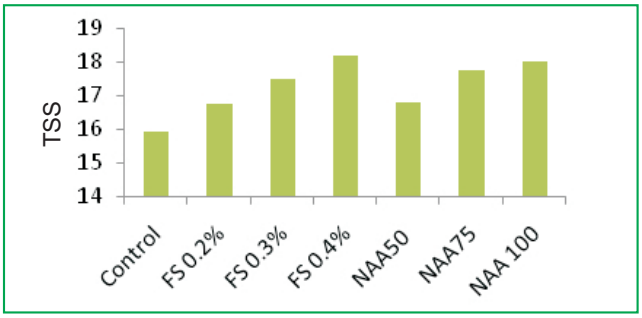


Fig. 65. Changes in TSS of fruits influenced by per harvest treatments

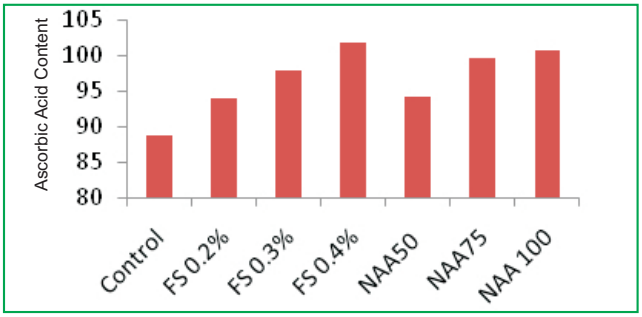


Fig. 66. Changes in Ascorbic Acid and TSS of fruits influenced by per harvest treatments

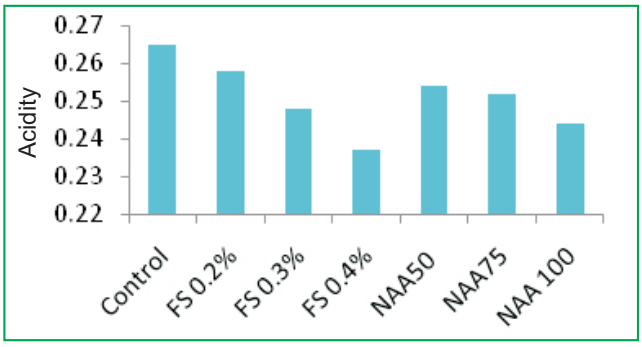


Fig. 67. Changes in acidity of fruits by foliar applications

The increased TSS and ascorbic acid content with ferrous sulphate may due to an increased photosynthetic activity and more production of starch and consequently conversion into sugars. The decrease in fruit acidity owing to the application of Ferrous Sulphate may be because acids may have been quickly converted into sugars and its derivatives by the reaction of glycolytic pathway.

TRANSFER OF TECHNOLOGY

Mobilizing Mass Media Support for Sharing Agro Information

D R Rai, S Chopra, Jitendra Singh

The major achievements in this project include four films on successful technologies, a series of radio programmes called Do Dooni Char, TV programmes, publications of news-items and success stories in leading national regional newspapers for creating mass awareness. An exhibition on showcasing of technologies was organized to provide interactive forum between scientists, farmers and entrepreneurs on October 20,2010.

a) Coverage in print media

More than 210 news-items on CIPHET activities were published during this period in leading newspapers, which included 120 English, 44 Hindi, 11 Punjabi and 35 web news (Fig. 68). The news coverage mainly focused on technology transfer, success stories, training visits of important personalities including DG ICAR and foreign delegates. Apart from this, participation of CIPHET in various exhibitions/events in different States of India was also covered in print as well as in web media.

Agri council calls for overseas collaboration in post harvest

1-2 May, 2010

Fig. 68. News item related to Post-harvest technology

b) Radio Programmes

Taking a new initiative, CIPHET in collaboration with All India Radio, Jalandhar (Fig. 69) started a new agriculture information programme on post harvest technology called Do Dooni Char, which means investment of two and earning four even in the farmer's village, from May 5.2010. 15 programs have been already aired. The programme has drawn huge response in terms of queries/requests/responses from entire northern region. The programme is broadcasted through a powerful 300 KW transmitter on medium wave frequency at 873 KHz over Punjab, parts of Haryana, Himachal Pradesh, Uttaranchal, J&K and Rajasthan. The programme content focused on explaining the processes and equipment by the experts in very simple, but attractive language along with local folklores. Many interactions were also made with successful rural entrepreneurs who have adopted these technologies and are benefiting from them. Each capsule comprised of local folksongs, details of technology by CIPHET Scientist and a question to be answered by listeners by SMS. The programme made an impact as institute is receiving lot of queries regarding the technologies and training programmes.

Fig. 69. Recording CIPHET programme Do Dooni Char at AIR Jalandhar

c) Video Films

In this period four films on successful farmers/entrepreneurs have been made (Fig. 70). These included *Grass root entrepreneur*-a success story of CIPHET trained entrepreneur Kailash

Chowdhary, *Low cost storage transforming farmers lives*- based on successful technology of Evaporative Cooled room, *Potato enriched cattle feed* developed under the NAIP Project on Value chain on potato and potato products and *Shaping a new tomorrow* - a film on NAIP Project on livestock in Kandi (Hoshiarpur). These films were shown on important events/exhibitions/visits for creating mass awareness and motivating farmers/entrepreneurs to replicate successful models.

Fig. 70. Recording of video film

d) Showcasing of technologies

Aiming to provide platform for different agricultural institutes and give a bouquet of technologies to farmers/entrepreneurs under one roof, CIPHET, organized an exhibition (Fig. 71) on October 20, 2011. ICAR institutes including NDRI, DWR, IARI, SAU, food processing industry, entrepreneurs and NGO's took part in the one day event. Vice-Chancellor of GADVASU Dr V.K Taneja was chief guest and Mr. Sharma, GM, NABARD was guest of honour on the occasion which was widely covered in print and electronic media by different channels.

Fig. 71. Exhibition at CIPHET, Ludhiana

e) Television Programmes

Dissemination of technologies through Television was aggressively followed. Around 14 television programmes on CIPHET technologies and events were broadcasted on leading channels including Doordarshan, CNBC, Zee News, PTC News etc. The coverage by TV included details of CIPHET developed technologies and special training programmes organized by CIPHET. An overview of the various activities carried under this project is detailed in Table 1.

Achievements at a glance :

Activity	Achievements
News-clippings	210 News-items (including 120 English, 44 Hindi, 11, Punjabi and 35 web-news have been published
Radio Programmes	15 dehati programme named "Do Dooni Chaar" have been aired on AIR, Jalandhar
TV Programmes	11 news-reports & programmes on Doordarshan, Zee News, Star News, IBN, CNBC, PTC etc
Video films on successful technologies/entrepreneurs	Four films have been made on successful technologies/entrepreneurs 1. *Grass root entrepreneur* 2. *Low cost storage transforming farmers lives* 3. *Potato enriched cattle feed* 4. *Shaping a new tomorrow*
HRD Training	Scientists/technical officials were trained at IIMC Delhi and IIM Lucknow in creative writing under capacity building programme

Value chain on potato and potato products (NAIP)

D Dhingra

a. Pelleting and extrusion for making feed

Pelleted and extruded feed samples were prepared by incorporating potatoes. In order to use culled or unmarketable potatoes these were mechanically dewatered by using a screw expeller.

Mechanical dewatering of potatoes, yielded 60-65 % pulp with a moisture content of approximately 50-55 %. The pulp obtained with reduced moisture content was directly mixed with other feed ingredients for pelletization. The pelleted feed obtained had a moisture content of 20-22 %. These were subsequently dried. Proximate composition of feed prepared with 30 % pulp (dewatered potatoes) was analyzed. The feed pellets had 11.40 % moisture, 13.86 % protein, 4.96 % fat and 6 % ash. The neutral detergent fibre, acid detergent fibre, cellulose and lignin were observed to be 35, 13.4, 13 and 2.5 % respectively. The mechanical strength of the pellets was observed to be 0.83 MPa.

Extruded feed has several advantages over the feed pellets like compact in size, increased digestibility, water stable, easy to store etc. The compounded feed consisting of potato waste (30 %), barley (20 %), maize (20 %), oil cake (10 %), husk (9 %), rice polish (9 %), mineral mixture (1 %), and molasses (1%) was prepared through extrusion. The extruded feed was formed by passing the hydrated mixture (15-16 %) of feed ingredients through the single screw extruder with die speed of 500 rpm. The sample is presented in Fig. 72. The extruder had a die opening of 0.2 mm with screw length and diameter of 165 and 40 mm respectively. The moisture, protein, fat, ash and carbohydrate content of the extruded cattle feed were observed to be 8, 13, 16.2, 5.3 and 57.5 % respectively. The hardness of the extruded feed was observed to be 0.48 MPa.

Fig. 72 .Extruded Cattle Feed Sample

Aflatoxin content of all the feed samples was analysed using AOAC 990.33 method. The aflatoxin B1, B2, G1 and G2 were observed to be non detected with MDL (Method Detection Limit) 30 ppb. A video film on preparation of feed using potato waste and trials of feed on animals by farmers was prepared.

b. Extraction of dietary fibre from potato peel

The enzymatic-chemical process for the extraction of dietary fibre from the potato peel was standardized. The process is outlined in the flow-chart (Fig. 73). The process involved treatment of peel with enzyme (alpha amylase) at 90 °C for 30 min. Then the sample was treated with sulphuric acid at 60 °C for 30 min. After acid treatment the sample was neutralized using sodium hydroxide to bring the pH of the sample to 7. Finally the sample was bleached with 3 % hydrogen peroxide at 60 °C for 3 hrs. The bleached product was dried at 70 °C and its size was reduced so that it passed through 100 mesh. The product thus obtained is termed as dietary fibre from potato peel. Proximate composition of the potato peel and the extracted dietary fibre from the potato peel was analyzed and is presented in Table 19.

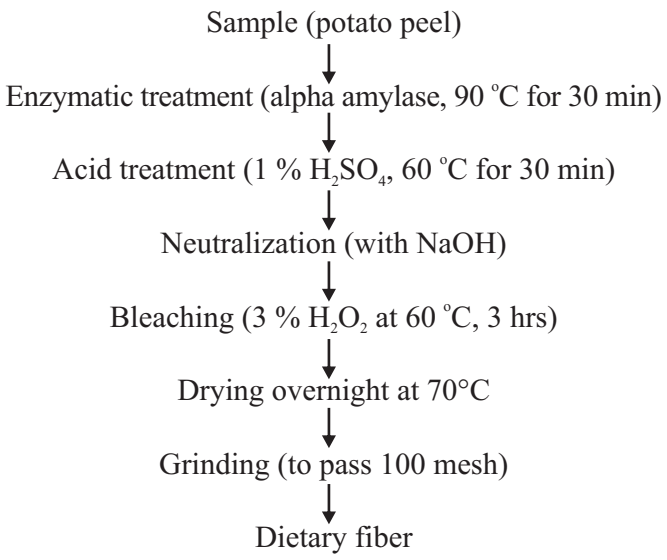


Fig. 73 .Flow-chart for extraction of dietary fiber from potato peel

Different physical characteristics like fat absorption, water retention, swelling, hydrated density, bulk density, true density, average particle size and water solubility index of the extracted fibre from potato peel were determined and are presented in Table 20. Different levels (5, 10 and 15 %) of the extracted fibre were incorporated in biscuits and chapattis (Fig. 74) The biscuit and chapatti samples with 5 % extracted fibre were acceptable.

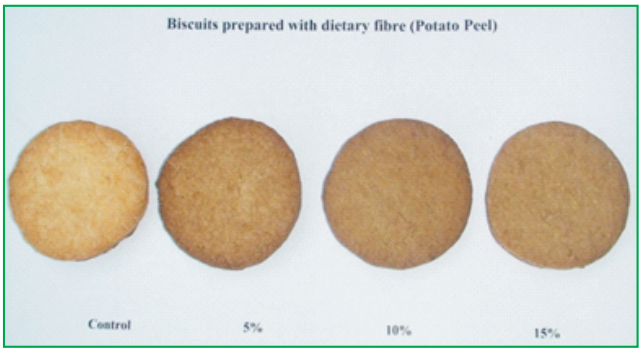


Fig. 74 .Biscuits prepared with extracted fibre from potato peel

Table 19: Proximate composition of the potato peel and the extracted dietary fibre

Parameter (%)	Potato peel	Extracted dietary fibre
Moisture	7.85	7.13
Protein	10.94	1.61
Fat	5.85	1.40
Ash	4.90	9.70
Total dietary fibre	70.41	79.59
Soluble dietary fibre	2.39	2.01
Insoluble dietary fibre	67.61	77.96

Table 20: Physical characteristics of extracted dietary fibre from potato peel

Physical characteristics	Contents
Fat absorption (g/g)	3.34 (3.05-3.80)
Water retention (g/g)	5.15 (4.8-5.4)
Swelling (cm^3/g)	7860 (7640-7990)
Hydrated density (kg/m^3)	1310(1005-1670)
Bulk density (kg/m^3)	250 (226.7-256.5)
True density (kg/m^3)	1853
Water solubility index (%)	9.7
Average Particle size (mm)	104.4±73.35

Impact assessment of entrepreneurship development programmes conducted by CIPHET

Sangeeta Chopra, A. K. Dixit, Indu Karki

The impact indicators for impact assessment were identified and survey schedule/questionnaire was prepared. A performa which may be got filled by participants before and after EDP participation was developed. The participants were contacted to obtain the feedback. For an EDP on technology of powder making from beetroot and carrot, 26 participants (from Payal, Mullanpur, Raikot and Ludhiana districts) were contacted. All the participants of the EDP got trained about the technology, its utility and detailed technical knowhow and the venture was started by 4 % of the participants. A total of 16 entrepreneurs, who took training on snack foods, ground nut, soy milk paneer, green chili powder were contacted through telephone. Among those who attended training and licensing of soymilk paneer and curd technology, one person has adopted the technology and installed his plant.

Outreach and inhouse studies on power factor correction systems for agro processing equipment.

Sangeeta Chopra, Devinder Dhingra

Power factor is the ratio of actual load power (kW) to the apparent load power (kVA) drawn by an

equipment and is a measure of the current being converted into useful work output. It is an indicator of the effect of the load current on the efficiency of the supply system. An electric load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. The higher current in the circuit increases the energy lost in the distribution system, and requires larger wires and other equipment. A higher cost of energy consumption may also be charged for low power factor. The power factor of burr mill, dhal mill, pelletizer and hammer mill installed in agro-processing centre and pilot plant for cattle feed in the institute were measured and are presented in Table 21.

Evaluation of screw press mechanism for oil expelling as effect of process parameters

Dilip Jain, Rajesh Vishwakarma

The screw in conventional screw-presses is a set of worm and the screw pitch is broken with spacers. For validation of model a set of continue screw spiral of variable pitch (Fig. 75) was fabricated for verification of the theoretical model.

A theoretical model of screw-press mechanism, which was developed earlier for prediction of flow and pressure for oil expelling was modified for the new screw configuration. The pattern of velocity and pressure profile in the screw channel were similar. The material flows in the channel at height of 12 mm at the variable length (150, 350, 430, 470 and 500 mm) and width (~12, 8.5, 6.5, 6, 3 mm) of path way (Fig. 76) with the velocity ranged from 0.1 to 0.15 m/s. The pressure profile at the different length/ pitch of the barrel was computed with the velocity modeling of screw press and pressure equation. The surface response of pressure distribution in screw channel was similar to the velocity profile which represented the initial level of velocity and pressure in the screw channel at the screw RPM of 42. (Fig.77). The pressures in the screw press ranged from 1×10^5 to 12×10^5 Pa, which was sufficient to express oil from most of the oil seeds. While, the velocity and pressure distribution at the 500 mm is shown in Fig. 78 respectively, which represented the final level of velocity and pressure in the screw channel at the end of the screw with same revolution.

A continues screw spiral of variable pitch was fabricated for verification of the theoretical model. A datalogger with automatic temperature and pressure measurement was attached with screw barrel at different length. The theoretical pressure was validated with experimental observation. The experimental pressure obtained with pressing the mustard and sunflower oilseeds were in the range of 1×10^5 to 10×10^5 Pa and validated the theoretical results.

Table 21: Power factor of agro processing equipment

Name of the equipment	Motor Rating (kW)	Condition of Operation	Power Factor	Angle of lag (deg)
Dhal mill	1.5	No Load On Load	0.95 0.99	18.2 7.66
Burr Mill	3.7	No Load On Load	0.36 0.76	68.9 40.6
Hammer mill	7.5	No Load On Load	0.58 0.74	55.0 41.6
Vertical Pelletizer	7.5	No Load On Load	0.27 0.46	74.2 62.9
Horizontal Pelletizer	5.5	No Load On Load	0.21 0.42	77.5 64.2

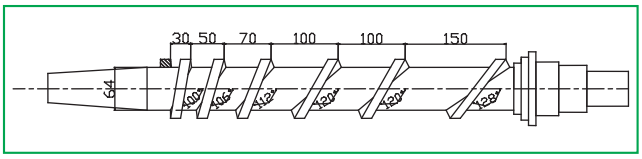


Fig. 75. Schematic drawing of screw spiral

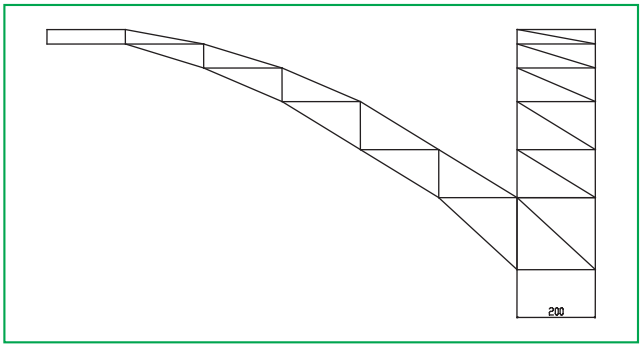
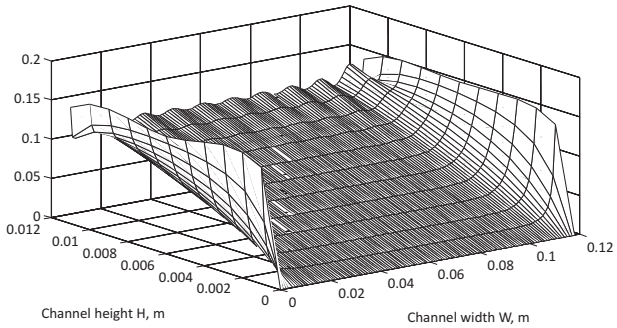
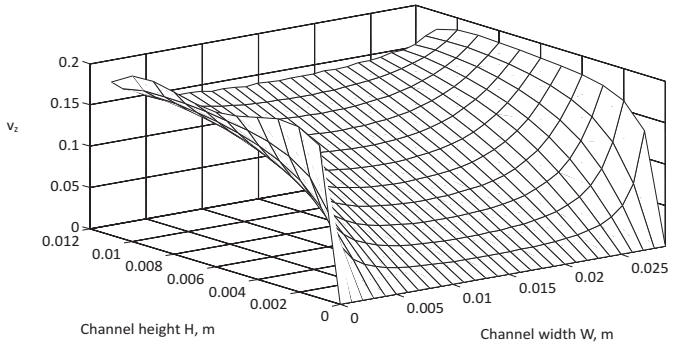


Fig. 76. Unfold screw spiral (Path of flow)



1.



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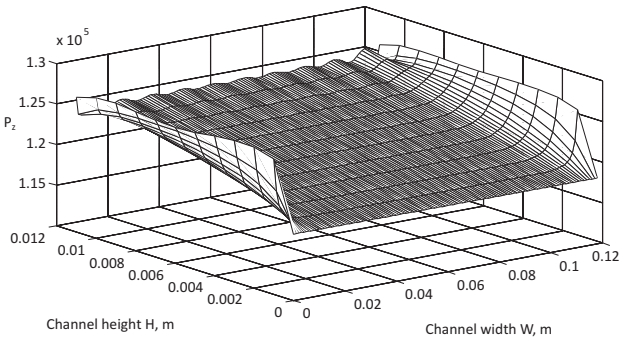
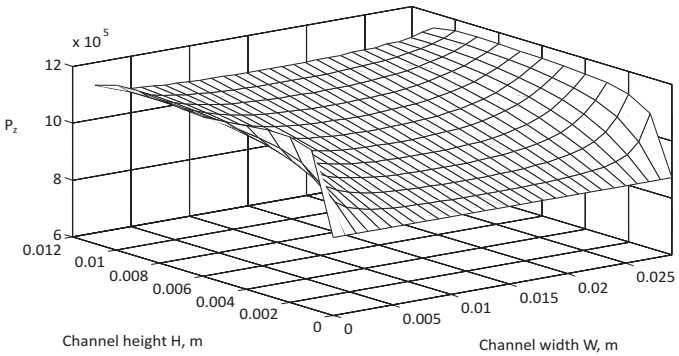


2.

Fig. 77. (1) Velocity profile in screw channel due to a combined drag and pressure flow
(2) pressure distribution at 150 mm of screw length



4.

Fig. 78. (3) Velocity profile in screw channel due to a combined drag and pressure flow
(4) pressure distribution at 500 mm of screw length

Technology for plant and dairy ingredients based formulated and functional foods using extrusion-cooking. (AKI) project

Dilip Jain, Mridula D

a) Formulations for the infants' food

The food formulations for the infants (up to 3 years of age) were developed using the abundantly available cereal (rice), coarse grain (maize), fruits (banana and guava) and vegetable (tomato and pumpkin) pulp were prepared and extruded successfully. Products were organoleptic acceptable with above 8 score. The moisture content of the feed material for extrusion prepared with the fruit and vegetable pulp ranged from 17 to 20 %. The extrudates based on maize and banana observed to have expansion ratio of 2.1, bulk density 0.350 g/cc at temperature 145°C, feeder speed 20 rpm and screw speed 275 rpm. Similarly, the maize / tomatoes extrudates were having expansion ratio 2.0, bulk density 0.470 g/cc at temperature 145°C, feeder speed 30 rpm and screw speed 275 rpm.

b) Glass and Melt Transition Temperature (T_g and T_m) on Phase Transition Analyzer

The knowledge of glass and melt transition of biopolymer are important for mass and energy audit on an extrusion system. It enables an extrusion technologist to accurately map the extrusion process - a valuable aid to troubleshooting and better characterization. The Wenger phase transition analyzer was procured which is a closed-chamber capillary rheometer, which uses a combination of pressure, temperature, time and moisture to measure the T_g and T_m of biopolymer. The rice and pumpkin based feed was experimented on PTA and the glass (T_g - 122.3 °C) and melt (T_m -142.6 °C) transition temperature and displacement vs temperature curve was obtained.

Structured outreach agro processing training module for rehabilitation of jail inmates of Central Jail, Ludhiana.

Nilesh Gaikwad, S. Chopra, A K Dixit, D. R. Rai

CIPHET in association with Ludhiana Central Jail started a unique training program (Fig. 79) in food processing for men and women prisoners. The aim of the program was to enable inmates to earn respectful livelihood after they complete their sentence in jail. CIPHET has developed number of technologies in food processing which could help jail inmates in setting up their own commercially viable units. These training programs (Table 22) were aimed at creating awareness among them and help them being useful to society.

Table 22: Training program schedule in Central Jail, Ludhiana

Name of training program	Date of program	Area on which training was given and products made
	Central Jail for Men	
Powdering technology of ginger, garlic and onion.	19th April 2010	Ginger powder and garlic slice
Value added Meat products.	12th May 2010	Meat nuggets, sausages and patties
Extruded Snacks products and Pasta	8th Sept. 2010	Extruded products and pasta from rice and millets
	Central Jail for Women	
Mixed Pickle and Cauot Candy preparation	20th January 2011	Mixed pickle form carrot, cauliflowers and turnip. Carrot candy
Ginger, garlic powder technology	17th February 2011	Ginger powder Garlic slice
Jam/Jelly preparation	25th March 2011	Guava Jelly Apple Jam

Fig. 79. Training by CIPHET Scientists in men and women jail

Refinement and evaluation of fish descaling machine and entrepreneurship development

(Collaborative research project of CIPHET and GADVASU)

Nilesh Gaikwad, Tanbir Ahmad, Ajit Singh

A visit was made to the local fish retailers at Ludhiana to understand the existing practice of fish descaling, tools used and problems faced by them. The fish retailers used wooden tool which was provided with the nails fixed on wooden surface (Fig. 80). Retailers usually sit in drooping posture, carry out the descaling by moving the tool in to and fro motion and this causes improper descaling. Further the sharp side of nails remained in contact with the fish skin while descaling. The process was cumbersome and lead to injuries while descaling.

A new electrical fish descaling machine was designed. The design considerations included reduction in the drudgery and time required for descaling with improved occupational safety from injury and fatigue due to improper postures. The proposed machine had three important components viz. descaling head, power unit and safety shield. The power drive was provided from 3 phase, 1 hp AC motor and AC drive was used for the speed variation. The different cylindrical descaling heads namely 13 slots (Fig. 81), 26 slots (Fig. 82) and inverted v

Fig. 80. Conventional fish descaling tool used presently by fish retailers

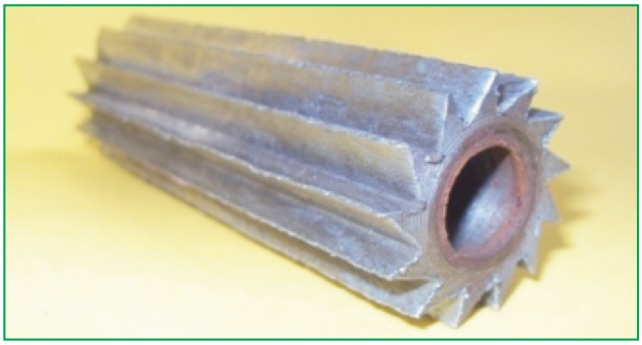


Fig. 81. Slots descaling head

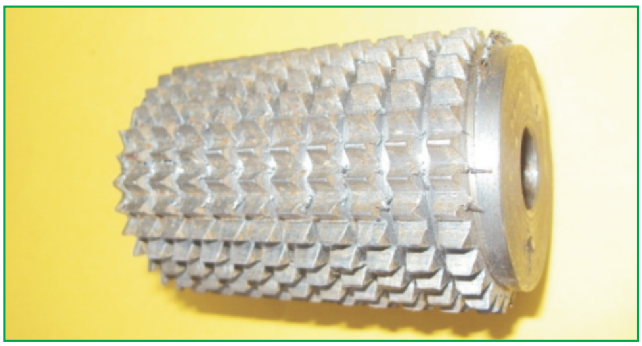


Fig. 82. Inverted v shaped descaling head

shaped teeth (Fig. 83) were developed with diameter of 30 mm and length of 8 cm in mild steel. The safety shield was made of stainless steel sheet of 18 gauge. The safety shield covered the descaling head but for the surface of descaling head which remained in contact with the fish skin.

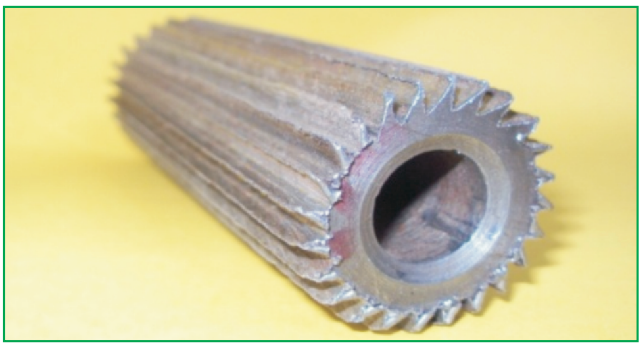


Fig. 83. Slots descaling head

Trainings organized

a) CIPHET has initiated a training programme on post harvest technologies at Ludhiana Central Jail for prisoners with an aim to train them to earn respectful living after they get released from the jail. A total of six trainings were conducted in men and women jail.

b) A seven days training programme on primary processing of medicinal and aromatic plants was organized at CIPHET, Ludhiana, during June 5 – 11, 2010. It was sponsored by Herbal Research and Development Institute, Gopeshwar, Uttarakhand for fourteen participants belonging to high altitude blocks of district Pitorahgarh, Uttarakhand. The group was exposed to the concepts of processing of extraction techniques, their utilization, drying and modified atmosphere packaging of medicinal and aromatic plants like aloevera, shatawar, mulhati, cymbogan grasses and patharchur. Practicals were conducted and they were given hands on training on beetroot and ginger powder. Dr. D. Dhingra and Dr. Sangeeta Chopra co-ordinated the programme.

c) Seven days integrated training programme on 'Design and Manufacturing of Agro-Processing Machinery and Storage Structures' for 24 farmers including women from Bihar state was organized by AICRP on PHT, CIPHET, Ludhiana, during June 13 – 19, 2010. The first session of the training programme included design, layout, principle, and operation of post harvest tools and equipments. Second session was on design and construction of storage structures such as evaporated cool room for fruits and vegetables, and metallic bin and silo for food grains storage. Third session was on processing technologies for novel food products and their marketing. A visit of participants was also arranged

to Department of Processing and Food Engineering, PAU Ludhiana, Markfed Canneries Jalandhar, Nijjer Agro Industry Ltd, Amritsar. Dr. A. K. Dixit and Dr. S. Chopra coordinated this training programme.

d) A training programme on 'Processsing and value addition of soybean and groundnut' was held for the farmers from ATMA Gurdaspur for 5 days from July 26 – 30, 2010. The training was provided on processing and value addition of groundnut into milk, paneer and yoghurt and soybean into soya milk and tofu. The participants were given hands-on-training and demonstration of the pilot plants. Dr. D. Dhingra and Dr. Sangeeta Chopra co-ordinated the programme.

e) A batch of seventeen farmers attended training program on 'Post-Harvest Technology for Rural Catchments' at CIPHET, Ludhiana, during August 12-18, 2010. The training programme was sponsored by SIRD, Assam. Training was given on processing of grains, pulses, oilseeds, fruits and vegetables

including processing of guava, minimal processing, packaging, storage of vegetables. Field visits were made to Markfed Canneries, Jalandhar**,** Nijjer Agro Industry Ltd, Amritsar,where the participants were exposed to processing of different commodities including canning process. The programme was coordinated by Dr. S. Chopra and Dr. D.R.Rai.

f) Three days training programme on micro-processing and packaging for SMS from North Zone KVKs was organized at CIPHET during Sept. 2-4, 2010. It was coordinated by Dr. D.R. Rai and S. Chopra.

g) A week-long training program on 'Post harvest technology for rural catchments' for farmers sponsored by the State Institute of Rural Development (SIRD), Assam, was organized at CIPHET during Sept. 9-18, 2010. The programme was coordinated by Dr D.R.Rai, and Dr S. Chopra, Program included processing and value addition of groundnut and soybean, concept of agro processing for rural production catchments, food packaging for rural catchments, meat processing technologies, processing and value addition of beetroot and carrot, low cost storage of fruits and vegetables and processing of rice and by-product utilization etc.

h) One day workshop on safety and quality for sweet manufacturers was organized at CIPHET, Ludhiana on October 11, 2010. CIPHET has taken a unique initiative to educate and support sweet manufactures in producing hygienic products to benefit consumers eventually.

i) A NAIP sponsored training programme on 'Processing & value addition of ginger' was organized from Nov 30 to Dec. 8, 2010 for the research personnel from Orissa. The training was coordinated by Dr. D. Dhingra and Dr. I. Karki.

j) Eleven day long training programme on Agro-Processing Equipment Design for research engineers and PIs of AICRP on PHT. It was jointly coordinated by TOT and AICRP on PHT from Dec. 27, 2010 to January 7, 2011.

k) Seven-day training programme on 'Post Harvest Technology for Rural Catchments' was organized from December 18 to 23, 2010 for participants from Kaimur, Bihar, coordinated by Dr. D. R. Rai and Dr. S. Chopra. It was attended by 20 participants.

l) Aiming to develop entrepreneurship among farmers, CIPHET, Ludhiana initiated a 7-days soybean training program on February 2-8, 2011. Seven farmers participated in the training program sponsored by the Agricultural Technology Management Agency (ATMA). Dr. D. Dhingra and Dr. I. Karki coordinated the training programme.

m) A seven-day training programme on “Post Harvest Technology on Rural Catchments” for participants from SIRD Assam (Khanapara) was inaugurated on February 9 -15, 2011 at CIPHET. A total of 15 farmers participated in the training program. Dr. S. Chopra and Dr. D.R.Rai coordinated the training programme.

Participation in Exhibitions

1. CIPHET participated in Agri Expo-Haritkranti-2010 held at Baramati, Maharashtra on Nov. 1-4, 2010. The event was inaugurated by the Minister of Agriculture, Government of India, Sh. Sharad Pawar. Sh. Ajeet Pawar, Deputy Chief Minister, Maharashtra was also present on this occasion. Farmers were found to be concentrating on processing and value addition to their produce to get more income. There was great interest among farmers to know about the institute and technologies. CIPHET on the occasion displayed mechanically operated Pomegranate Aril Extractor and hand held Extractor.

Hon'ble Shri Ajeet Pawar Deputy Chief Minister, Maharashtra visiting CIPHET stall

2. CIPHET participated in CII AGRO-TECH 2010 exhibition held at Chandigarh during Dec. 2-6, 2010. CIPHET Technologies like rotary maize sheller and banana comb cutter attracted heavy rush of visitors to the stall.

3. CIPHET participated in India International Crop Summit 2011 on 'Global Outlook on Crop Production & Protection' held in Bhubaneswar during Jan. 10-11, 2011. The summit was organized by Indian Chamber of Commerce, Kolkata and jointly sponsored by Ministry of Agriculture, GOI, National mission on micro-irrigation and ICAR. Dr. Dilip Jain participated as an eminent speaker from CIPHET and presented a talk on 'Scope and Opportunities in Postharvest Sector Appropriate to Indian Socio-Economic Condition'.

4. CIPHET Participated in 4th progressive farmer's meet 2011 held on Feb. 18, 2011 at CII, Chandigarh. Dr. Indu Karki explained the technologies to the audience. The participants took keen interest in them. Success stories of the farmers were discussed in the meet and their problems were also addressed.

5. CIPHET participated in "Agrovision 2011" workshop, National Expo. and Conference held at Nagpur Maharashtra from March 4 – 7, 2011. CIPHET stall attracted huge crowd which was interested in Institute developed technologies. Dr. Nilesh Gaikwad made presentation on the topic "Post harvest management and value addition" in workshop session on the 'Pre and Post Harvest Technologies'.

6. On March 9, 2011, CIPHET displayed its technologies including Evaporative Cooled Room, Cocoa based jaggery products, Pomegranate Aril Extractor, Banana Comb Cutter etc. at the National Exhibition on Plant Machinery for Horticulture Crops at PAU campus. Large number of inquiries for the training programmes to be conducted by the institute were generated. Farmers and entrepreneurs were inclined towards food processing sector and looking at possible alternatives for increasing their stagnant income.

7. National Exhibition of plant and Machinery was organized by National Horticultural board at PAU, Campus, Ludhiana, from March 10-12, 2011. CIPHET participated in the exhibition and displayed the technologies to visiting famers from all corners of the country who came to attend the exhibition with the financial support of NHB.

8. CIPHET participated in the PAU Kisan Mela on March 18, 2011. Mr. O.P Moondan, Technical Officer with CIPHET informed farmers about various training programmes organized at the CIPHET. Farmers of Punjab showed keen interest in maize cob sheller. The technologies including maize cob Sheller and Evaporative Cooled room attracted a heavy crowd to CIPHET stall.

9. CIPHET exhibited technologies during National Seminar on 'Pomegranate Plant Nutrition, Protection & Post harvest management' held at Sangola Dist. Solapur (MS) on April 9-11, 2010. The event was organized by Maharashtra Pomegranate Growers Research Association, Pune. Dr. Nilesh Gaikwad Scientist TOT and Mr. Kishor Navale of Padmatech Engineering, who is a licensed manufacturer of CIPHET developed pomegranate aril extractor also attended the national seminar. They demonstrated the CIPHET pomegranate aril extractor to the pomegranate growing farmers. The CIPHET pomegranate aril extractor drew huge attention from the pomegranate farmers. The Director of the Pomegranate Growers Association applauded the machine and efforts of the CIPHET.

Programmes organized

National Bank for Agriculture and Rural Development (NABARD) sponsored one-day workshop on 'Investment opportunities for farm and non-farm sector' was conducted at the CIPHET Campus, Ludhiana. The objective was to create awareness about various schemes initiated by NABARD for increasing self- employment in farm and non-farm sectors and getting feedback for ongoing schemes of NABARD. Representatives from NGOs, banks officials and chartered accountants took part in the workshop.

Eight progressive farmers sponsored by Krishi Vigyan Kendra (KVK) Hoshiarpur visited CIPHET to get first hand information about activities and process/product development initiated by the institute in area of food processing. The visit was a part of training course on 'Processing of Agricultural Produce at Rural level' organized by College of Agricultural Engineering and Technology of Punjab Agricultural University. During the visit, the farmers were taken to different facilities of the institute and were made aware about recent achievements and novel technologies developed by the institute. Dr. Dilip Jain coordinated the visit of farmers and informed them about mandate of institute in the development of post harvest technologies. A film on CIPHET was also screened for the farmers.

Recording of Programmes on All India Radio

Two programmes on harvesting, handling, storage and packaging of fruits and vegetables were recorded by All India Radio, in the local dialect (Punjabi) by Dr. D.R. Rai and Dr. Sangeeta Chopra. The scientists explained the utilization of evaporatively cooled room/ structures, proper harvest and handling techniques as well as way to extend the shelf-life of fruits and vegetables through modified atmosphere packaging. The programmes were aired on Oct 28, 2010 and Nov 8, 2010 respectively.

Documentary film on post-harvest technologies of CIPHET

A Documentary film on various post harvest technologies developed by CIPHET was prepared in Hindi & English. It was coordinated by TOT division.

AICRP
on
Post Harvest Technology

RESEARCH ACHIEVEMENTS

Development of mini pilot plant for production of tender wheat shoot powder (Akola centre)

Using the green part of tender wheat shoot in its juice or chopped form as dietary supplements is an age old practice in some parts of India as well as temperate region of Europe and USA. A multi tier rack growing system for tender wheat shoot cultivation and also a pilot plant for production of tender wheat shoot powder have been developed at Akola (PDKV) centre under AICRP on PHT to facilitate its availability round the year. The present pilot plant setup (Fig. 84), having 1 kg powder per day capacity, consists of a grinder and a cyclone separator. The unit is operated with 1.5 kW electric

Fig. 84. Pilot plant for tender wheat shoot powder

load. It is estimated that this plant can result a profit of about Rs.1000/- per day and will be a successful, rural based, women-managed cottage level unit. The tender wheat shoot powder (Fig. 85) contains 38.13 % protein, 0.83 % fat, 35.6 % carbohydrates and 16.3 % fibre on the basis of dry matter and is rich with vitamins A, B_1, B_2, B_3, B_5, B_6, B_7, B_9, C, E and K.

Fig. 85. Tender wheat shoot powder

Development of small capacity animal feed plant using dal mill waste (Akola centre)

Byproducts (brokens + powder + husk) of mini dal mill which constitutes about 25 to 28 % of the raw material and contains nearly 18-20% of proteins, is coarse ground, conditioned with water and thoroughly mixed. Subsequently for preparing briquettes from the above material, a small capacity (100kg/day) machine has been developed.

Dehuller for barnyard millet (Almora centre)

A 5 hp electric motor driven dehuller of 45-50 kg/h capacity was developed. The machine and process parameters of this dehuller were optimized using CCRD and RSM for maximizing efficiency and minimizing specific energy consumption and broken grains. The dehulling efficiency of 88.3±2.8% having specific energy consumption of 0.078± kWh kg–1 grain and broken grain to the extent of 6.1±1.1% were obtained with the optimized machine parameters (9 canvas strips and 3 mm over hanging width) and operational parameters (8.6 m/s peripheral speed; 5 passes and 8.4% db moisture content).

After applying pretreatment (i.e. 9 min steaming and 31 g/q mustard oil treatment), the actual dehulling

efficiency, specific energy consumption and broken grain were 76.3±3.6%, 0.018±0.004 kW h kg–1 and 7.3±1.5%, respectively in single pass of dehulling.

Development of pedal operated, low cost, light weight winnower-cleaner-grader for millets (Almora centre)

A manually operated winnower-cleaner-grader (Fig. 86) has been developed at Almora (VPKAS) centre under AICRP on PHT. The machine was fabricated using locally available materials. The machine weighs 60 kg and has overall dimension 1450x1450x1210 mm with an estimated cost of Rs 6000. The winnowing/ cleaning/ grading capacity of the machine is 250-300 kg/h. In addition to millets, this multipurpose machine is also suitable for winnowing, cleaning and grading of wheat, paddy, lentil and soybean.

Fig. 86. Pedal operated winnower-cleaner-grader

Utilization of spent charge from distillation of patchouli oil in manufacture of agarbatti (Bangalore centre)

Patchouli spent charge, the by-product (waste) obtained after extracting essential oil from patchouli herbage was sun dried and ground to 20-40 mesh powder using a shredder and a grinder. This powder can substitute up to 10% of wood powder normally used at about 15% level in the manufacture of agarbatti base sticks (Fig. 87) which are subsequently dipped in fragrance solutions to get commercial agarbattis. The 'spent charge' powder also contains about 0.1-0.5% aromatic essential oil, hence the agarbattis can have added patchouli smell. In such cases where patchouli oil is used in the agarbatti dip (fragrance) solution, , the costly oil usage is reduced by using these agarbatti base sticks prepared using the 'spent charge' powder.

Tubular aeration system for improved on- farm storage of potato (Bangalore centre)

This system consists of a horizontal perforated duct with vertical tubular risers (Fig. 87). The main duct is made up of 100 mm dia PVC pipe with 13 mm dia perforations at a pitch distance of 50 mm along

Fig. 87. Tubular aeration system for on-farm storage of potato

the axial direction. The length of the pipe will be equal to length of the potato heap. The hole-to-hole distance in the lateral direction (along the circumference) is also 50 mm. There are air vents (risers) at a distance of 1 m between them. The vents are 60 mm in dia and 1.2 m long PVC pipes whose bottom ends are connected to the main horizontal aeration duct and the top ends emerge out of the potato heap to the atmosphere. The vents basically help the warm air collected inside the main duct to go up to the atmosphere due to natural convection. The main duct is placed horizontally along the length of potato heap at the centre, 0.30 m above the bottom surface and the ends of the duct protrude slightly outside the heap by about 50 mm. A gentle slope of about 2^{o} to the horizontal is kept for the duct so that moisture, that may condense shall run down the slope of the duct and go out of the potato heap. The entire aeration system is placed inside the traditional potato heap or pit as explained earlier to reduce tuber losses during storage.

Development of a Peeler-Corer-Slicer for Pineapple Processing (Bhubaneshwar centre)

A hand-operated peeler-cum-corer-cum-slicer for pineapple (Fig. 88) has been developed and evaluated at Bhubaneswar (OUAT) centre. A slicing plate was attached in a spiral form to the SS central shaft. Once the slicer is penetrated into the whole fruit (cut from both ends), it cuts open the internal core and external peel at the same time. The pulp slab is separated and sliced with the device. By using this device, which costs only Rs 500, up to 20 no. of pineapple fruits can be easily peeled and sliced by a skilled worker in one hour. Traditional processing using a knife could accomplish these operations for 4 to 5 pineapple fruits per hour while the SS punch and corer developed earlier could yield 10 to 12 pine apple fruits per hour. The annular ring shaped pineapple slices produced by this device can be easily further processed through canning or osmotic dehydration.

Fig. 88. Hand operated peeler-corer-slicer-slicer for pineapple

Mechanized honey filtration unit (Ludhiana centre)

A fully mechanized honey filtration unit with separate heating and filtration arrangements with two separate sensors for sensing and controlling the temperature of heating water and honey in the main chamber was developed. The performance of the unit was evaluated at different process conditions (25 kg capacity at 60°C temperature with 20 min. holding time; 50 kg capacity at 50°C temperature with 40 min. holding time). The optimum capacity was 50 kg of raw honey with total time (heating & filtration) requirement of 99 minutes and 148 minutes, respectively. The honey processed through new modified honey unit was compared with raw honey as well as commercially processed honey for its microbiological and biochemical quality attributes viz., reducing sugars, moisture content, acidity (formic acid%), pH and total soluble sugars. It was observed that the process of filtering reduces or eliminates microbes. No significant difference in biochemical quality attributes was found in commercially processed honey and honey processed through modified honey unit.

Wine from Mahua flowers (Udaipur centre)

Fermentation study was conducted in 250 ml Erlenmeyer flasks on different conditions of pH (4, 4.5 &5), temperature (25 & 30 ^{o}C) and duration (7, 14 & 21 days). Higher ethanol was obtained at 30 ^{o}C temperature with pH 4.5 and 7 days period of fermentation but it was not selected due to presence of higher titrable and volatile acidity. Scale up of Mahua flower juice fermentation was conducted under optimized condition (25 ^{o}C, 4.5 pH and 7 days) in batch type fermentor (3.5 litre capacity) resulted into alcoholic beverage with 9.82% ethanol which may used as a wine after proper aging and clarification.

Continuous grain pearler-cum-polisher (Udaipur centre)

A machine has been developed for multiple uses viz. dhal milling, grain pearling/ polishing and deawning of coriander. The machine consists of an abrasive tapered roller, an aspirator, separation sieve box, mixer/conveyor, oil/water tank and 1.5 kW single phase motor. The machine costs Rs 40,000/= (inclusive motor) with capacity of 75 kg/hr. The cost of operation is Rs 100/q for dhal milling, and Rs 70/q for deawning and pearling/polishing. Maximum efficiency for pigeon pea milling as 76%, maize pearling as 91-93%, wheat pearling as 93-96% and

coriander deawning as 82% could be obtained at different rotor speed viz. 864, 600, 900 and 200 rpm respectively. The unit can be utilized for imparting oil/water pretreatment.

Jaggery and Khandsari (Lucknow centre)

A mechanical filtration unit for filtration of sugarcane juice was developed, tested and evaluated. The unit consists of a pre-filter and four filters in series. Each filter was made of plastic cartridge and inside the cartridge, synthetic candle (70 mm dia and 260 mm long) were kept. A pump of 800 l/h (operated with 12 watt power supply) was used for pumping the juice. The filtration efficiency and capacity were found as 80.00 % and 800 l/h respectively.

Boiling juice churning device has been developed to use for mixing of the hot juice during the boiling operation. It is operated manually, when juice boils in the open pan, at the speed of 11-15 rpm. Rotors lift the juice from the boiling pan and pour it back to the boiling pan during their rotary motion.

A compact, mini cane crusher has been developed for household use, driven by 0.25 hp motor through sprocket chain transmission system. The crushing unit consisting of three horizontal crushing rollers (king, feed, and extraction), in counter-rotating fashion, a guide, power transmission system, sugarcane entry and bagasse exit port and framing plate in rectangular shape and an electric motor has been developed. Testing of the unit is in progress.

Soy protein isolate incorporated buffalo meat sausage (Aligarh Centre)

Soy protein isolate could be incorporated up to 10% in buffalo meat product, viz. low fat emulsion sausage (prepared with 30% edible offals, up to 5% starch, alginate and pectin 2%). It was found that when fat mimicking substances (starch) was incorporated in the lean meat at the levels of 1 to 5%, it improved texture and reduced the fat level in the meat products. Aluminum coated laminated film was found better packaging material. Based on study of physico-chemical, microbiological and sensory parameters of sausage, the product was under safe limit up to 25 days of storage at 0^{o}C temperature.

Utilization of buffalo bile for manufacturing of bile concentrate (Mumbai centre)

Buffalo slaughter house byproduct such as bile was collected day to day basis immediately after slaughter of buffalo. About of 350-600 ml of bile from each animal was collected in a clean, dry plastic can and stored at chilling temp (4±1°C). Bile concentrate (Fig. 89) was prepared from this using two methods: (1) Open fire drying (3 to 4 h) and (2) Hot air oven drying (10h). Yield of bile concentrate from by hot air oven drying was more (i.e. 71 g/l) than by open fire drying method (i.e. 61.87 g/l).

Fig. 89. Bile concentrate

Development of Fish Deboner (Raichur centre)

A fish deboner (Belt and drum type) (Fig. 90) has been developed at Raichur (UAS) centre under AICRP on PHT. to separate the meat and bone from the under-utilized fishes. The mechanism involves feeding of washed and dressed fish between a counter rotating belt and a perforated drum. The meat squeezed through the holes is collected inside the drum while bones and skin are retained on the outside of the drum and ejected out. The machine is

Fig. 90. Fish deboner

operated by a single phase 1 hp motor and has capacity of 45-65 kg/h. The production cost of fish deboner is Rs. 60,000/- and cost of operation of this machine is about Rs 48 per hour (for the processor) or Rs 1.50 per kg (for the customer). The payback period for the machine is estimated at 1.08 years (13 months) with a benefit-cost ratio of 1.48.

The fish deboning machine rapidly removes the bones to recover meat from fillet trimming which will facilitate development and preparation of a range of value added products from low value fish.

Assessmens of Post-Harvest Losses

The results of the study were presented to the Parliamentary Standing Committee on Agriculture (PSCA) on 10-06-2010. Final Report titled "Estimation of Harvest and Post-Harvest Losses of Major Crops and Livestock Produce in India" was submitted, in Hindi and in English, to the PSCA in September 2010.

Central Sector Scheme

Demonstrations : Altogether 364 no. demonstrations in respect of 56 technologies of AICRP on PHT to 10346 farmers.

Trainings : 39 no. of trainings were conducted by the centres on the technologies developed under AICRP on PHT for 675 farmers/ entrepreneurs.

Agro Processing Centres

Agro Processing Centres already established were monitored successfully in different states of India by AICRP on PHT centres, viz, Akola (Maharashtra), Almora (Uttarakhand), Bangalore (Karnataka), Bapatla (Andhra Pradesh), Bhubaneswar (Orissa), Coimbatore (Tamil Nadu), Jabalpur (Madhya Pradesh), Jorhat (Assam), Junagadh (Gujrat), Kasargod (Kerala), Kharagpur (West Bengal), Ludhiana (Punjab), Pantnagar (Uttarakhand), Pusa (Bihar), Solan (Himachal Pradesh), Tavanur (Kerala) and Udaipur (Rajasthan). These APC have been quite effective in post harvest loss reduction, value addition income augmentation as well as employment generation in rural areas.

Impact assessment of technologies developed under AICRP on PHT

Anil K. Dixit

The impact of APCs established by AICRP on PHT have been realized from two perspectives i.e. i)

Following new APCs were established during the reported period:

1.	JABALPUR	:	Agro Processing Centre Mahalakshmi Associates Katni Road, Suhagi,Jabalpur (MP)
2.	JORHAT	:	Bihaguri Seuji Krishok Sammittee Pithakhowa, Bihaguri Dist: Sonitpur (Assam) Pin:784153
3.	LUDHIANA	:	Agro Processing Centre Abnashi Singh, Nirmal Singh And Karamjit Singh V&PO Mehaduda Distt. Samrala (Punjab)
4.	LUDHIANA	:	Agro Processing Centre Gurlalal Singh Sarpanch V&PO Kohe Distt. Faridkot (Punjab)
5.	RAICHUR	:	Vaishnav Mata Sharada Rice Mill Village : Tumukur Taluka: Yadagir District : Yadagir (Karnataka)
6.	TAVANUR	:	Model Agro Processing Centre Kelappaji College of Agril Engg & Technology, Tavanur–679573 (Kerala)

economic (improved financial and physical capital accumulation, leverage effect resultant from market integration), and ii) social (employment generation, proper allocation of family labour, positive health impact on dairy animals, improving crop productivity through backward integration and women empowerment).

The economic benefits to an entrepreneur from a PKV Mini Dal Mill (Akola centre) are estimated to the tune of Rs. 3.45 lakh per annum, besides generating employment of about 480 mandays. The consumers are more benefited than the entrepreneur, as a result of improved recovery, because most of the milling in unorganized sector is done on custom hiring basis. Likewise, insect trap is rated as star technology as far as adoption and PH loss reduction in eco friendly manner during storage is concerned. The technology on extraction of apricot kernel oil was found superior over conventional practices on account of higher recovery of 11 percent and reduction in cost by 22.41 percent, besides reduction in women drudgery. The results obtained from economic surplus model, i.e., NPV (486), IRR (44%) and benefits-cost ratio (21.83) have been found quite attractive.

AICRP
on
Application of Plastics in Agriculture

RESEARCH ACHIEVEMENTS

The All India Coordinated Research Project on Application of Plastic in Agriculture is operating at eleven centers with its coordinating unit located at CIPHET, Ludhiana. The salient achievements are given below.

- Plastic packaging of freshwater fish and its product was investigated for PE, PP and laminated PP packaging materials by CIFA, Bhubaneswar center. A gel containing the protein has been prepared from Catla and Rohu for use as preservative in fish packaging experiments. The gel was treated separately with several probiotic cultures of Lactobacilli, Nisin and spices. Rohu and catla fish chunks treated with spice mix Nisine and pro-biotic cultures like *Lcasei*, P. *pentosaseus*, *L. bulgaricus* and *S. thermophilius,* shown keeping quality of the fish patties up to 12 days at chilling (5±2°C) and up to one months in freezing (-20 ±2 °C). Fish flesh mixed with 20% fish gel of same species produced even better keeping quality *i.e.,* 15 days under chilling and 2 months under freezing. Modified Atmosphere Packaging (MAP) for rohu and catla fish patties made by incorporating 20% rohu and catla gel, incorporating Spice mix, *Lactobacillus Casei,* Nisin as biopreservatives, enhanced the keeping quality upto 24 hours at ambient storage, 15 days at chilling and 3 months under frozen storage. Maximum microbial load was controlled upto 10^3 log microbial load.
- Fillets, chunks and nuggets are being packed in Styrofoam tray and wrapped by LDPE, polypropylene and laminated pouches studied by CIFA, Bhubaneswar center. Laminated pouch has been found most suitable for packing of fish cut-up parts. Transparent polypropylene boxes with cover were studied as a packaging material for retail marketing of fresh fish products. The chilled products maintained the quality, color, odor and presentation for seven days in these packs.
- Junagadh center studied transportation losses for tomato. It has been transporting from Junagadh to Jamnagar and return (approx 300 km) in different containers, viz. gunny bag (GN), gunny bag lined with bubble sheet (GBS), Foldable plastic box with cells (FPBC) (Fig. 91), Polypropylene bag(PPB), Egg tray in CFB cartoon (ETB), plastic crate (PC) and CFB cartoon (CFB) and arranged in four layer in goods rickshaw. Results indicated that total losses of the tomato was less in FPBC (2.55%) and higher in PP and GN (18-19%).

Fig. 91. Tomato packaging in FPBC

- Junagadh center studied the shelf life of sapota. It was observed to be 49 days when stored at 6 ºC temperature followed by 35 days at 11 °C in 25 µ LDPE bags with 5 % O_2+10 % CO_2 gas concentration without change in physical, biochemical and sensory characteristics. Total cost of packaging of sapota per ton was estimated Rs. 4250 and net profit generated by selling modified packed fruit was worked out Rs.

8750 per ton. Foldable plastic box (Fig. 92) was designed and developed for 390×325×245mm size and thickness 3.5 mm for safe transportation of sapota. It was made from poly propylene sheet (650 g/m^2). The size of cell was kept 60×60×55 mm and total four layers each with 30 cells were provided in the box.

Fig. 92. Sapota Packaging in FPBC at JAU, Junagadh

- Junagadh center has modified and converted the existing net house at the nursery in to screen house (SH) to get sufficient light intensity in the structure so as to increase metabolic activities of the plants. Seedlings of capsicum raised in the pots were transplanted into the SH. The observations revealed that temp., Rh and light intensity were found in the range of 18.3 – 28.3°C, 45 – 60% and 10 – 408 (100 lux) respectively. Plant height, number of leaves and number of branches were recorded 48, 78 and 24 respectively. A yield of 43.7 t/ha and 23.6 t/ha, respectively. The annual cost for polyhouse was worked out Rs. 38,49,712/ ha and that of nethouse Rs. 13,32,758/ha. The returns were Rs. 26,20,680/ha and Rs. 1413780/ha, respectively for the two environments. The cultivation of capsicum was found profitable in nethouse, while it was not economically viable in polyhouse.
- A study was conducted to enhance the grafting success in walnut plantation material inside the polyhouse by Srinagar center. The grafting success of walnut inside polyhouse was 68% while in open field it was 32%. The grafter material is high in demand as it starts giving fruits within 3-4 years while normal plants take 10-12 years to bear fruits.
- During winter months when no vegetation is possible in outside conditions in Kashmir valley due to low temeperatures and snowfall, the climatic conditions inside the polyhouse (Fig. 93) was studied in Srinagar center. In January, extreme winter conditions outside (-3 to +4 °C), the favourable temperature zone (25 °C -30 °C) for crops occurred inside the polyhouse during 12 pm to 2 pm and thereafter temperature reduces sharply in the range of 8 – 10 °C. The

Fig. 93. Off-season vegetable production in the polyhouse at SKUAST-K, Srinagar

shade net covering at a height of 2 m from the ground inside the polyhouse during evening 4 pm to next day morning 10 am in the last week of February month showed a slight increase in the temperature from 2-5 °C in reference to the lowest temperature attained outside (2°C) during 4 am – 6 am. The heat trapped inside the polyhouse was conserved. After the first week of March, with the outside rise in ambient temperature from 12-18 °C, the rise in daytime temperature increase upto 25-28 °C was observed inside the polyhouse, showing it in the favourable crop temperature zone. The green leafy vegetables viz. fenugreek, table radish, kale and palak were successfully sown and nursery of tomato and capsicum in the second half of January month inside the polyhouse. Intercultural operations were continued in

different timings in these beds.

- The agro-techniques for cut flower production of gerbera in low cost polyhouse was standardized for Meghalaya region based on the two year study by Barapani center. The most appropriate growing media identified was Soil + FYM + Sand + Cocopeat followed by Soil + FYM + Perlite + Vermiculite + Cocopeat. Flowers are obtained for the 2 and half years which can be extended for one more year. Micro climate in polyhouse was very congenial (air temperature 22 to 24 ºC and RH 70–80% at 2 pm. The B C ratio for gerbera cultivation in the low cost poly house was found to be 4.5:1.
- Barapani center has studied the hydraulic evaluation of gravity fed drip irrigation in hilly terraces of Meghalaya shown that the system can be operated in the strawberry plantation with a minimum of 2.5 m head is required for obtaining the uniformity coefficient of 0.80 when 70 drippers (in three lines with 22, 24 and 24 drippers in each line) were in operation. The head was taken as elevation difference between water level in the overhead tank and farthest dripper. The average discharge at drippers was found as 1.8 lph.
- Ranchi center has developed a low cost detachable roof polyhouse. The developed structure (except roof) was covered with insect net proof material (40 mesh) but the roof was covered with UV stabilized film (200 micron) with the provision for quick removal and replacement, so the developed structure will act as polyhouse (November-February), rain shelter (June-october) and shade net (March-May). It will provide opportunity to intensive cropping round the even by making overcoming climatic adversaries with a particular covering during different periods.
- Udaipur center constructed the plastics based animal housing, an animal house of 4.2 x 6.0 m floor and 3 m height has been fabricated. Ramp around the plastic based animal housing is prepared. Selection of calves for experimentation is finalized. Multichannel Data Logger is installed for accurate climate data monitoring.
- PAU, Ludhiana center studied the evaluation of low tunnel for capsicum cultivation in Punjab revealed that the mean capsicum yield in 75 cm tunnel height was highest followed by 90 cm and 60 cm tunnel height treatments which may be due to higher air and soil temperature in 75 cm tunnel height. The treatments of 75 cm tunnel height gave an increase of 7.45% yield over 60 cm tunnel height and an increase of 3.90% yield over 90 cm tunnel height. Best drip irrigated treatment (i.e. drip irrigation, IW/CPE= 0.75) gave an increase of 24.11% over the furrow irrigated paired row planting and an increase of 28.6% over furrow irrigated single row planting.
- VPKAS, Almora center studied the use of plastic in the development and fabrication of pedal operated-winnower cum cleaner-grader (Fig. 94), insect trap and small hand tools. Small hand tools with plastic coated grip have become popular in the Uttarakhand. A total of 59 nos. of hand fork, 6 hand hoe, 33 kutla, 2 line maker, 6 garden rake, and 7 khurpi has already been sold to farmers from the outlet of VPKAS, Almora. The fans of winnower cum cleaner-grader were fabricated using FRP. It resulted into reduction not only in weight but in mechanical vibrations as well in a comparison to fans of MS sheet of the same size and shape.

Fig. 94. Winnower cleaning cum grading

LIST OF ON-GOING RESEARCH PROJECTS

INHOUSE & COLLAOBRATIVE PROJECTS

Sr. No.	Project Name	Name of Project Leader & Associates
1.	Studies on processing of guar (Cyamopsis tetragonoloba) for production of guar gum.	Er. R.K. Vishwakarma (PI) Dr. S.K. Nanda (Co-PI) Dr. U.S. Shivhare (Co-PI)
2.	Production of Potato flour and starch and its use for product diversification and value addition.	Dr. Sanjeev Kumar Tyagi (PI) Dr. Mridula Devi (Co-PI) Dr. Devinder Dhingra (Co-PI) Dr. Rajbir Singh (Co-PI)
3.	Evaluation of screw press mechanism for oil expelling as effect of process parameters for high value crops.	Dr. Dilip Jain (PI) Dr. S. Balasubramanian (Co-PI) Er. R. K. Vishwakarma (Co-PI)
4.	Post harvest management and value addition in coriander and cumin seed spices.	Dr. V.K. Bhargav (PI) Dr. R.K. Vishwakarma (Co-PI) Dr.S.K. Malhotra, Scientist from NRCSS
5.	Design, development and evaluation of composite dhall mill	Dr. R.K. Goyal (PI upto 02/2009) Er. R.K. Vishwakarma (Co-PI upto August 2009) Dr. Mridula Devi (Co-PI) Dr. D.M. Kadam PI w.e.f August 2009,
6.	Development of cooling systems for comfort and enhanced production of dairy cattle.	Dr. Sangeeta Chopra (PI) Dr. Puneet Malhotra (Co-PI from GADVASU) Dr. S.N. Jha (Co-PI) Dr. M.L. Mehra (Co-PI from GADVASU)
7.	Effect of cooling systems on thermal comfort and production of poultry birds.	Dr. Sangeeta Chopra (PI) Dr. S.S. Nagra (Co-PI) Dr. D.R. Rai (Co-PI) Dr. Daljeet Kaur (Co-PI)
8.	Development of bio-coatings and improved packaging techniques for enhancing the self life of mango and guava.	Dr. Ramesh Kumar (PI) Dr. A.K. Thakur (Co-PI) Dr. R.K. Gupta (Co-PI)

Sr. No.	Project Name	Name of Project Leader & Associates
9.	Shelf –life extension of meat and meat products through innovative packaging interventions.	Dr. Deepak Raj Rai (PI) Dr. S.K. Devatkal (Co-PI) Dr. Pranita Jaiswal (Co –PI) Dr. S.K. Devatkal
10.	Packaging and allied applications for bioactive compounds, antioxidants and microbiological safety of fresh and fresh cut fruits and vegetables.	Dr. Manjunatha M (PI) Dr. D.R. Rai (Co-PI) Dr. P. Jaiswal (Co-PI)
11.	Shelf life extension of meat and meat products using natural extract and vacuum packaging as hurdles.	Dr. Suresh K. Devatkal (PI) Dr. K. Narsaiah (Co –PI) Dr. D.R. Rai (Co-PI)
12.	Development of microorganisms based ripening/anti-ripening agent for mango and banana.	Dr. P. Jaiswal (PI) Dr. S.N.Jha (Co-PI)
13.	Studies on earth tube heat exchanger (ETHE) to enhance the efficiency of Evaporative cooled room	Er. S K Aleksha Kudos (PI) Dr. Dilip Jain
14.	Development of process and technology for dry degerming of maize at small scale.	Dr. P.Barnwal (PI) Dr. D. M. Kadam (Co-PI)
15.	Development of a technology for home production of cereal-soy tempeh.	Dr. S.N. Bhowmik (PI) Dr. D.N.Yadav (Co-PI) Dr. S. Balasubamanian (Co-PI)
16.	Development of dairy analogues from peanut kernel and utilization of deoiled cake for food purposes.	Dr. Deep Narayan Yadav (PI) Dr. S.N. Bhowmik (Co-PI)
17.	Studies on post harvest treatments and storage behavior of pear fruits.	Dr. Goutam Mandal (PI) Dr. Jitender Singh (Co-PI) Dr. R.K. Gupta (Co-PI)
18.	Development of Litchi peeler cum destoner.	Er. R.K. Vishwakarma (PI)
19.	Impact assessment of entrepreneurship development programme (EDP) conducted by CIPHET	Dr. Sangeeta Chopra (PI) Dr. A K Dixit (Co-PI) Dr. Indu Karki (Co-PI)
20.	Impact assessment of technologies developed under AICRP on PHT	Dr. S.K.Nanda (PI) Dr. Anil Kumar Dixit (Co-PI) Dr. S.K. Aleksha Kudos
21.	Development of partial dewatering process for onion for value addition and safe storage.	Er. Manpreet Kaur Grewal (PI) Dr. S.N. Jha (Co-PI)

Sr. No.	Project Name	Name of Project Leader & Associates
22.	Design construction and evaluation of bulk storage structure for food grains.	Dr. Devinder Dhingra (PI) Dr. D.R. Rai (Co-PI) Dr. Manjunatha M (Co-PI)
23.	Rapid identification and detection of microbes in poultry meat using IR spectroscopy and chemometrics.	Er. Manpreet Kaur Grewal (PI) Dr. P. Jaiswal (Co-PI)
24.	Development of novel value added meat products (Pastries & spreads) with or without use of non meat ingredients.	Dr. Yogesh Kumar (PI) Dr. Tanbir Ahmad (Co-PI) Er. Manpreet Kaur Grewal (Co-PI)
25.	Development of nutritive functional flour & food products.	Dr. Mridula D. (PI) Dr. M.R. Manikantan (Co-PI) Dr. P. Barnwal (Co-PI) Dr. Anita Kochar (Co-PI from PAU) Ms. Monika Sharma (Co-PI)
26.	Characterization, fortification, cooking and quality evaluation of soft rice.	Dr. Mridula D. (PI) Ms. Deepika Goswami (Co-PI) Dr. N. Shobha Rani (Co-PI) from DRR, Hyderabad) Dr. Suneetha Kota (Co-PI) from DRR, Hyderabad)
27.	Development of enzyme assisted technology for effective dehulling of pigeonpea via agriculturally important microorganisms.	Dr. S.N. Bhowmik (PI) Dr. M.R. Manikantan (Co-PI) Ms. Deepika Goswami (Co-PI)
28.	Development of pilot level process and technology for the production of protein rich flour from deoiled sesame and sunflower seeds.	Dr. M.R. Manikantan (PI) Dr. D. N. Yadav (Co-PI)
29.	High pressure processing of primary products of fruits for preservation and value addition.	Er. R.K. Vishwakarma (PI) Er. V.Eyarkai Nambi (Co-PI) Dr. R.K. Gupta (Co-PI)
30.	Enhancing the shelf life of fruit juices by non -thermal preservation techniques.	Er. V.Eyarkai Nambi (PI) Er. R.K. Viswakarma (Co-PI) Dr. R.K. Gupta (Co-PI)
31.	Development and execution of a post-harvest training module for women jail inmates.	Dr. Sangeeta Chopra (PI) Dr. Tanbir Ahmad (Co-PI) Dr. Deepak Raj Rai (Co-PI)
32.	Outreach and inhouse studies on power factor correction systems for agro processing equipments.	Dr. Sangeeta Chopra (PI) Dr. D. Dhingra (Co-PI)

Sr. No.	Project Name	Name of Project Leader & Associates
33.	Refinement and evaluation of fish descaling machine and entrepreneurship development.	Dr. Gaikwad Nilesh Nivrutti (PI) Dr. Tanbir Ahmad (Co-PI) Dr. Ajeet Singh (CO-PI) from GADVASU
34.	Structured outreach training modules for rehabilitation of inmates of Central Jail, Ludhiana. Sub Project A: Acivity for men jail:Agro-processing training activities for men jail inmates. Sub Project B: Activity for women jail: Development and execution of a woman specific post-harvest training module.	Dr. Gaikwad Nilesh Nivrutti (PI) Dr. Sangeeta Chopra (PI) Dr. A.K. Dixit (Co-PI) Dr. Deepak Raj Rai (Co-PI)
35.	Standardization and entrepreneurship development on production and preservation of Chicken haleem.	Dr. Tanbir Ahmad (PI) Dr. Yogesh Kumar (Co-PI)
36.	Assessment of poultry, goat sheep and fish processing and its refinement and upgradation through technological intervention.	Dr. Tanbir Ahmad (PI) Dr. Gaikwad Nilesh Nivrutti (Co-PI) Dr. Yogesh Kumar (Co-PI)
37.	Standardization of process parameter for the production of leafy vegetables powder.	Dr. S.K. Aleksha Kudos (PI) Dr. D.M. Kadam (Co-PI)
38.	Evaluation of Insect net for Insect dynamics and microclimate inside net house for vegetable production in semi-arid region.	Dr. Jitendra Singh (PI) Dr. Ramesh Kumar (Co-PI) Er. D.D. Nangare (Co-PI)
39.	Optimization of shade net house design to create suitable climate for cultivation of vegetables and cut flowers in semi arid region.	Dr. D.D. Nangare (PI) Dr. Jitendra Singh (Co-PI) Dr. R.K. Gupta (Co-PI) Dr. Anil Kumar Dixit (Co-PI) Sh. V S Meena (Co-PI)

EXTERNALLY FUNDED PROJECTS

Sr. No.	Project Name	Name of Project Leader & Associates from CIPHET
1.	Optimization of parameters for utilization of paddy straw, kinnow pulp and pea pods for production of cellulases, ethanol and feed supplements.	Dr. H.S. Oberoi (CPI) Dr. V.K. Bhargav
2.	Design and development of foam mat dryer for selected liquid foods.	Dr. D.M. Kadam (PI) Dr. Balasubramanian (Co-PI) Dr. D.R. Rai (Co –PI) Dr. K. Narsaiah. (Co-PI) Ms. Monika Sharma
3.	Development of nondestructive systems for evaluation of microbial and physiochemical quality parameters of mango.	Dr. S.N. Jha (Consortium PI) Dr. K.Narsaiah (CCo-PI) Dr. Ramesh Kumar (CCo-PI)
4.	Value chain on potato and potato products	Dr. Devinder Dhingra, (CCPI)
5.	Development of process & equipments for value addition of small millets at rural level.	Dr. R.K. Gupta (PI) Er. R.K. Vishwakarma (Co-PI)
6.	Efficient expelling and extraction of oil from seeds and utilization of deoiled cake.	Dr. Mridula Devi (PI)
7.	Value chain on commercial exploitation of underutilized fruits of tribal zones of Rajasthan.	Dr. R.K.Gupta (PI) Dr. A.K. Thakur (Co-PI) Dr. Ramesh Kumar (Co-PI) Er. R.K. Vishwakarma (Co-PI) Er. V. Eyarki Nambi (Co-PI.)
8.	Technology for plant and dairy ingredients based formulated and functional foods using extrusion cooking.	Dr. Dilip Jain (PI) Dr. Mridula Devi (Co-PI)
9.	Novel biotechnological process for production of high value products from rice straw & baggasse.	Dr. R.T. Patil, Director, CIPHET, Dr. H.S. Oberoi (CPI) Dr. V.K. Bhargav (CCo –PI)
10.	Studies on cryogenic grinding for retention of flavour and medicinal properties of some important indian spices.	Dr. R.T. Patil Dr. S. Balasubramanian (CCPI) Dr. D.M.Kadam (Co-CPI) Dr. P. Barnwal, (Co-CPI)

Sr. No.	Project Name	Name of Project Leader & Associates from CIPHET
11.	Assessment of gender issues and identification and refinement of selected women specific technologies in horticultural crops.	Dr. R.K. Gupta (PI) Dr. Ramesh Kumar (Co-PI)
12.	A value chain on composite dairy foods with enhanced health attributes.	Dr. S. Balasubramanian Dr. D.N. Yadav
13.	Livelihood Improvement and Empowerment of Rural Poor through sustainable farming systems in North East India.	Dr. Devinder Dhingra (Consultant)
14.	Value chain on novelty pork products under organized pig farming system.	Dr. K. Narsaiah (CPI) Dr. S.K. Devatkal (CC –PI)
15.	Mobilizing Mass Media Support for Sharing Agro-information under the National Agricultural Innovation Project (NAIP)	Dr. D.R. Rai (PI) Dr. Jitender Singh (Co-PI) Dr.(Mrs.) Sangeeta Chopra (Co–PI)
16.	Development of technologies for pelletization, delignification and saccharification of cellulosic biomass such as rice straw, cotton stalk, sweetsorghum, switchgrass, Prosopis juliflora and Lantana camara.	Dr. H.S. Oberoi (PI) Dr. K. Narsaiah (Co PI) Dr. V.K. Bhargav Dr. R.T. Patil
17.	Developing commissioning, Operating and Managing an online examination system for NET/ARS-Prelims. Exam for ASRB, ICAR	Dr. R.T. Patil Dr. D. Dhingra
18.	Microencapsulation methods for bacteriocins for their controlled release.	Dr. K. Narsaiah Dr. S.N. Jha Dr. M.R. Manikantan

RESEARCH PAPERS PUBLISHED

Arumuganathan T, Manikantan M R, Indurani C, Rai D R, Kamal Shwet (2010) Texture and quality parameters of the oyster mushroom as influenced by the drying methods. *International Agrophysics*, 24, 339-342.

Babbar N, Oberoi H S, Uppal D S and Patil R T (2011) Total phenolic content and antioxidant capacity of extracts obtained from six important fruit residues. *Food Research International*. 44, 391-396.

Balasubramanian S, Borah A, Singh K K, Patil R T (2010) Effect of selected dehulled legume incorporation on functional and nutritional properties of protein enriched sorghum and wheat extrudates. *Journal of Food Science and Technology*. DOI: 10.1007/s13197-010-0209-8.

Balasubramanian S, Viswanathan R (2010) Influence of moisture content on physical properties of minor millets. *Journal of Food Science and Technology*. 2010. 47(3):279-284.

Balasubramanian S, Singh K K, Patil R T, Onkar K K (2010) Quality evaluation of millet-soy blended extrudates through linear programming. *Journal of Food Science and Technology*. DOI: 10.1007/s13197-011-0297-0.

Barnwal P, Tiwari G N (2010) Experimental Validation of Hybrid Photovoltaic-Thermal (PV/T) Greenhouse Dryer under Forced Mode. *International Journal of Food Engineering 6(6):* Article 17. DOI: 10.2202/1556-3758.1451.

Barnwal P., Singh K.K., D Mridula, Kumar R., Rehal J. (2010) Effect of moisture content and residence time on dehulling of flaxseed. *Journal of Food Science and Technology.* 47(6): 662-667.

Devatkal S K, Jaiswal P, Jha S N, Bharadwaj R, Viswas K N (2011) Antibacterial activity of aqueous extract of pomegranate peel against *Pseudomonas stutzeri* isolated from *poultry* meat. *Journal of Food Science and Technology*, DOI: 10.1007/s13197-011-0351-y.

Devatkal S K, Jaiswal P, Jha S N, Bharadwaj R, Viswas K N (2011) Gene bank accession number for sequence submitted to NCBI: BankIt1426014 seq1 HQ896768. *(Pseudomonas stutzeri)*.

Devatkal S K, Kadam D M, Naik P K, Sahoo J (2011) Quality Characteristics of Gluten-Free Chicken Nuggets Extended with Sorghum Flour. *Journal of Food Quality,* doi:10.1111/j.1745-4557.2010.00367.x

Devatkal S K, Narsaiah K, A Borah (2010) Antioxidant effect of extracts of kinnow rind, pomegranate rind and seed powders in cooked goat meat patties. *Meat Science*. 85, 155-159.

Devatkal S K, Narsaiah K, Borah A (2010) Effect of salt, extract of kinnow and pomegranate fruit by-products on colour and oxidative stability of raw chicken patties during refrigerated storage, *Journal of Food Science and Technology*. DOI: 10.1007/s13197-011-0256-9.

Devatkal S K, Naveena B M (2010) Effect of salt, kinnow and pomegranate fruit by-product powders on colour and oxidative stability of raw ground goat meat during refrigerated storage. *Meat Science* 85,306-311.

Dhaliwal S S, Oberoi H S, Sandhu S K, Nanda D, Kumar D and Uppal S K (2011) Enhanced ethanol production from sugarcane juice by galoctose adaptation of a newly isolated thermotelerant strain of *pichia kudrjavzeii*. Bioresource Technology 102, 5908-5975.

Dhingra D, Michael M, Rajput H,Patil RT (2010) Dietary fibre in foods - A review. *J Food Sci Technol* (DOI 10.1007/s13197-011-0365-5)

Dixit A K, Sharma P C, Nanda S K, Kudos S. K. A (2010) Impact of Processing Technology in Hilly Region: A Study on Extraction of Apricot Kernel Oil. *Agricultural Economics Research Review*, Vol. 23 (Conf. No.), 405-410

Dixit A K, Sharma Sanjeev (2010) Potato in Garhwal Region of Uttarakhand: Some Issues and Suggestions. *Potato Journal*, Vol. 37 (3-4):158-164

Gupta R K, Kumar Pradeep, Sharma Alka, Patil R T (2010) (available on line). Color kinetics of Aonla shreds with amalgamated blanching during drying, *International Journal of Food Properties*, DOI: 10.1080/10942911003637343

Gupta R K, Sharma Alka, Kumar Pradeep (2010) Physico-chemical properties of ginger, *Spice India*, 23(9): 15-19

Jain D, Mridula D, Patil R T, Barnwal P, Kumar R (2010) Kinetics of convective heat and mass transfer coefficient of green chilli during open sun and green house drying. *Desalination and Water Treatment* (2010), Vol. 24: 38-46.

Jaiswal P, Prasanna R, Singh P K (2010) Characterization of the Biocidal Spectrum of Extracellular Filtrates of *Microcystis aeruginosa. Indian Journal of Microbiology* DOI 10.1007/s12088-011-0136-z.

Jha S N and Sharma R (2010) Modeling of milk absorption and geometrical characteristics of popped gorgon nut (*Euryale ferox*). *Journal of Agricultural Engineering*, 47(3), 36-39

Jha S N and Sharma R (2010) Physical, gravimetric and functional characterization of various milling fraction of popped *makhana* (*Euryale ferox*). *Journal of Food Science and Technology*, 47(5): 564 – 570

Jha S N, Basedia A, Narsaiah K, Sharma R, Jaiswal P, Kumar R, Bhardwaj R (2011) Measurement techniques and application of electrical properties for nondestructive quality evaluation of foods: A Review. *Journal of Food Science and Technology*, 48(4), 387-411.

Jha S N, Gunasekaran S (2010) Authentication of sweetness of mango juice using Fourier transform infrared – attenuated total reflection spectroscopy. *Journal of Food Engineering* 101(3): 337-342.

Jha S N, Jaiswal P, Narsaiah K, Bhardwaj R, Sharma R, Kumar R, Basedia A (2010) Post-harvest Micro Flora on Major Cultivars of Indian Mangoes. *Scientia Hortculturae* 125 (2010): 617–621.

Jha S N, Rai D R, Gunasekaran S (2010) Visual spectroscopy and colour modeling for nondestructive evaluation of quality of apple. *Journal of Agricultural Engineering,* 47(2), 9-13.

Jha, S N and Garg R (2010) Nondestructive prediction of quality of intact apple using near infrared spectroscopy. *Journal of Food Science and Technology,* 47(2), 207 – 213.

Jha, S N, Narsaiah K, Sharma A D, Singh Manpreet, Bansal Sunil, Kumar R (2010) Quality parameters of mango and potential of non-destructive techniques for their measurement – a Review. *Journal of Food Science and Technology*, 47(1), 1-14.

Kadam D M, Balasubramanian S (2011) Foam mat drying of tomato juice. *Journal of Food Processing and Preservation*. DOI. 10.1111/j.1745-4529.2010. 00492.x

Kadam D M, Dhingra D (2011) Mass Transfer Kinetics of Banana Slices During Osmo-Convective Drying. *Journal of Food Process Engineering.* 34 (2); 511–532. doi: 10.1111/j.1745-4530.2009.00373.x

Kadam D M, Rai D R, Patil R T, Wilson R A, Kaur Sumandeep, Kumar R (2011) Quality of fresh and stored foam mat dried Mandarin powder. *International Journal of Food Science and Technology*. 46 (4); 793–799 doi:10.1111/j.1365-2621.2011.02559.x

Kadam D M, Wilson R A, Kaur Sumandeep (2010) Determination of biochemical properties of foam mat dried mango powder. *International Journal of Food Science and Technology*. 45 (8); 1626-1632 doi: 10.1111/j.1365-2621.2010.02308.x.

Kadam D M, Goyal K K, Gupta M K (2001). Mathematical modeling of convective thin layer drying of Basil leaves. Journal of Medicinal Plants Research vol 5 (online).

Kumar V, Biswas A K, Sahoo J, Chatli M K, Devatkal S K (2010) Quality evaluation of chicken nuggets formulated with green banana and soybean hulls flours. *Indian Journal of Poultry Science, 45 (3).34-36.*

Kaur P, Rai DR and Paul S (2011) Quality changes in fresh-cut spinach (Spinacia oleracea) under modified atmosphere with perforations. *Journal of Food Quality* 34: 10-18.

Manikanatan M R, Varadharaju N. (2010) Optimization studies on development and evaluation of HDPE based nanocomposite films for food packaging. Submitted to *Journal of Applied Polymer Science* (APP-2010-03-0965)

Mridula D, Jain D (2010) Optimization of process parameters for absorption of moisture by carrot kheer mix, *Ind. J. Nutr. Dietet.,* 2010, 47, 345-355.

Mridula D, Jain Rita and Singh K K (2009) Quality acceptability and shelf life of micronutrient fortified Indian traditional *sattu*. *Journal of Agricultural Engineering*, 46(2): 26-32.

Mridula D., V.K. Bhargav, R.T. Patil, D.M. Kadam and Rita Jain (2011). Performance Evaluation of a Low Cost Flour Mixer. Agricultural Engineering Today, 34(4), 24-28.

Mridula D, Singh K K and Patil R T (2010) Value Added Health Mix from Extrudates, Beetroot and Carrot Powder. *Ind. J. Nutr. Dietet.,* 47, 453-462.

Narsaiah K, Jha S N, Devatkal S K, Singh R B and Sahoo J (2010) Tenderizing effect of blade tenderizer and pomegranate fruit products in goat meat. *Journal of Food Science and Technology* 48 (1), 61-68,

Oberoi H S, Vadlani P V, Brijwani K, Bhargav V K, Patil R T (2010) Enhanced ethanol production by fermentation of rice straw using hydrolysate adapted *Candida tropicalis* ATCC 13803. *Process Biochemistry* 45: 1299-1306

Oberoi H S, Vadlani PV, Nanjundaswamy A, Bansal S, Singh S, Kaur S and Babbar N (2011) Enhanced ethanol production from Kinnow mandarin (*Citrus reticulata*) waste *via* a statistically optimized simultaneous saccharification and fermentation process. *Bioresource Technology*. 102, 1593-1601.

Oberoi H S, Babbar N, Dhaliwal S S, Kaur S, Vadlani P V, Bhargav V K and Patil R T (2010). Enchanced Oil recovery by pre-treatment of mustard seeds using crude enzyme extract obtained from mixed-culture solid-state fermentation of cinnow *citrus reticulata* waste and wheat bean. Food and Bioprocess Technology. Doi : 10.1007/s 11947-016-0380-v

Oberoi H S, Vadlani P V, Saida L, Bansal S and Highes J D (2011) Ethanol production from Banana peels using statistically optimised simultaneous saccharification and fermontation process. Waste management 31, 1901-1904.

Paul S, Rai D R (2010) An empirical approach for assessment of safe storage period for button mushroom (Agaricus bisporus) based upon colour changes under modified atmosphere packaging. *J Food Process Preservation*, 34, 557-570.

Rai D R, Chadha S, Kaur M P, Jaiswal P, Patil R T (2010) Biochemical, microbiological and physiological changes in Jamun (Syzyium cumini L.) kept for long term storage under modified atmosphere packaging. *Journal of Food Science and Technolo*gy 48(3): 357-365.

Rai D R, Chourasiya V K, Jha S N and Wanjari O D (2010) Effect of modified atmospheres on pigment of antioxidant retention of betel leaf (PIPER BETEL L.). *J.Fd Bio Chem*. 34 (2010) 905-915.

Rai D R, Kaur P, Patil RT (2010) Quality Changes in Fresh-cut Capsicum (Capsicum Annum) Shreds under Modified Atmospheres during Simulated Retail and Home Storage. *J Food Proc and Preservation,* doi:10.1111/j.1745-4549.2010.00481.

Rai D R, Chadha S, Kaur MP, Jaiswal P, Patil RT, (2011) Biochemical, microbiological and physiological changes in Jamun (Syzyium cumini L.) kept for long term storage under modified atmosphere packaging. *J Food Sci Technol,* DOI 10.1007/s13197-011-0254-y.

Rai D R, Singh R (2011), Package Headspace dynamics for babycorn under modified atmosphere packaging with macro-perforations. *J. Food Process Engng, DOI*: 10.1111/j.1745-4530.2010.00580.x.

Rathore S, Karki I (2010) A trend analysis of farmers' communication sources. *Journal of communication studies*, 28: 3-7.

Sharma Alka, Gupta R K, Kumar Pradeep (2010) Clove: An Endowed Spice, *Spice India*, 23(5): 23-27

Sharma M, Soni R, Nazir A, Oberoi H S, Chadha B S (2010) Evaluation of glycosyl hydrolases in the

secretome of *Aspergillus fumigatus* and saccharification of alkali-treated rice straw. *Applied Biochemistry and Biotechnology,* 163, 577-591.

Sharma R, Sogi D, Balasubramanian S (2009) Aerodynamic characteristics of unshelled and shelled sunflower seeds: significance of moisture and cultivars. *International Journal of Food Properties.* DOI:10.1080/10942911003687215

Singh R K, Bhowmik S N, and Pandey C B (2011) Biocultural diversity, climate change and livelihood security of the *Adi* community: grassroots conservators, of eastern Himalaya Arunachal Pradesh. *Indian Journal of Traditional Knowledge,* 10, pp. 39-56.

Siva Kumar S, Balasubramanian S, Biswas A K, Chatli M K, Devatkal S K, Sahoo J (2010) Efficacy of soy protein isolate as a fat replacer on physicochemical and sensory characteristics of low fat paneer. *Journal of Food Science and Technology*. DOI: 10.1007/s13197-010-0193-z .

Siva kumar S, Devatkal S K Balasubramnian S, Kadam D M, Biswas A K, Sahoo J (2010) Quality characteristics of low fat sweetened dahi formulated with soy protein isolate and carrot juice. *Indian Journal of Dairy Science.* 63 (2), 86-90.

Thakur A K, Saharan V K, Gupta R K (2010) Drying of 'Perlette' grape under different physical treatment for raisin making, J Food Sci Technol (Nov–Dec 2010) 47(6):626–631

Vishwakarma R K, Shivhare U S and Nanda S K (2010) Moisture adsorption isotherms of guar (*Cyamposis tetragonoloba*) grain and guar gum splits. *Food Science & technology*, LWT. doi:10.1016/j.lwt.2010.09.002.

Vishwakarma R K, Shivhare U S and Nanda S K (2010) Physical properties of guar seeds. *Food and Bioprocess Technology*. DOI 10.1007/s11947-011-0514-x.

Yadav D N, Patki P E, Srihari P, Sharma G K, Bawa A S (2010) Studies on polyphenol oxidase activity of heat stabilized whole wheat flour and its chapatti making quality. *International Journal of Food Properties*, 13:142-154

Yadav D N, Rajan A (2011) Fibres as an additive for oil reduction in deep fat fried poori. *Journal of Food Science and Technology*. DOI: 10.1007/s13197-010-0218-7

Yadav D N, Rajan A, Sharma G K (2010) Effect of fiber incorporation on rheological and chapatti making quality of wheat flour. *Journal of Food Science and Technology*, 47 (2):166-173

Yadav D N, Singh K K, Rehel Jagbir (2011) Studies on fortification of wheat flour with defatted rice bran for chapatti making. *Journal of Food Science and Technology.* DOI 10.1007/s13197-011-0264-9

Yadav D N, Singh K K, Bhowmik S N & Patil R T (2010) Development of peanut milk–based fermented curd. International *Journal of Food Science and Technology*, 45, 2650-2658

TECHNICAL/POPULAR ARTICLES PUBLISHED

Arumuganathan T, Manikantan M R, Oberoi H S, Chandrika Ram (2010) Kam moolya ka mausami *vabe-mausami* mushroom utpadak kaksha. *Krishi Prasanskaran Darpan – Rajbhasha Patrika*, 8, 12-16.

आलम, मो0 शफीक और अहमद, तनबीर (2010)। आँवला के उच्च गुण उत्पाद। कृषि प्रसंस्करण दर्पण, अंक 8, जनवरी–जून 17, 19A

अहमद तनबीर, कुमार योगेश और कुमार मनीष (2010)। जम्मू–कश्मीर के पारम्परिक मांस उत्पाद । कृषि प्रसंस्करण दर्पण, अंक 8, जनवरी–जून 33, 36A

बर्नवाल पी, कदम डी एम (2010) मोबाइल कृषि प्रसंस्करण केन्द्र एवं इसकी उपयोगिता. कृषि प्रसंस्करण दर्पण, राजभाषा पत्रिका, अंक 8, (जनवरी– जून 2010): 31–32.

बर्नवाल पी, सिंह के के (2009) कृषि प्रसंस्करण केन्द्रः रखरखाव एवं सावधानियाँ. कृषि प्रसंस्करण दर्पण, राजभाषा पत्रिका, अंक 7 (जुलाई–दिसम्बर, 2009): 13–15.

बर्नवाल पी, सिंह के के (2009) क्रायोजेनिक प्रौद्योगिकी द्वारा मसाला पिसाईः उपयोगिता एवं लाभ. कृषि प्रसंस्करण दर्पण, राजभाषा पत्रिका, अंक 7 (जुलाई–दिसम्बर, 2009) : 05–07.

Dhingra D and Patil R T (2010) Gunn Sammilat Soy Utpadan. In: *Pindan ate Aurta De Vikas Lai Lahewand Kittian Di Technology* (eds. Arora J K, Sharma V, Bakshi D K and Pandha Y S). *Punjab State Council for Science and Technology*, Chandigarh. pp: 169-177.

Dhingra D and Patil R T (2010) Value Added Soy Products. In *Technological Options for Women Empowerment and Rural Development* (eds. Arora J K, Sharma V and Bakshi D K and Pandha Y S), *Punjab State Council for Science and Technology, Chandigarh*. pp: 169-177.

Hardesh R, Dhingra D, Mona M (2010) Aloo Ka Vyarth Padarth ka Prasanskaran Aur Udyog ki Sambhavnaess. *Krishi Prasanskaran Darpan.* pp: 10-11.

Jain D, Mridula D (2009) *Hari Mirch ka puree va powder banana ki vidhi*. *Krishi Prasanskaran Darpan*, Ank 7, 10-11.

Kumar R (2010) Shrink-wrap packaging of fruits and vegetables. *Booklet on CIPHET Developed Post Harvest Technology* (2010) (eds. Patil R T, Kadam DM and Kaushik P). CIPHET, Ludhiana.: 1: 44-49.

Kumar R, Patil R T, Gupta R K (2010) Implication of food additives in relation to their safety. *Cold Chain Management of Horticultural Commodities*, (eds. by R. K. Gupta, R. T. Patil and R. K. Vishawakarma), 110-119.

Manikantan M R, Arumuganathan T, Chandrika R (2009) Vibhinna sukhane ki vidhiyon se button mushroom ki gunavatta aur texture par prabhav. *Krishi Prasanskaran Darpan– Rajbhasha Patrika*, 7, 17-20.

मृदुला डी., पी. बर्नवाल ,के. के. सिंह (2010) अलसी आधारित पौष्टिक 'एनर्जी बार'. कृषि प्रसंस्करण दर्पण, राजभाषा पत्रिका, अंक 8, (जनवरी– जून 2010): 8–10.

एम. आर. मणिकंठन, पी. बर्नवाल, चंद्रिका राम (2010) खाद्य पैकेजिंग में नैनो प्रौद्योगिकी का महत्व. कृषि प्रसंस्करण दर्पण, राजभाषा पत्रिका, अंक 8, (जनवरी– जून 2010): 20–23.

Yadav D N, Balasubramanian S, Kaur Jaspreet, Anand Tanupriya (2010) बाजरा प्रसंस्करण की आधुनिक तकनीकियाँ, कृषि प्रसंस्करण दर्पण अंक–8, जनवरी–जून, 5-8.

Patil RT. (2010). Post Harvest Technology-Need for increased share in global trade. In THE HINDU SURVEY OF INDIAN AGRICULTURE 2010, 69-70

Patil RT and RK Gupta. (2010). Bajar pethya Sheti Vyavasthe Chya Dishene. Agrowon (Marathi) April 20, pages 7, 10

Patil RT (2010). Hiravya Mirchichi powder va puree. Agrowon (Marathi) July 17, page 7

Patil RT and S. Balasubramanian (2010). Low cost collet extrusion for puffed snacks. Science Tech Entrepreneur April, 2 pages

Patil RT and VK Garg (2010). Lotus Seed Decorticator. Science Tech Entrepreneur March, 2 pages

Patil RT and DB Singh, (2010). Pomegranates and its value added products. Science Tech Entrepreneur October, 5 pages

Patil RT and HS Oberoi (2010). Rapid method of ethanol production from sugarcane juice. Science Tech Entrepreneur Sept., 3 pages

Patil RT and VK Garg (2010). Development of castor depodder and decorticator. Science Tech Entrepreneur August, 2 pages

Patil RT et al. 2010. Mobile Iced Fish Storage and Transport Chamber. Science Tech Entrepreneur July 2010, 2 pages

Patil RT 2010. Lac scraping machine. Science Tech Entrepreneur June 2010, 3 pages

Rai DR, Patil, RT (2010), Modified atmosphere packaging (MAP), a versatile solution, Polymers, 10:4, pp 5-10.

Balasubramanian S and R. T. Patil. 2011. Modern processing technologies for sorghum products. Processed food industry. 14(3): 13-18.

Patil R T and D N Yadav. 2009. Innovations in Post Harvest Management Techniques and Equipment Appropriate to Production catchments in India . Indian Food Packer, Nov-Dec, 76-81.

Patil RT et al. 2010. Shrink wrap packaging of fruits & vegetables. Science Tech Entrepreneur May 2010, 4 pages

Patil RT 2010. Wealth from Animal fat-A Waste. Poultry Express Oct Nov 2010, p 4.

PAPERS PRESENTED AND PUBLISHED IN PROCEEDINGS OF SEMINARS/CONFERENCES/WORKSHOPS/SYMPOSIA

Ahmad T (2011) Methods of Slaughter and Hygienic Meat Production in Workshop cum Training Programme for meat workers organised jointly by Indian Institute of Crop Processing Technology (IICPT) and National Meat and Poultry Processing Board (NMPPB) at Ludhiana.

Babbar N, Kaur U, Dhaliwal S S, Oberoi H S, Uppal S K (2010) Enzymatic hydrolysis of alkali-pretreated sugarcane bagasse by crude enzyme produced by a newly isolated strain of *A*spergillus niger *in* 51st annual AMI conference at BIT, Ranchi, December 14-17.

Babbar N, Oberoi H S, Dhaliwal S S, Kaur S (2011) Effect of enzymatic maceration treatment on enhancement in juice content, total phenolic content and antioxidant activity in guava juice in *New Horizons in Bioprocessing of Foods (NHBF) held at SLIET, Longowal during February 25-26.*

Barnwal P (2010) **अंकुररहित मक्का प्रसंस्करण** in Vaigyanik Sangoshthi karyakrama, Hindi Pakhwada Samaroha (14 – 28 September, 2010) at CIPHET Ludhiana.

Bhowmik S N (2010) Role of biotechnology in post harvest technology. Indo-Swiss Collaboration in Biotechnology Planning Workshop at Swiss Agency for Development and Cooperation, Embassy Of Switzerland New Delhi on Oct. 23.

Bhowmik S N, Manikantan M R, Goswami D (2010) Effect of growth of trichoderma and aspergillus on dehulling efficiency of pigeonpea" *In Proceedings* of *51st Annual Conference of Association of Microbiologists of India (AMI) and International Symposium on Recent Advances in Cross-disciplinary Microbiology: Avenues & Challenges*. Ranchi, Dec. 14-17, pp. 214.

Bhowmik S N, Manikantan M R, Goswami D (2010) Effect of growth of Trichoderma and Aspergillus on dehulling efficiency of pigeonpea. Poster paper presented and proceedings of 51st Annual Conference of Association of Microbiologists of India (AMI) and International symposium on Recent Advances and Challenges. Dec. 14-17 at Ranchi. pp. 214.

Bhowmik S N, Singh R K (2011) Effect of low temperature and ultraviolet radiation on yeast concentration in some traditional fermented foods of adi tribe of India. *In Proceedings of International Conference on Preparing Agriculture for Climate Change, International Conference on Preparing Agriculture for Climate Change.* Ludhiana. Feb., 6-8, pp 29.

Chopra S, Rai D R, Kaur D, Nagra S S and Patil R T (2010) Effect of cooling systems on thermal comfort and production of poultry birds. National seminar on Engineering Interventions to enhance income of small and marginal farmers at The Institutions of Engineers, Delhi, September 29-30, 2010.

Chopra Sangeeta, Dhingra D, Rai D R, Patil R T (2010) Engineering instrumentation to enhance energy use efficiency in agricultural processing sector. National Bilingual Conference on Agrionics and Food Processing Instrumentation (NCAFPI), CSIO Chandigarh on Sept., 29.

Devatkal S K, Jaiswal P, Bharadwaj R (2010) Evaluation of antioxidant and antibacterial activities of water extract of pomegranate peel in poultry meat. Compendium of Fourth Convention of Indian Meat Science Association , IVRI-Izatnagar. Oct. 29-30, pp.125.

Devatkal S K, Manjunath M, Narsaiah K (2010) Evaluation of physicochemical, textural and microstructural characteristics of chicken meat emulsion prepared using different equipment. Compendium of IX Annual conference and symposium of Indian Association of Veterinary Public Health, BVC, Mumbai, Jan 28-29, pp.218.

Devatkal S K, Narsaiah K, Borah A (2010) Antioxidant effect of kinnow and pomegranate extracts in ground poultry meat. XXVII Annual Conference and national Symposium of Indian Poultry Science Association. Chennai, Sept. 16-19, pp.263.

Dhaliwal S S, Oberoi H S, Sandhu S K, Babbar N (2011) Statistical process optimization for cellulolytic enzyme production using pea pods and a newly isolated strain of *Aspergillus niger,*

Dhingra D, Chopra Sangeeta, J Prem Kumar (2011) Principle and Applications of Ohmic Heating in Food Processing' INAE National Symposium on Emerging Innovative Technologies for Assurance of Quality and Safety in Processed Foods (FoQSAT 2011), Indian Institute of Technology Kharagpur, Feb. 24-25.

Dhingra D, Kumari R, Michael M, Rajput H (2010) Utilization of potato industry waste, as alternate feed ingredient. 10th National seminar on compound feeds organized by The Solvents Extractors Association of India. Kolkata, July 24.

Dhingra D, Patil R T, Rajput H and Michael M (2010) Equipment for production of animal feed using crop residues and processing waste. National seminar on Engineering Interventions to Enhance Income of Small and Marginal farmers, New Delhi, Sept. 29-30.

Dixit A K (2011) Cost estimation of agro processing equipments and value added products. Training programme of RE/ PI of AICRP on PHT held at CIPHET, Dec. 27 – Jan. 7.

Dixit A K (2011) Marketing aspects of food products. Training of Indo-Africa Forum Summit organized by CIPHET Ludhiana, Feb. 8-22.

Dixit A K (2010) Marketing of novel food products and impact assessment. Winter school organized by CIPHET Ludhiana, Sept. 1-21.

Dixit A K (2011) Impact of Processing Technology in Hilly Region: A Study on Extraction of Apricot Kernel Oil. Annual conference of Agricultural Economics Research Review. NAARM Hyderabad, Nov. 18-20.

Gaikwad N (2011) Post harvest management and value addition of horticultural crops. Workshop session of Agrovision workshop, National Expo. and Conferencce, Nagpur, March 4-7.

Gaikwad N Nivrutti (2011) Development and evaluation of weight grading machine for oranges. 45th Annual Convention of ISAE and International Symposium on Water for Agriculture, Nagpur, Maharashtra, Jan. 17 – 19.

Gaikwad N, Samuel D V K (2011) Development and evaluation of weight grading machine for oranges. *In* Proceedings of 45th ISAE Convention 2011.

Grewal Mannpreet Kaur and Pranita Jaiswal (2011) Quality assurance, HACCP and other safety aspects in food processing industry. Indo-Africa forum summit sponsored training programme on Post harvest processing and value addition of food grains, Feb. 8-22.

Gupta R K, Patil R T, Vishwakarma R K (2010) Hand tools and appropriate technologies for postharvest management and value addition of selected underutilized fruits. *In* proceeding of National Seminar of Institutions of Engineers , New Delhi, Sept. 29-30, pp: 64-68.

Gupta R K, Patil R T, Vishwakarma R K (2010) Hand tools and appropriate technologies for postharvest management and value addition of selected underutilized fruits. National Seminar of Institutions of Engineers, New Delhi, Sept. 29-30.

Gupta R, Kaur D, Chopra S, Nagra S S, Rai D R and Patil R T (2010) Efficacy of two cooling systems on broiler performance during hot-dry season. XXVII Annual Conference and National Symposium of Indian Poultry Science Association (IPSACON 2010), Madras Veterinary College, Chennai, Sept. 16-18.

Jain Dilip, Mridula D, Kumar R, Patil R T (2011) presented paper on "Study the effect of machine and process parameters on viscosity of green chilli puree" in 13th Indian agricultural scientist and farmers congress on sustainable development strategies for food security, biodiversity and livelihood security during 19-20 February 2011.

Jaiswal P (2010) Food regulation and International standards in "International Training Course on Post Harvest Management & Technology for Loss Reduction and Value Addition of Horticultural Produce" for participants of AARDO training programe at CIPHET Ludhiana organised by CIPHET Abohar.

Jha S N (2010) Nondestructive approach for quality evaluation of fresh and processed foods. Invited paper in ISPT Canada and DBT India Workshop, NABI, Mohali, Nov. 24-25.

Jha S N, Gunasekaran S (2010) Prediction of real juice content in mango nectar using FTIR spectroscopy. Annual meeting of Institute of Food Technologists, USA, Chicago, July 18–20.

Jha S N, Manjunath M, Patil R T (2010) Postharvest management strategies for fruits and vegetables in harsh climate. Lead paper in National Symposium on Food Security in Context of Changing Climate held at CS Azad University of Agriculture and Technology, Kanpur, Oct. 30– Nov. 01.

Jha S N, Sharma R, Jaiswal P, Narsaiah K, Kaur P P, Kumar Ashish, Kumar R (2011) Eating quality of Indian mango cultivars as a function of harvesting stage. 45th Annual Convention and International Symposium of Indian Society of Agricultural Engineers, Nagpur Jan.17-19.

Jha S N, Sharma R, Kaur B P, Kaur S (2011) Characterization of gorgon nut (*Euryale ferox*) starch modified by acid thinning and hydrothermal treatment. 45th ISAE Annual Convention and International Symposium, Nagpur, Jan.17-19.

K. Narsaiah, S K Devatkal, Pallabi Das Baruah (2011) *Pork Carcass Storage and Transport using Insulated Boxes along with Packed Gel Bottles.* 45th Annual Convention and International Symposium of Indian Society of Agricultural Engineers, Nagpur, Jan. 17-19.

Kadam D M, Kaushik P, Kumar Ramesh (2011) Development of guava products using pilot scale facilities. 45th Annual Convention of ISAE and International Symposium on water for agriculture, Akola (Maharasthra) Jan 17-19.

Kadam D M, Patil R T, Sharma Monika, Chadha Sonia, Wilson Robin A (2011) "Development of foam mat dried tamarind powder" *45th Annual Convention of Indian Society of Agricultural Engineers and International Symposium on Water for Agriculture,* PDKV, Nagpur, Jan. 17-19.

Karki Indu (2011) CIPHET developed technologies in 4th progressive farmer's meet, CII Chandigarh, Feb.18.

Karki Indu (2010) Women friendly farm tools & equipments, Interaction workshop, DRWA, Bhubaneshwar Oct. 4-5.

Kaur U, Oberoi H S, Bhargav V K (2010) Hydrolysis of alkali- and ozone-treated cotton stalks with cellulolytic and pectinolytic enzymes in 51st annual AMI conference at BIT, Ranchi, Dec. 14-17.

Kumar Ramesh, Thakur A K, Gupta R K and Patil R T (2010) Quality and decay of mango fruits as influenced by application method of anti-fog shrink film. 4th Indian Horticulture Congress on Horticulture; Hort. Business and Economic Prosperity, IARI, New Delhi, Nov.18-21

Kumar Ramesh, Thakur A K, Gupta R K, Patil R T (2010) Quality and decay of mango fruits as influenced by application method of antifog shrink film. 4th Indian Horticulture Congress, NPL, Delhi, Nov.18-21

Manikantan M R, Varadharaju N (2011) Preparation and properties of low density poly ethylene based nanocomposite films for food packaging. 45th Annual ISAE convention and symposium on water for Agriculture, Nagpur, Jan.17-19.

Manjunatha M (2011) Smart packaging–A novel food packaging for future. ISAE–45th Annual convention and International Symposium. PDKV, Nagpur.

Manjunatha M (2011) Advances in Packaging Technology for Processed Food Products" as a Resource Person for NAIP (ICAR) national training program at CIAH, Bikaner Feb. 26.

Manjunatha M, Samuel D.V.K. (2011) Effect of crop-machine parameters on the performance of garlic peeler. ISAE–45th Annual convention and International Symposium. PDKV, Nagpur.

Mridula D, Singh K K, Barnwal P, Rehal Jagbir (2011) Development of Omega-3 Rich Energy Bar with Flaxseed. 45th Annual Convention of ISAE & International Symposium at Nagpur,Jan. 17-19, (Abstract No. ACP-1.4, Page 171).

Nangare D D, Singh K G (2011) Evaluating salinity distribution under drip irrigation with saline water using SALTMED model. 45th Annual convention of ISAE and International symposium on water for Agriculture, Nagpur Jan.17-19. (MIS-6.19:109)

Nangare D D, Singh K G and Gupta R K (2010) Saline water in conjunction with canal water for improving quality of tomato in semi arid region of Punjab. Abstract published in souvenir of Regional workshop on "Groundwater salinity, Assessment, management and mitigation" to be organized by Central ground water board, Chandigah and held at CSSRI, Karnal w.e.f. 18 to 19th March, 2011.

Narsaiah K, (2010) Micro and nano encapsulation of food ingredients for their controlled release. Indo-Canada partnership meet Vision & Partnerships for Innovations in Agri-Food Research, NABI, Mohali. Nov. 21-23.

Narsaiah K, (2011) Encapsulation of nutraceuticals for functional foods. Lecture as resource person for NAIP (ICAR) National Training course-Biotechnological approach for the enhanced production of nutraceauticals in fruits and vegetables of arid zone, CIAH Bikaner, Feb. 14-27.

Narsaiah K, Devatkal S K, Baruah Pallabi Das (2010) Engineering and Technological Interventions for Indian Meat Industry. National Seminar on Engineering Agriculture for Evergreen Revolution. Tiurpati, organized by ISAE, AP Chapter, Sept. 24-25.

Narsaiah K, Jha S N, Jaiswal P, Singh A K, Kaur P P, Kumar R (2011) Biomolecular interactions using surface plasmon resonance array system for biosensor development. Accepted for presentation at International conference on "Advances in bio-detection and biosensors" organized by Select Bioscience and European Lab Automation at Hamburg, Germany during 30 June to 1 July.

Nayak L K, Jha S N (2010) Performance evaluation of jute-fibre based pads in evaporatively cooled storage structure. 9th National Symposium on Recent Outlook on Sustainable Agriculture, Livelihood Security and Ecology of Coastal Region, Indian Society of Coastal Agricultural Research, Goa, Oct. 27-30.

नारायण मुकुन्द, गुप्ता आर के, पाटिल आर टी भारत में क्षारीय भू–जल की स्थिति, कारण एवं निराकरण (2011) Souvenir of Regional Workshop on Ground water Salinity: Assessment, Management and Mitigation, CSSRI, Karnal, March 18-19, 39-43.

Oberoi H S (2010)Automation of fermentation processes and their applications. National conference on Agrionics and Food processing instrumentation, CSIO, Chandigarh, Oct. 26-28.

Oberoi H S (2011) *Ethanol production from fruit residues- Prospects and problems. National conference on New Horizons in Bioprocessing of Foods (NHBF), SLIET, Longowal, Feb. 25-26.*

Oberoi H S (2010) Evaluation of soft carbohydrates in enzymatic saccharification of rice straw and bagasse. 51st annual AMI conference at BIT, Ranchi, Dec. 14-17.

Oberoi H S (2010) Total phenolic content and free radical scavenging activities of extracts obtained from wastes of four different plant materials. National conference on Effect of climate change on horticultural crops, PAU, Ludhiana, Oct. 6-8.

Oberoi H S (2011) Utilization of crop residues for production of value-added products" Workshop on Integrated Bioprocessing and Bioproducts Technologies for Sustainable Food Security at NABI, Mohali under the ISTP Canada- DBT, India, Nov. 24-25.

Patil R T, Gupta R K and Vishwakarma R K (2010) Advances in Mechanization of Post Harvest Management of Horticultural Crops. *4th Indian Horticulture Congress on Horticulture; Hort. Business and Economic Prosperity, IARI, New Delhi, Nov. 18-21.*

Patil R T, Jain D (2011) Handling, Packaging, Storage and Transportation of Fresh Produce :CIPHET Intervention: in National Seminar on "Good Agricultural Practices" organised by BIS, New Delhi on 17 March 2011 at CIAE, Bhopal.

Patil R T, Gupta R K, Vishwakarma R K (2011) Postharvest handling technologies to meet the changing environmental conditions. Impact of Climate Change in Fruit Crops. Lead paper presented in the National Seminar on Impact of Climate Change on Fruit Crops held at PAU Ludhiana during Oct 6-8, 2010.

Patil R T, Jain D (2011) presented a paper "Scope and Opportunities in Postharvest Sector Appropriate to Indian Socio-Economic Condition" in the India International Crop Summit 2011, "Global Outlook on Crop Production & Protection" during 10th & 11th January, 2011 at Bhubaneswar.

Patil R T, Jain D presented an invited paper 2010 "Green technology for sustainable agribusiness development from CIPHET" in "National seminar on Green technology for sustainable agribusiness development" on 11 May, 2010, at PHD House, New Delhi.

Patil R T et al. (2010) Model Agro Processing Centres for KVKs. The KVK Interface-2010 was organized by the Division of Agriculture Extension, Indian Council of Agricultural Research (ICAR) during April 26-27, 2010.

Patil R T (2010) Appropriate post harvest management techniques and equipment for horticultural crops in production catchments" National Conference on "Horticultural Bio-diversity for Livelihood, Economic Development and Health Care" held at University of Horticultural Sciences, Bangalore organized by Lt. Amit Singh Memorial Foundation on May 29-30, 2010.

Patil RT 2010 Emerging Technologies in Post Harvest Management & Value Addition in front of Empowered Committee of NAIP for the National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSRA) during June 28 -29, 2010.

Patil RT 2010 Food Security through Novel Grain Storage Practices in the workshop on "Accomplishing food security of stored grains through novel storage practices" organized on May 27, 2010 at PAU Ludhiana.

Patil RT 2010 Food Processing Technologies developed by ICAR. In "Entrepreneurs Meet" organized by Ministry of Food Processing Industries at New Delhi on July 2, 2010

Patil RT 2010 "Overview of post harvest engineering and value addition technologies developed by various ICAR institutes and promoted by ZTMC-BPD units located at different places" ICAR-Industry meet 2010 at NASC Complex, New Delhi on July 28-29, 2010.

Patil RT 2010, "Post Harvest Management & Value Addition of Oilseeds".in brain storming session on "Strategies for Increasing Production of Oilseeds/Vegetable Oils" at the Directorate of Oilseeds Research, Hyderabad on August 7-8, 2010.

Patil RT et al. 2010 Developments of Technologies for Processing of Oilseeds in Production Catchments in the All India Seminar on "Engineering Interventions to Enhance Income of Small and Marginal Farmers" under the aegis of Agricultural Engineering Division Board of IEI during September 29-30, 2010

Patil RT et al. 2010 Post- harvest handling technologies to meet the changing environmental conditions. In National Seminar on Impact of Climate Change on Fruit Crops held at PAU Ludhiana during Oct 6-8, 2010.

Patil RT et al. 2010 Advances in Mechanization of Post Harvest Management of Horticultural Crops in the 4th Indian Horticulture Congress 2010 was held at New Delhi from Nov. 18 to 21, 2010.

Patil RT. 2010 Simple, Reliable and Cost Effective Postharvest Technologies for Horticultural Produce in APAARI Expert Consultation on Post Harvest & Value Addition of Horticultural Produce at Putrajaya, Malaysia during 29.11.2010 to 02.12.2010.

Sandhu S K, Dhaliwal S S, Oberoi H S (2010) Statistical optimization of hydrolysis process for Kinnow Mandarin (Citrus reticulate) peel using crude enzyme consortium obtained from newly isolated Aspergillus oryzae *in* 51st annual AMI conference at BIT, Ranchi, December 14-17.

Singh Indira, Shah Kavita, Singhal Sumit, Somvanshi Yogesh, Jain Chirag (2010) Challenges and opportunities for Indian livestock produce trade in the WTO Era. XIX Annual Conference of the and international conference on "Physiological capacity building in Livestock under changing climate scenario", 11-13th Nov., 2010

Singh K K, Mridula D, Barnwal P, Rehal J (2011) Some moisture dependent physico-mechanical properties of flaxseed (var. Garima). Paper presented in 45th Annual Convention of ISAE & International Symposium at Nagpur during January 17-19, 2011 (Abstract No. ACP-1.4, Page 170).

Singh K K, Mridula D, Barnwal P, Rehal Jagbir (2011) Some Moisture Dependent Physico-Mechanical Properties of Flaxseed (Var. Garima). Paper presented in 45th Annual Convention of ISAE & International Symposium at Nagpur during January 17-19, 2011 (Abstract No. ACP-1.4, Page 170).

Yadav D N participated and presented peanut milk technology at Institute-Industry Interface Meet organized by ZTMU Unit, IARI, New Delhi on 14th June, 2010.

Yadav D N, Balasubramanina S, Kaur Jaspreet, Ananad T (2010) Presented (Oral) "Development of pearl millet based instant halwa dry mix". In: International Conference on Traditional Foods 2010 organized by Pondicherry University at Pondicherry from 1st to 3rd Dec 2010.

Yogesh K, Moudgal R P, Sirajudeen M, Sastry K V H, Tyagi J S, Jagmohan (2010) Improved broiler production by offsetting reproductive anomalies occurring at sexual maturity: A phytohormonal remedial approach. XXVII Annual Conference and National Symposium of Indian Poultry Science Association, 16-18th Sept., 2010.

Sharma Monika, Kumari Santosh, Gupta S K (2011) "Preparation of *sev* fortified with unripe banana" In proceeding of *National conference on New Horizons in Bio-processing of Foods,* held at Sant Longowal Institute of Engg. & Technology from February 25-26, 2011.

Sharma A K, Dixit A K (2010) Emerging Issues in Horticulture Sector in Uttarakahand: A Perspective Approach for Planning. National Symposium on Conservation Horticulture - 2010 Souvenir, pp 298-303

N Gaikwad delivered lecture on topic "Role of Agro-Processing Technologies for Entrepreneurship Development" at the training programme on Processing and Value Addition of Agriculture Produce organized by Sher-e-Kashmir University of Agriculture Science & Technology, Jammu, J & K.

T Ahmad delivered a lecture on 9th Nov 2010 on "Role of Extension in Popularizing Value Addition of Livestock Products" in the training programme on Extension Delivery Systems for field Vets organised by Department of Vety. & Animal Husbandry Extension, GADVASU, Ludhiana, Punjab.

BOOKS/CHAPTERS IN BOOKS/TECHNICAL BULLETINS

Babbar N, Oberoi H S, Uppal D S and Patil R T (2011) Total phenolic content and free radical scavenging activities of contracts obtained from wastes of four different plant materials, in proceedings of the national, conference on "Impact of climate change on fruit crops", under publication at PAU, Ludhiana.

Bhowmik S N (2010) Modern Dehulling of Pulses: Prospects of Enzyme Conditioning. In: Compendium on Novel techniques in food processing, co-product utilization and quality assurance, Mridula D and Manikantan MR (eds). CIPHET, Ludhiana.

Bhowmik S N (2010) Tempeh: A Nutritional and Functional Food for the Third Millenium. In: Compendium on Novel techniques in food processing, co-product utilization and quality assurance, Mridula D and Manikantan MR (eds). CIPHET, Ludhiana.

Bhowmik S N (2011) Potential of Enzyme Assisted Food Fermentation Technology for Value Addition of Root, Tuber and Food Grains in Developing Countries. In: Patil RT and Manikantan MR (eds) Compendium on Post Harvest Processing and Value addition of Food Grains. CIPHET. Ludhiana

Barnwal P. 2001. Maize milling and degerming. In : *Training Manual for Indo-Africa Forum Summit Training on "Post harvest Processing and Value Addition of Food Grains", (Eds.)* Patil, R.T. and Manikantan, M.R., pp 51-70.

Barnwal P. 2010. Novel techniques in maize processing. *In: Compendium of ICAR sponsored Winter School on "Novel Techniques in food processing. co-product utilization and quality assurance"* (Eds. Mridula D., Patil, R.T. and Manikantan, M.R.), pp 74-83.

Barnwal P., Singh K. K. 2010. Application of cryogenic technology for grinding of spices. *In: Compendium of ICAR sponsored Winter School on "Novel techniques in food processing, co-product utilization and quality assurance"* (Eds. Mridula D., Patil, R.T. and Manikantan, M.R.) pp 26-32.

Chopra S, Oberoi H S, Aleksha Kudos (2011) Passive evaporative cooled room for storage of fruits and vegetables. In *Booklet on CIPHET developed Post Harvest Technologies Vol. 1.* (eds.) Patil R T, Kadam D M and Kaushik P. CIPHET, Ludhiana. pp: 22-25.

Dhingra D (2010) Production of Cattle Feed from Potato Industry Waste In Booklet on CIPHET developed Post harvest technologies Vol. I (eds. Patil R T, Kadam DM and Kaushik P). CIPHET, Ludhiana. pp: 107-111

Dhingra D (2010) Production of Ginger Powder. In Booklet on CIPHET developed Post Harvest Technologies Vol.1. (eds. Patil R T, Kadam DM and Kaushik P). CIPHET, Ludhiana. pp: 50-56.

Dhingra D (2010) Conversion of milling by products, oilseeds derivatives, animal by-products and agro-industrial wastor into animal feed, In: compendium on "Novel Techniques in Processing, Co-Product Utilization and quality Assurance, Mridula D, Manikantan M R and R T Patil (Eds) CIPHET, Ludhiana. pp : 194-204.

Goswami D Frozen Bakery Foods. ICAR sponsored Winter School (1-21 Sept. 2010) on “Novel Techniques in Food Processing, Co-product utilization and Quality Assurance”. pp. 140-145.

Grewal M K and Jaiswal P (2011) “Quality assurance, HACCP and other food safety aspects in food processing industry” In: compendium of Indo- Africa forum Summit sponsored training programme on

"Post harvest processing and value addition of food grains" organized at CIPHET from 8th-22nd February 2011, edited by R T Patil and M R Manikantan.

Gupta R K, Manikantan M R, Vishwakarma R K, Mridula D (2010) Development of sunflower kernel based confectionery product. In: Booklet on CIPHET developed post harvest technologies Vol.I, 102-106, Patil RT, Kadam, DM, Kaushik, P (eds). CIPHET, Ludhiana. pp 120.

Gupta R K, Patil R T and Viswakarma R K (2010) Cold Chain Management of Horticultural Commodities for Better Quality, Increased Food Supply and Exports. CIPHET, Ludhiana, pp 136.

Jain D, Mridula D, Kumar R (2010) Production of green chilli powder. *Booklet on CIPHET Developed Post Harvest Technology* (eds. Patil R T, Kadam DM and Kaushik P). CIPHET, Ludhiana.: 1: 70-74.

Jha S N, Chopra S (2011) Construction, operation and maintenance of CIPHET Evaporative cooled structure for storage of fruits and vegetables. In *Booklet on CIPHET developed Post Harvest Technologies Vol. 1.* (eds.) Patil R T, Kadam D M and Kaushik P. CIPHET, Ludhiana. pp: 26-30.

Jain Dilip, Mridula D, Patil R T (2010) Optimization of Ingredients Formulations for Development of Functional Foods. In: Extruded Functional Foods using Plant and Dairy Ingredients PC Bargale and SD Kulkarni (eds), Soybean Processing and Utilization Centre, CIAE, Bhopal. p101-105.

Jaiswal P (2010) Microbial quality evaluation of food products. In: Compendium of winter school on "Novel Techniques in Food Processing, Co-product Utilization and Quality Assurance" organized by Dr. D. Mridula (Sept 01 to Sept 21, 2010) D Mridula and Manikantan MR (eds), pp 49-52.

Jha S N (2010) Colour measurements and modeling (Chapter II). In: Nondestructive Evaluation of Food Quality: Theory and Practice, S. N. Jha (ed), Springer-Verlag, Germany: 17-40.

Jha S N (2010) Food quality and safety – an overview (Chapter I). In: Nondestructive Evaluation of Food Quality: Theory and Practice (ed S. N. Jha), Springer-Verlag, Germany: 1-16.

Jha S N (2010) Heat Transfer and Applications (Unit 4). In: course #3 "Food Processing and Engineering" for one year course of PG Diploma in Food Technology of Indira Gandhi National Open University (IGNOU), New Delhi.

Jha S N (2010) Miscellaneous techniques (Chapter VIII). In: Nondestructive Evaluation of Food Quality: Theory and Practice (edi S. N. Jha), Springer-Verlag, Germany: 235- 283

Jha S N (2010) Near infrared spectroscopy (Chapter VI). In: Nondestructive Evaluation of Food Quality: Theory and Practice (edi S. N. Jha), Springer-Verlag, Germany: 141-212.

Jha S N (editor) (2010) Nondestructive Evaluation of Food Quality: Theory and Practice. Springer – Verlag GmbH Berlin Heidelberg, Germany, ISBN 978-3-642-15795-0, doi 10.1007/978-3-642-15796-7: 288p

Jha S N and Sharma R (2010) Cleaning (Unit 7). In: Course #3 "Food Processing and Engineering" for one year PG Diploma Food Technology of Indira Gandhi National Open University (IGNOU), New Delhi.

Kadam D M, D Dhingra (2011) CIPHET Banana-Comb/Hand Cutter. In *Booklet on CIPHET developed Post Harvest Technologies Vol. 1.* (eds.) Patil R T, Kadam D M and Kaushik P. CIPHET, Ludhiana. pp: 1-4

Kumar R (2010) Manufacturing guava products. *Booklet on CIPHET Developed Post Harvest Technology* (2010) (eds. Patil R T, Kadam DM and Kaushik P). CIPHET, Ludhiana.: 1: 92-97.

Kadam D M (2011) *Nirmit Sudharth Yantre* (Marathi), *Kaanda Sukhavan padathee* in *Shetkari* MAGZINE, March Page 35-36.

Kadam D M (2011) *Nirmit Sudharth Yantre* (Marathi), *Keli Ghadh Todani Yantra* in *Shetkari* MAGZINE March Page 36, Publication by Dy. Director Agri. / Editor Shetkari, Commissionerate of Agriculture, Maharashtra State, Pune.

Kadam D M, *Nirmit Sudharth Yantre* (Marathi), *Tray dryer* in *Shetkari* MAGZINE March 2011 Page 36.

Kadam D M, Dhingra D (2010) CIPHET Banana-Comb/Hand Cutter (Chapter 1). Booklet on CIPHET Developed Post Harvest Technologies Vol-I by Patil R T, Kadam D M, Kaushik Pratibha, Director CIPHET (ICAR), Ludhiana. 1-4 pp.

Kadam D M (2010) *Kele Ki Katayee Karega comb cutter* in Ammar Ujjal Choupal (Hindi), New Delhi Edition November.

Kadam D M, Nangare D D (2010) Dried Onion Flakes and Powder (Chapter 11). Booklet on CIPHET Developed Post Harvest Technologies Vol-I, Patil R T, Kadam D M, Kaushik Pratibha (eds), Director CIPHET (ICAR), Ludhiana. pp 57-63.

Kadam D M, Patil R T, Kaushik Pratibha (2010) Foam Mat Drying of Fruit and Vegetable Products (Chapter 5). In book entitled "Drying of Food, Vegetables and Fruits" Volume 'A': Fundamental Topics, Dr. Sachin Jangam, Dr. Chung Lim Law and Professor Arun Mujumdar (eds), pp 111-124.

Kadam Dattatreya M., Dhingra Devinder, Prasad Mathew and Patil R. T (2009). Osmotic Dehydration in Banana Slices (Chapter 40). Banana New Innovations by H P Singh and M M Mustaffa (1st Edition), Westville Publishing House, New Delhi, pp 238-243.

Kaliya Anita, Sharma Promila, Singh Sucheta and Karki Indu (2011) Ergonomic assessment of farm activities of women farmers of mountain of India, approach towards drudgery, Chapter 47, Advances in occupational, social and organizational ergonomics. Vink P and Kantola J (eds), CRC Press. Pp 444-451 print ISBN: 978-1-4398-3507-4. Ebook ISBN: 978-1-4398-3509-8.

Karki Indu and Sharma Promila (2011) Status of ward nurses in health care industry of Uttarakhand state of India: An approach through hospital ergonomics. Chapter 38, Advances in occupational, social and organizational ergonomics. Edited by P. Vink and J. Kantola. CRC Press. Pp 444-451 print ISBN: 978-1-4398-3507-4. Ebook ISBN: 978-1-4398-3509-8.

Manikantan M R (2010) Application of nanotechnology in packaging of food products. In: Compendium on "Novel techniques in Food processing, co-product utilization and quality assurance", 176-182, (Eds Mridula D, Manikantan M R, Patil RT) CIPHET, Ludhiana. pp.277

Manikantan M R (2010) Evaluation of physico-mechanical properties of food products. In: Compendium on "Novel techniques in Food processing, co-product utilization and quality assurance", 249-253, (Eds Mridula D, Manikantan M R, Patil R T) CIPHET, Ludhiana. pp.277

Manikantan M R (2010) Primary processing of food grains. In: Training Manual on "Post harvest processing and value addition of food grains", 1–22, (Eds Patil R T, Manikantan M R) CIPHET, Ludhiana. pp.281.

Manikantan M R, Patil R T (2010) Evaluation of physico-chemical properties of food products. In: Training Manual on "Post harvest processing and value addition of food grains", 201 – 210, (Eds Patil R T, Manikantan M R) CIPHET, Ludhiana. pp.281.

Mridula D, Manikantan M R and Patil R T (2010) Compendium on "Novel techniques in Food processing, co-product utilization and quality assurance", CIPHET, Ludhiana. pp.277.

Mridula D, Jain Dilip, Patil R T (2010) Changes in Nutritional Quality of Extruded Foods. In: Extruded Functional Foods using Plant and Dairy Ingredients Eds: PC Bargale and SD Kulkarni, p 120-132. Soybean Processing and Utilization Centre, CIAE, Bhopal.

Oberoi H S, Sandhu S K, Babbar N, Dhaliwal S S and Kaur U (2011) Ethanol production from fruit residues-Prospects and problems, Bioprocessing of Foods, with Asia Tech, New Delhi. pp

Patil R T, Dattatreya M. Kadam and Pratibha Kaushik (2010) Booklet on CIPHET Developed Post Harvest Technologies Vol-I, Director, CIPHET (ICAR), Ludhiana (Punjab)

Patil R T, Gupta R K, Vishwakarma R K (2011) Mechanization: Post harvest Equipment. Published in Horticulture to Hort-Business (Eds. KL Chadha, AK Singh and VB Patel), Westiville Publishing House, New Delhi

Patil R T, Gupta R K, Vishwakarma R K (2011) Postharvest Handling Technologies to meet the changing environmental conditions. Impact of Climate Change in Fruit Crops (Eds W.S. Dhillon and P.S. Aulakh), Narendra Publishing house, Delhi, 335-47.

Patil R T, Manikantan M R (2010) Training Manual on "Post harvest processing and value addition of food grains", CIPHET, Ludhiana. pp.281.

Patil R T(2010)Post Harvest Technology-Need for increased share in global trade. In THE HINDU SURVEY OF INDIAN AGRICULTURE, pp 69-70

Patil R T, R K Gupta (2010) Bajar pethya Sheti Vyavasthe Chya Dishene. Agrowon (Marathi) April 20, pp7-10.

Patil R T (2010) Hiravya Mirchichi powder va puree. Agrowon (Marathi) July 17, p 7.

Patil R T et al (2010) Low cost collet extrusion for puffed snacks. Science Tech Entrepreneur, April, 2 pages

Patil R T et al (2010) Lotus Seed Decorticator. Science Tech Entrepreneur, March, 2 pages

Patil R T et al (2010) Pomegranates and its value added products. Science Tech Entrepreneur October, 5 pages

Patil R T et al (2010) Rapid method of ethanol production from sugarcane juice. Science Tech Entrepreneur September, 3 pages

Patil R T et al (2010) Development of castor depodder and decorticator. Science Tech Entrepreneur August, 2 pages

Patil R T et al (2010) Mobile Iced Fish Storage and Transport Chamber. Science Tech Entrepreneur July, 2 pages

Patil R T (2010) Lac scraping machine. Science Tech Entrepreneur June, 3 pages

Patil R T, D N Yadav (2009) Innovations in Post Harvest Management Techniques and Equipment Appropriate to Production catchments in India. Indian Food Packer, Nov-Dec, pp 76-81.

Patil R T et al (2010) Shrink wrap packaging of fruits & vegetables. Science Tech Entrepreneur May, 4 pages

Patil R T (2010) Wealth from Animal fat-A Waste. Poultry Express Oct.-Nov., p 4.

Rai D R, Patil R T (2010) Modified atmosphere packaging (MAP), a versatile solution, Polymers, 10:4, pp 5-10.

Singh R K, Bhowmik S N, Pandey C B (2011) Biocultural diversity, climate change and livelihood security of the *Adi* community: grassroots conservators, of eastern Himalaya Arunachal Pradesh. Indian Journal of Traditional Knowledge, 10, pp. 39-56.

Yadav D N, Singh K K, Bhowmik S N & Patil R T (2010) Development of peanut milk–based fermented curd. International Journal of Food Science and Technology, 45, 2650–2658

Yadav D N, Singh K K, Bhowmik S N, Dixit A K, Patil R T (2010) Groundnut based flavoured beverage, curd, and paneer. In: Patil R T, Kadam D M, Kaushik P (eds.) Booklet on CIPHET Developed Post harvest technologies, Vol 1, CIPHET, Ludhiana, p120.

PARTICIPATION IN INTERNATIONAL/NATIONAL TRAINING PROGRAMMES/SEMINARS

Dr R T Patil attended the APAARI Expert Consultation Meeting on "Post Harvest & Value Addition of Horticultural Produce" jointly organized by APAARI and MARDI and co-sponsored by FAO, GFAR, Hort CRSP and MAFC, held at Putrajaya, Malaysia during 29.11.2010 to 02.12.2010. Dr. Patil, made a presentation on "Simple, reliable and cost effective post harvest machineries for horticultural produce" and explained processing machines and protocols for value addition in production catchment.

Dr R T Patil attended a bilateral workshop at University of Saskatchewan, Saskatoon Canada during Feb 13-15, 2011. The main objective of the workshop was to provide an opportunity for bringing together researchers, scientists, students, industry partners and policy makers from both Countries and developing an understanding to form a broader and strong cluster partnership linking several departments and institutions in India and Canada. This workshop provided opportunity for showcasing current India-focused research and scholarly activities by faculty and researchers at U of S, and colleagues from other Canadian universities.

Dr R T Patil attended the World Food Day celebrations at Department of Food Technology at Guru Jambeshwar University, Hisar, Haryana on 16th October, 2010.

Dr R T Patil attended the Directorate of Mushroom Research, Solan and Central Potato Research Institute, Shimla during May 8-9, 2010 to discuss collaboration of CIPHET for minimal processing & packaging of mushroom and up-scaling the potato flour technology suitable for adoption at rural catchments.

Dr R T Patil attended the Meeting for examination of Subject "Minimizing Post Harvest Crop Losses" a sitting of the Parliamentary Standing Committee on Agriculture on 10th June, 2010.

Dr R T Patil attended the Meeting at IHBT, Palampur on July 9, 2010 as a special guest in IHBT-Industry Interactive Meet under Technology and Innovation Management Centre.

Dr. R.T Patil attended the Brain storming session on "Strategies for Increasing Production of Oilseeds/ Vegetable Oils" at the Directorate of Oilseeds Research, Hyderabad on August 7-8, 2010 and presented an invited paper on "Post Harvest Management & Value Addition of Oilseeds".

Dr R T Patil attended the Interaction Meeting with Horticulture Directors at Indian Institute of Horticultural Research, Bangalore on 10-11th November, 2010.

Dr R T Patil attended the Review meeting of ASRB-NAIP Project "Developing, Commissioning, Operating and Managing an Online System for NET/ARS Prelim Examination in ASRB, ICAR" on November 16, 2010 at Krishi Bhavan, New Delhi.

Dr R T Patil attended the 4th Indian Horticulture Congress 2010 to present a paper on "Advances in Mechanization of Post Harvest Management of Horticultural Crops" held at New Delhi from 18-21st November 2010.

Dr R T Patil attended the Meeting on Dec 6, 2010 for conceptualizing a mega project "Natural Agriculture Entrepreneurship Project" under ICAR.

Dr R K Gupta, Dr. D.R.Rai, Dr S Balasubramanian, Dr. S.Chopra attended National Seminar on Engineering Interventions to enhance income of small and marginal farmers, IEI and ISAE, Delhi during 29-30, September 2010.

Dr R K Gupta participated and presented a invited paper in Seminar on Development of Horticulture in Bihar: Issues and Strategies organized at Bihar Veterinary College, Patna during 28-29th January 2011.

Dr R K Gupta participated and presented an invited paper in 13th Indian Agricultural Scientists and Farmers Congress was held at Allahabad during 19-20th February 2011.

Dr R K Gupta attended Brain Storming Meeting on Post-Harvest Technology and Value Addition of Agricultural Produce: Scenario, Issues and Strategy was held at during May 1-2, 2010 at CIPHET), Ludhiana.

Dr R K Gupta attended and participated in the Workshop of AICRP on PHT Scheme was held at CIAE, Bhopal during 28-31st October 2010

Dr R K Gupta participated in the Interactive workshop on Skill Development & Consultancy Initiatives for NIFTEM on 30th August 2010 organized in New Delhi.

Dr R K Gupta attended one day District level workshop on forward Marketing/Trading of NABARD held at CIPHET, Abohar on 4th January, 2011

Dr. D.R.Rai, Dr D M Kadam, Dr. Nilesh Gaikwad participated in ICAR-Industry meet 2010 at NASC Complex, New Delhi on July 28-29, 2010.

Dr. D.R.Rai, Dr H S Oberoi, Dr. S.Chopra attended the National conference on Agrionics and Food processing instrumentation held at CSIO, Chandigarh.

Dr S Balasubramanian attended Seminar on extrusion processing: science and applications, KSU (USA) & MPAU&T, Udaipur during 17-18, June 2010.

Dr S Balasubramanian attended National Seminar on Millet, NIRD, Hyderabad during12-13, November 2010.

Dr S Balasubramanian attended International Conference on Traditional Food (ICTF, 2010), Pondicherry University during 01-03, December 2010.

Dr S Balasubramanian, Dr K Narsaiah, Dr Mridula D, , Dr D M Kadam, Dr M R Manikantan, Dr D D Nangare, Dr Manjunatha M attended 45th Annual Convention of ISAE & International Symposium at Nagpur during 17-19, January 2011.

Dr S Balasubramanian attended Special Invite in the task force meeting on millet at KB, New Delhi during 21, January 2011.

Dr S Balasubramanian attended Annual workshop of NAIP (Comp-4), IIHR, Bangalore during 7-8, March 2011.

Dr S Balasubramanian attended Inaugural lecture in the AW of AICRP on Pearl millet, HAU, Hisar during 12, March 2011.

Dr H S Oberoi attended the ISTP Canada- DBT, India workshop on Integrated Bioprocessing and Bioproducts Technologies for Sustainable Food Security at NABI, Mohali.

Dr H S Oberoi p*articipated in the National conference on New Horizons in Bioprocessing of Foods (NHBF) held at SLIET, Longowal..*

Dr H S Oberoi participated in the National conference on Effect of climate change on horticultural crops, PAU, Ludhiana.

Dr H S Oberoi participated in the 51st annual AMI conference at BIT, Ranchi and delivered an invited lecture.

Dr K Narsaiah attended Brain Storming Meeting on Post-Harvest Technology and Value Addition of Agricultural Produce: Scenario, Issues and Strategy (1-2 May, 2010)

Dr K Narsaiah attended National Seminar on Engineering Agriculture for Evergreen Revolution. Sept. 24-25, at Tiurpati, organized by ISAE, AP Chapter.

Dr D M Kadam attended SAS Installation Training Programme at NDRI Karnal from 17 to 18 June 2010.

Dr D M Kadam has attended one week training programme on Data Analysis using SAS of the NAIP Consortium, Strengthening Statistical Computing for NARS, during 22-27 November 2010 at NDRI, Karnal.

Dr D M Kadam attended the Network of Indian Agri-Business Incubators (NIABI) 2011-An Initiative of ICAR-NAIP Global Agri-Business Incubation Conference at ICRISAT, Hyderabad from 8 to 10, March 2011.

Dr M R Manikantan and Dr Deepika Goswami participated in the six days training on Data analysis using SAS at NDRI, Karnal during 18-24, December 2010.

Dr. M.R.Manikantan, participated one day sensitization cum training workshop for Nodal Officers on the use of PIMS-ICAR for data entry and updating of projects data on 26.04.2010 and 15.11.2010 at IASRI, New Delhi

Dr R Kumar participated 4th Indian Horticulture Congress held at NPL, Delhi during 18-21 November, 2010.

Dr R Kumar attended short term training on biotechnological approaches for enhanced production of nutraceutical in fruits and vegetables at CIAH Bikaner w.e.f. 14.02.11 to 27.02.11

Dr Suresh K Devatkal attended Agrotech conference 2010 at Chandigarh (December 0210).

Dr Suresh K. Devatkal attended and presented a research paper during XXVII Annual Conference and national Symposium of Indian poultry Science Association. Chennai, Sept. 16-19.

Dr Pranita Jaiswal attended International conference on Greening food processing sector for sustainable food supply at Thanjavur on 31st October, 2010 & presented paper entitled "Near infra red raising technique for measuring swetnus of Larava.

Dr Pranita Jaiswal attended International workshop on HACCAP and GMP on dairy and meat industries and ISO certification at Thanjavur on 30th October, 2010

Dr Manpreet G. attended National seminar on "Food Safety management systems as per IS/ISO 22000' on 1st June, 2010 at Patna. The seminar was organized by organized by Bureau of Indian Standards.

Dr. Manpreet G. participated in one day International Workshop on "HACCP and GMP in Food Industries and ISO Certification" on 30th October 2010 at IICPT, Thanjavur, Tamilnadu.

Dr Manpreet G. attended in-house training on biosensor Surface Plasmon Resonance at CIPHET, Ludhiana and one week training on data analysis using SAS at NDRI, Karnal on Nov. 22-27, 2010.

Dr Yogesh Kumar participated in Winter School on Requirements and developments in processed meat sector for better utilization of meat animal resources, organized by NRC on Meat, Hyderabad - 500 039 (7th-16th December 2010).

Dr N Gaikwad participated in National Seminar on "Pomegranate Plant Nutrition, Protection & Post harvest management" at Sangola Dist. Solapur (MS) organized by Maharashtra Pomegranate Growers Research Association Pune.

Dr N Gaikwad participated in training programme on Ultraviolet, Visual and Near Infra Red Spectroscopy methods and data analysis for evaluation of foods and biomaterials at commercial level at CIPHET

from Jan. 3-8, 2011.

Dr N Gaikawad participated in Training programme on "Ultraviolet, Visual and Near Infra Red Spectroscopy methods and data analysis for evaluation of foods and biomaterials at commercial level" at CIPHET from 3rd to 8th January 2011.

Dr Monika Sharma attended Foundation Course for Agricultural Research Service in 90th FOCARS during 20th April to 17th August 2010 at NAARM, Hyderabad.

Dr Monika Sharma participated in Training programme on "Data Analysis Using SAS" held at NDRI, Karnal, from Jan 24 – 31, 2011.

Dr Monika Sharma attended National Conference on, "New Horizons in Bio-processing of Foods (NHBF-2011)" and presented a poster entitled 'Preparation of *sev* fortified with unripe banana' held at SLIET, Longowal, Punjab during 25-26 February 2011.

Dr Indu Karki participated in an International Conference on Women and child issues: National and international perspectives held at Patiala on February 11-12, 2011

Dr T Ahmad participated in the X Agriculture Science Congress and exhibition at NBFGR, Lucknow from 10/02/2011 to 12/02/2011.

Dr T Ahmad attended training programme on Creative Writing on Agriculture held from 14-18 Feb, 2011 at Indian Institute of Mass Communication, New Delhi.

Dr T Ahmad T attended workshop on state level training planning for the KVKs of Punjab, at PAU Ludhiana.

Dr Rahul K. Anurag attended a training programme on Data Analysis using Statistical Analysis System of the NAIP Consortium "Strengthening Statistical Computing for NARS: at National Dairy Research Institute, Karnal during March 22-28, 2011.

Dr Manjunatha M undergone training program on Use of ICT in project monitoring and evaluation at MANAGE, Hyderabad during Feb 7-11, 2011.

INSTITUTE ACTIVITIES

Institute Technology Management Unit (ITMU)

Liscensing and commercialization of technologies

During 2010-11, 11 technologies have been commercialized and 28 more technologies are ready for commercialization. Also 13 entrepreneurs have registered as member of institute for advisory & consultancy of different projects. The technologies commericialized and consultancies provided by the institute during 2010-11 are listed as under :

Technologies commercialized and consultancies provided by ITMU (2010-2011)

Sr. No.	Name of the technology	Contracting party
1.	Post-harvest Turmeric Processing	Ms. Sukhwinder Singh Grewal,Vill. kotli, The Payal Distt. Ludhiana
2.	CIPHET EC Technology (Capacity 5-7 ton)	Sh. (Dr.) Jatinder Singh Dhaliwal, Project Manager Industrial area-26, Gurdaspur
3.	Evaporative cooled room (Capacity 2 ton)	Sh. (Dr.) Jatinder Singh Dhaliwal, Project Manager Industrial area-26, Gurdaspur.
4.	Groundnut milk & Paneer Technology	Mr. Chandra Pal Jain S/o Sh. Mohan Lal Jain, 27, Mithla Puri, Phase-III, Delapeer, Bareilly(U.P)
5.	Green Chili Powder and Puree.	Mr. Shrichand Mandloi S/o Kamalchand Mandloi 4, Gujan, Sanawad, Pin-451111 (M.P)
6.	Green Chili Powder and Puree.	Mr. Ajeet Kumar Singh S/O Shri Ombir Singh, 51/5, Nehru Nagar East, Bhilai Nagar, Pin-490020, Chhattisgarh.
7.	Green Chili Powder and Puree.	Mr. Anirudha H. More S/o Shri Hari K. More, Rukhmini Niwas, Rahuri Khurd, Rahuri, Dist-Ahmednagar (Maharashtra), A' Nagar, Pin-413705
8.	Guava bar technology	Mr. Vikas Punia S/O Sh. Omparkash Punia, 51, Gali No: 8, Shanty, Bhiwani (Haryana)
9.	Production of baby foods and extruded products	Mrs. Veenu Sood, # 248-H, SRS Nagar, Pakhowal Road Ldh.
10.	Green Chili Powder and Puree.	Mrs. Pratibha Mahajan C/O Suresh Mahajan 39, Ravinder Nagar Khargon Dist. Khargon M.P.
11.	Green Chili Powder and Puree.	Mr. T. Santosh Kumar, 86, DhanaLakshmi Colony, Mahendra Hills, Secundrabad.
12.	Green Chili Powder and Puree.	Mr. Vikhil Dhyaneshwar Gudadhe, #864, Near Shiv Temple, Jaitala, Nagpur-16
13.	Makhana Kheer Mix Technology	Mrs. Gouri Mahto C/o Raj Kumar Mahto M/S Vijay Raj & Company, Baheri Darbhanga-847105 Bihar
14.	Microencapsulator with multiple air jet droplet generators for production of microcapsules	M/s Unique Biotech Ltd. Plot no 2, Phase -2, S.P. Biotech park, Kolthur, Shameerpet Mandal, Ranga Reddy Distt. -78, AP.
15.	Bee breeding and keeping profile	Mr. Jaswant Singh Tiwana, Tiwana Bee farm, G. T. Road, Doraha, Ludhiana

Sr. No.	Name of the technology	Contracting party
16.	Soymilk Paneer and curd Technology	Mr. Gurdeep Singh Village Kartarpur P/O Lehal dist. Ludhiana
17.	Technology for Snack Foods	Mr. Rishi Aggarwal M/s Hoshiarpur Roller Flour Mills Pvt. Ltd. Bye Pass Naloyan, Hoshiarpur
18.	Onion powdering technology	Mr. Dilip B. Sangle A/P Shedgaon Tal-Sangamner Dist. Ahmednagar (MH.)
19.	Onion powdering technology	Mr. Vijay. U. Pankade, E-90, Balaji Nagar, Behind Sindhi Colony Aurangabad-431005
20.	Green Chili Powder and Puree.	Mr. Vikhil Dhyaneshwar Gudadhe, #864, Near Shiv Temple, Jaitala, Nagpur-16
21.	Green Chilli Processing Technology.	Farm Green Company, 17/41 Singhpura Mohalla, Near Jagraon Bridge, Ludhiana
22.	Ohmic heaters for Rice bran Stabilization	Mr. V. Gowthaman, Surya & Co., F-3 Sripatham apartments, 33/4, Sir C.V. Raman Road, Alwarpit, Chennai-600018
23.	Groundnut/Soyamilk Paneer Technology	Mr. Mahinder Singh Vill.Kauri, PO Khanna Dist. Ludhiana
24.	Green Chilli Processing Technology.	Mr. S.K. Chaudhari At/PO Vadri Taluk Yawal Dist. Jalgaon
25.	Training and Licensing of Green Chilli Powder.	Mr. Suresh D. Navale A/P Padegaon Tal-Khandala Dist. Satara (MH).
26.	Extrusion Technology for Snack Foods	M/S Jyotirmay Foods, Mr. Kuldeep Kumar, Vill. Khapparwada Post: Dangnia, Gumderdehi Durg (C.G.)
27.	Technology for preparation soymilk, paneer etc.	Mr. Sham Sunder, Near Sanjay Flour Mall, Factory Road, Kotkpura Distt. Faridkot
28.	Consultancy & Detailed project profile on guava processing	Mr. Paramveer Singh Rai, 104-G, BRS Nagar, Ludhiana
29.	Extrusion Technology for Snack foods	Mr. T. S. Kumarasamy, Christy Friedgram Industy A2&A3 SIDCO Industrial Estate Andipalayam, Tiruchengode-637214., Tamilnadu.
30.	MOU for Information about Technologies and other Post harvest related activities	Mr. Sajiv Anand INEXT Bureau-Servicing Last Mile Pvt.Ltd. L-6, CR Park, New-Delhi 110019.
31.	Green chili puree & green chili powder	Mr. Ashok Khasgiwala, 38, Mahaver Nagar, Kanadia Road, Indore
32.	Licensing & training of Guava product processing	Mr. Paramveer Singh Rai, 104-G, BRS Nagar, Ludhiana
33.	Meat processing and value addition Technologies	Mr. B.Srinivas Rao, Sh. Laxmi Emu Farms, Kakinado (AP)
34.	Meat processing and value addition Technologies	Mr. Jaspreet Singh Sangha, California Farms, Bhrowal Khurd, Ludhiana
35.	Meat processing and value addition Technologies	Mr. Gursharanjit Singh Padam, White Pearls Poultry Farms, 40-F Sarabha Nagar, Ludhiana

Brain Storming Meeting on Post-Harvest Technology and Value Addition of Agricultural Produce

Brain storming meeting to review the present scenario of the post-harvest technology research in India and to identify critical gaps and formulate future strategy for research in post-harvest technology, including partnership among R & D institutions was organized at CIPHET, Ludhiana during May 1-2, 2010. The meeting was chaired by Hon'ble Dr S Ayyappan, Secretary DARE and D.G. (ICAR), New Delhi. Dr M. M. Pandey, DDG (Engg.) ICAR; Dr Arvind Kumar, DDG (Edu. & Fisheries) ICAR; Dr H. P. Singh, DDG (Horticulture) ICAR; Dr Bangali Baboo, National Director, NAIP; Dr R. P. Kachru, Ex-ADG (PE) ICAR; Dr Pitam Chandra, Director, CIAE; Dr C. S. Prasad, ADG (ANP), ICAR; Dr K. K. Singh, ADG (PE), ICAR; Prof Satish Bal, Ex-Head of the Dept., IIT Kharagpur and Dr N P S Sirohi, ADG (Engg.), ICAR chaired and co-chaired the important sessions. The brain storming meeting was organised in six sessions namely: Food Grains & Oilseeds Processing; Animal Housing and Livestock Products Processing; Fish Processing; Processing of Horticultural and Cash Crops; Crop Residues Utilization and Natural Fibre Processing and Plenary Session.

Dr S Ayyappan, Secretary DARE and D.G. (ICAR), New Delhi sensitized the delegates and participants about the need of the hour in the area of post harvest engineering and technology. Dr Ayyappan mentioned that reduction in post harvest losses should be given immediate attention as it will make available more food. In addition to this Dr Ayyappan suggested the following few important issues for consideration during the brain storming session:

The content of post harvest research in ICAR for food and non-food crops may be decided.

Prioritize few commodities for next five years, keeping in mind the huge clientele in India which prefers fresh material.

Establish visible enterprises.

Evaluate existing technologies in terms of efficiency, economy, performance, and handling.

Identify 3-4 core areas in which we have strength.

Establish high tech agri-processing facilities in most relevant areas.

Feedback to the breeders on processing characteristics is an important issue and should be addressed.

Facilities for testing of food safety and quality may be established.

Interaction with industry representatives should be taken up to refine our planning.

Wherever required the concept of reverse engineering may be utilized, for downsizing important equipments.

Annual meeting of all post harvest scientists from ICAR institutes may be organized for sharing their work.

CIPHET should act as a repository for all post harvest technologies.

New centres may be proposed for establishment during 12th five year plan.

Dr. R.P Kachru explained that how we should work on modern technology to keep pace with

development at the international level. Dr. Bangali Baboo was of view that close liaison with commodity institutes, centre wise need assessment for AICRP on PHT & AICRP on APA, market survey for clientele and techno economic analysis should also be taken up. Dr. Ayyappan asked to constitute a committee at national level to co-ordinate the activities on post harvest technology in various institutes of ICAR with CIPHET. For this DDG (Engg.) will be Chairman and Director, CIPHET will serve as Member Secretary and committee will have eight important ICAR institutes involved in research on post-harvest technology as its members. DDG (Engg.) expressed happiness on deliberations and expressed that close liaison with commodity institutes, complementarity's between CIPHET and AICRP's, selection of new projects based on need assessment, market survey for clientele, users and processors and techno-economic analysis should be given due importance.

Brain Storming Meeting on Secondary Agriculture

Another brainstorming meet on Post Harvest Technology and Value Addition (Secondary Agriculture) was held under the chairmanship Hon'ble DG, ICAR on December 13th, 2011. The major points emerged during the session included research on production of high end secondary agriculture products that can be taken up without affecting the need and necessities of Indian agriculture. Many important areas such as use of livestock processing waste and fish processing waste for bioactive compound extraction, use of natural fibers for bio-plastics and bio-composites, culled potato and tapioca for bio plastics, extraction of pectin's from peels of fruits, production of bio ethanol, extraction of vitamins and dietary fibre from vegetable waste taking place in bigger markets like Azadpur Mandi in Delhi along with the use of spent material as animal feed were discussed.

National Committee on Post-Harvest Technology and Value Addition

A committee under the chairmanship of DDG (Engg) ICAR, New Delhi has been constituted to take stock of the postharvest research activities in various institutes of ICAR. The composition of committee is as follows:

S. No.	Name	Designation
1.	DDG (Engg.), ICAR, New Delhi	Chairman
2.	Director, IIHR, Bangalore, Karnataka	Member
3.	Director, CIFT, Cochin	Member
4.	Director, NIRJAFT, Kolkata (W.B)	Member
5.	Director, IINRG, Ranchi	Member
6.	Director, CPCRI, Kasargod	Member
7.	Director, CTCRI, Trivandrum	Member
8.	Director, CISH, Lucknow	Member
9.	Director, CIRCOT, Mumbai	Member
10.	Director, IIVR, Varanasi	Member
11.	Director, CPRI, Shimla	Member
12.	Director, MAP Research, Anand	Member
13.	Director, NRC on meat, Hyderabad	Member
14.	Director, CIPHET, Ludhiana	Member-Secretary

The important functions of the committee are to (i) Assess status of postharvest research technology R&D at different institutes (ii) To assess postharvest technology requirements of different commodities and their value chain (iii) Prioritization of researchable issues (iv) Finalization of projects and partenerships and (v) To overarch the postharvest technology R & D in ICAR vis-à-vis needs at national level and activities of other organization.

Institute Research Council (IRC) Meeting

The 18th Institute Research Council Meeting was organized during August 20-21, 2010 at the institute.

The progress of completed projects, ongoing projects and new projects were discussed. Dr. Jarnail Singh, Professor-cum-Head, Department of Processing and Food Engineering, PAU, Ludhiana graced the occasion as an expert. Dr. R. T. Patil, stressed upon the need to adhere to the mandate of the division, institute and the nation in taking up the projects. He highlighted the use of hurdle technology to increase the shelf-life of the processed products, post-harvest management, packaging and value-addition to increase the farmer's return. He stressed the need for basic research in the area of storage of food grains in silos. He further emphasized that scientists with engineering disciplines should work in the area of equipment development. The advantages of the water-proof packaging of the food grains in the sacks were discussed. The major projects and their activities to be taken up in the coming years were planned under the following areas:

Development of machinery and process protocol for value addition of horticultural crops.

Equipment & protocols for safe handling of horticultural produce.

Design, development and refinement of equipment using newer concepts for processing of food grains.

Development of functional foods from food grains and their by products.

Development of technologies for environmental control for enhancement of shelf life of food products, livestock productivity and utilization of crop residues through fermentation.

Development of appropriate processes machinery and value added processes for livestock produce including fisheries.

Development of rapid and non-destructive methods for determining the food quality and safety parameters.

Modification, refinement and evaluation of post-harvest technologies and their multiplication.

Development of linkages through training, mass media & liaison for technology transfer.

Research Advisory Committee (RAC) Meeting

The Research Advisory Committee (RAC) meeting was held under the Chairmanship of Prof. Satish Bal, IIT Kharagpur on May 4, 2010. Dr. Patil in his welcome address expressed his desire to find out support systems needed for reducting post-harvest losses in 12th plan. He enumerated some infrastructures such as modern bulk storage system for grain, radiation facilities for fruits and vegetables for extending shelf life, modern efficient cold storage structures for fruits and vegetables and energy efficient cold store for livestock products. He also emphasized the need of an auditorium in CIPHET, Ludhiana, for organizing national and International seminars. Video conferencing and multimedia systems development for dissemination of CIPHET technology were other infrastructures

felt for CIPHET,Ludhiana. Dr. Patil informed the RAC about capacity building programme and trainings undertaken by various scientists cutting edge areas of research. Long term trainings of students in CIPHET and utilization of those in our

R&D work was also emphasized. In the light of brain storming session held on May 1-2, 2010, he informed the RAC that ICAR has felt a need to have some more centers of CIPHET. Dr. Patil also informed the RAC that the name of TOT division and its work/project also need to be discussed.

Another meeting of Research Advisory Committee (RAC) was held under the Chairmanship of Prof. Satish Bal, IIT Kharagpur on February 25 – 26, 2011. Dr. Patil appreciated the Chairman and other members for giving their valuable time as and when requested for enhancement of research output of CIPHET, Ludhiana. He informed that government is going to finance many projects and activities related to post-harvest engineering and technology in the 12th Plan. There is also possibility of 100% FDI through ASSOCHAM in this sector. Dr. Patil offered that CIPHET can provide leadership through KVK's and other ICAR institutes. The RAC chalked out the programmes to be taken up in 12th plan and identified the future thrusts.

Committee to Redraw Specification for Modern Godowns and Silos

The Deptt. of F & PD, Ministry of consumer affairs and public distribution constructed an expert committee headed by Director, CIPHET, Ludhiana to re-examine and redraw the specification for modern godowns and silos to be hired under guarantee scheme. This committee had an expert each from IIT, Kharagpur and IIT Roorkee. The members from Food Corporation of India (FCI), Bureau of Indian Standards (BIS), Central Warehousing Corporation (CWC) and National Cooperative Development Corporation (NCDC). The committee meetings were held in Ludhiana and New Delhi on 25th oct, 2010, 11th Feb, 2011 and 18th Feb, 201, respectively. The committee worked out the specifications for conventional godowns, specifications for modern godowns, methodology for mechanization of godown operations and specifications for construction of bulk storage silos. The committee looked into the new construction materials which could be used in place of asbestos sheets/ GI sheets and these have been included in specification for modern godowns. Rain Water harvesting and monitoring temperature/ handily has also been included in specifications of modern godowns. In order to reduce drudgery of labor a methodology has been suggested for mechanization of stacking, destacking and movement of grains bags. The specification for silos has also been included and these serve as an alternative to godowns. The committee opined that the mechanization need to be implemented in parts to watch performance hence a section on mechanization requirement and methodology to implement it in selected godowns has also been suggested. The mechanization is aimed to reduce drudgery and improve work efficiency of work force has been suggested.

Training Program for Egyptian Farmers

Dr Moustafa Saleh Emam, Chairman of Vegetable Handling Research Department, Agricultural Research Horticultural Institute, Gizo, Egypt, attended a training programme at CIPHET. He said that most of the country is under desert and also due to very small landholdings large scale mechanization of agriculture is not possible. Very less fruits and vegetables are processed and most of them are consumed as fresh. Dr Moustafa was quite impressed with research work on non-destructive methods to evaluate quality of fruits and vegetables, drying methods for fruits and vegetables and work on modified atmosphere packaging at CIPHET.

Indo-Africa Forum Summit Training

CIPHET organized Ministry of External Affairs, Government of India sponsored 15 days Indo-Africa Forum Summit Training on "Post Harvest Processing and Value Addition of Food Grains" from 8 – 22 February 2011. Dr.R.T.Patil, Director and Dr.M.R.Manikantan, Senior Scientist coordinated this training programme. A total of 13 participants working in Ministry of Agriculture and Allied fields from Egypt, Mali, Nigeria, Tanzania, Malawi, Mauritius, Niger and Mauritania attended this training programme. During this training

programme, the participants were exposed to primary processing, drying, milling, extrusion processing, baking, malting, storage and packaging of food grains and co-products utilization in the form of lectures, practical and demonstrations. The participants visited CIPHET, Abohar for demonstration of millet processing, M/s A.P.Organics Pvt. Ltd, Dhuri for rice bran oil extraction, M/s Lakshmi Energy and Feeds Ltd., Khamanu for rice milling, M/s Cremica Bector Foods Ltd., Phillaur for Biscuits plant, M/s B.K.Soya Industries, Sangrur for soy based dairy analogues and snacks plant, M/s Adani Agro Logistics Ltd., Moga for bulk handling and storage system for food grains. Some of the suggestive area of collaboration with CIPHET/ICAR by the participants are Agro machinery design and fabrication, cold storage of fruits and vegetables, value addition to the co-products from grain processing, Entrepreneurship Development Programme on prominent technologies, Assistance in rice milling turn key projects, post harvest quality control, extrusion processing, solar drying, packaging and storage, baking technologies, primary processing of food grains, processing and

International Training for participant from AARDO Member Countries

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

Collaborative Training Program at CIPHET, Abohar

One day training program on cottage level food processing entrepreneurship development for the farmers was jointly organized by CIPHET and Indian Institute of Crop Processing Technology (MOFPI, Govt. India, Thanjavur (Tamilnadu) on 2nd February, 2011 at CIPHET, Abohar. Around 70-80 farmers including men and women of nearby Abohar participated in the programme. The training included

lectures, practical and field visits. The hands on training was given to prepare value added products such as mixed fruit jam of apple, mango and papaya, lemon squash, lemon pickles, etc. Dr. R.K. Gupta, Head, HCP and Mr. Amutha Surabi, Scientist, IICPT, Thanjavur were the training coordinators.

Training programme on Value Addition of Fruits and Vegetables

Two days Exposure Programme on Cottage level manufacturing of value added products from Fruits and Vegetables for Rural Women (Under

MAI-BHAGO Women Empowerment Scheme of Cooperative Dept., Govt. of Punjab) jointly organized by CIPHET and The Kerakhera Multipurpose Cooperative Society Ltd., during 21-22 March 2011. Around 25-30 women of nearby this village participated in the programme. The training included lectures, practical and field visits. The hands on training was given to prepare value added products such as mixed fruit jam of apple, mango and papaya, lemon squash, lemon pickles, etc. Besides, the group also visited Grain Processing Plant, Small millet Plant and Kinnow grading and Waxing unit and other laboratories and field of the institute.

Awareness Camp for Rural Women on Food Processing at CIPHET, Abohar

One day awareness programme on Food Processing was organized by IFFCO with the technical support of CIPHET, Abohar for rural women. The camp was organized at Village Ghallu Tehsil Fazilka, Distt. Ferozpur on 30th July 2010. In this training programme 70-80 rural women have participated. The hands on training was given to prepare value added products such as mixed fruit jam of apple, mango and papaya, lemon squash, lemon pickles, etc. Besides, group has also been explained the process for preparation of value added products from aonla, Ber and Jamun.

Training on production of guava leather

Conducted lab cum demonstration programme for custom hiring of facility for processing of guava into guava leather to Ludhiana based entrepreneur from 22-25 August, 2010 and Zamidara Farm Solution, Fazilka from 22-24 March, 2011. The groups were exposed to various techniques of novel product development from guava by utilizing pilot facility for processing of fruits and vegetables at CIPHET Abohar.

VISITS

Deputy Director General (Crop Science) of Indian Council of Agricultural Research, Dr. S. K. Dutta visited the Institute on 28 August, 2010 to get firsthand account of various initiatives taken by the institute in the area of post harvest engineering and technology. Dr Dutta said that still more than 30 percent of Indian population was affected by malnutrition and providing food security was emerging as big challenge globally. He said that more focus should be given on development of high energy processed food so that people could stay active throughout the day.

Dr R.P. Dua, Assistant Director General (Food and Fiber Crops) visited the institute on 30th August 2010 to get information regarding various research activities initiated by the institute. Dr R.T Patil briefed Dr R.P Dua about various products and processes developed by the institute to help farmers increase their income level. It was emphasized that without value addition situation of farmers could not be improved. A video film showcasing achievements, activities and mandate of CIPHET was also screened for Dr Dua.

Dr Jiwan Singh Sidhu, Prof. and Head, Department of Family Science, Kuwait University delivered a talk on "Healthy Eating-View of Food Technologist" at CIPHET on 13th August, 2010.

Prof. Sun-Ok Chung & Prof. Dong-II Chang (Former President of Korean Society for Agricultural Machinery), Department of Biosystems & Machinery, Chungnam, National University, South Korea visited CIPHET on 20/08/2010 along with Dr. Manjeet Singh, Research Engineer, Deptt. Farm Power and Machinery, PAU Ludhiana.

Dr Manjit Singh Chhinnan from University of Georgia, delivered a lecture "Developing new food technologies and transferring them to private sector" at institute on Sept. 15, 2010. He emphasized that multidisciplinary coordination is required for developing commercially viable food products. Dr Chhinnan said that transfer of technology is the most crucial aspect for success of any product.

Dr Joyce I. Boye, from Agricultural & Agri Food Canada (AAFC), Government of Canada, visited the institute to find collaborative research projects and activities in area of food processing with special emphasis on processing of pulses. Notably, the visit was the part of Canada-India Memorandum of Understanding in year 2009 to explore opportunities to increase scientific co-operation between two countries. The objective of visit at CIPHET was to engage in discussions with key scientists in areas of value added food processing. Dr Joyce discussed research ideas on value added food processing & reduction of post harvest losses with Director CIPHET. She also made a presentation on value added processing in Canada focusing on research activities on pulses crops.

Sh. Bijay Kumar, Managing Director, National Horticulture Board (NHB), Govt. of India

visited CIPHET and held detailed discussions with Dr. R.T. Patil to explore possibilities of collaboration and get first hand information regarding research activities initiated by the CIPHET. He specifically emphasized on the promotion and mass production of the equipments developed for this sector by the institute. Sh. Bijay Kumar also indicated the possibility of funding Entrepreneurship Development Programmes for farmers as well as young entrepreneurs pertaining to PHM and value added product manufacturing from fruits and vegetables at CIPHET.

Dr. Workinesh Abede, Director, Agricultural Mechanization Research Processing of Ethiopian Institute of Agricultural Research visited CIPHET for finding various areas of collaboration. Mr. Abede informed that they are looking for simple, economic and effective solutions for their small farmers. He also desired to develop linkages with Indian institutes including CIPHET for adopting technologies.

Celebration of Foundation Day of CIPHET

On December 29, 2010, foundation day was celebrated at CIPHET Ludhiana. Dr. Anil P. Joshi, Padam Shree 2006 was the chief guest on the occassion. Dr. Joshi stated that "Judging growth of country by increasing GDP is not correct. The growth of country should be judged from fact how much better we have moved in terms of environment from previous years and how much more food we are able to make available to poorest of poor." The foundation day was attended by all the employees of the institute.

RESEARCH ADVISORY COMMITTEE

Sr. No.	Name & Address of RAC Members	Designation	Contact/Fax No/Email
1.	Dr. Satish Bal Professor Agricultural Engineering Indian Institute of Technology Kharagpur- 721 302 (W.B)	Chairman	Ph.: 03222-283100 (O) 03222-283101 (R) Mobile : 09434004812 Email : sbal@agfe.iitgp.ernet.in satish.bal@gmail.com
2.	Dr. N.C. Patel Dean, College of Agril. Engg. and Technology Junagarh Agricultural University Junagarh- 362 001 (Gujart)	Member	Ph.: 0285-2671018 Telefax (O) 0285-2672292 (R E-mail: ncpatel@jau.in caet@jau.in Mobile : 09879104668
3.	Dr. G. R. More Director Research Marathwada Agricultural University Parbhani - 431 038	Member	Ph.: 02452-220121 Telefax (O) 02452-232744 (R) Mobile : 09226388479 Email : directores@rediffmail.com
4.	Dr.(Mrs.) Kanta K. Sharma B- XI/8025, Vasant Kunj New Delhi - 110 070	Member	Ph.: 011-26137830 Mobile : 09810666873 Email : kantasharma@yahoo.co.in
5.	Sh. C.K. Basu, IAS (Retd.) President All India Food Processors Association 206, Aurbindo Place, Hauz Khas New Delhi - 110 016.	Member	Ph.: 011-26510860, 011-26518848 Fax : 011-26510860 Mobile : 09899252236 Email : aifpa@vsnl.net vishal@aifpa.net
6.	Dr. K.K. Singh ADG (PE), Agril. Engg. Division CIPHET, Ludhiana.	Member	011-25846492 095825-62695 (M) kksingh@icar.org.in
7.	Dr. R.T. Patil Director, CIHET, Ludhiana	Member	0161-2808669, 0161-2808674 (O) 0161-2808196 (R) 9216338421 (M) rtpatil@sify.com, ciphet@sify.com ramabhau@yahoo.com
8.	Dr. S. N. Jha (w.e.f 26-3-10) Head, AS & EC Division	Member Secretary	Ph.: 0161-2313109 (Off.) Ph. : 0161-2306169 (Off.) Fax : 0161-2808670 94176-01715 (Mobile) snjha_ciphet@yahoo.co.in ciphet@sify.com

INSTITUTE MANAGEMENT COMMITTEE

Sr. No.	Name & Address of IMC Members	Designation
1.	Director, CIPHET, Ludhiana	Chairman (Ex-Officio)
2.	Director of Agriculture Govt. of Punjab, Chandigarh	Member
3.	Director of Post Harvest Technology, Govt. of Maharashtra.	Member
4.	Dr. Partap Singh Dean, College of Agril. Engg., HAU, Hissar	Member
5.	Sh. Harinder Singh Lakhmirwala, P.O. Sunam, Distt. Sangrur	Member
6.	Sh. Feroze N. Masani, Harabaug, Gangapur, B.O Via YCMOU, P.O. Nasik-422 222 (Maharashtra).	Member
7.	Dr. Tarun Kapoor, Principal Scientist, Post Harvest Technology, Central Institute of Agricultural Engg. Nabhibagh, Baresia Road BHOPAL -462 038 (Madhya Pardesh)	Member
8.	Dr. Jaswant Singh, Head, Deptt. of Agril. Engg., Indian Institute of Sugarcane Research, P.O Dilkusha, LUCKNOW –226 002 (Uttar Pardesh)	Member
9.	Dr. Shyamal Banik, Principal Scientist, National Institute of Research on Jute & Allied Fibre Technology, 12, Regent Park, KOLKATA-700 040 (West Bengal)	Member
10.	Dr. R.K. Goyal, Principal Scientist, (AS&PE), CIPHET, Ludhiana	Member
11.	Dr. K.K. Singh, Asstt. Director General (PE), Indian Council of Agriculture Research, Krishi Anusandhan Bhawan-II, Pusa, NEW DELHI-110 012	Member
12.	Senior Finance & Accounts Officer, National Dairy Research Institute, KARNAL-132 001(Haryana)	Member
13.	Sh V.K. Garg, I/C, Head of Office, CIPHET, Ludhiana (In place of Sh. Tej Ram)	Member Secretary

PERSONALIA

PROMOTIONS

Dr. M.R. Manikantan has been promoted from Scientist (SS) to the post of Sr. Scientist w.e.f. 10th March, 2011.

Dr. Mukund Narayan has been promoted from T-4 to the post of T-5 (Technical Officer) w.e.f. 09-08-2009.

Sh.Pradeep Kumar has been promoted from T-1 to the post of T-2 (Field/Farm Technician) w.e.f. 23-09-2009.

Sh. B.C. Katoch has been promoted from Assistant to the post of Assistant Administrative Officer and Sh. Kunwar Singh & Sh. Avtar Singh have been promoted from Upper Division Clerk to the post of Assistant w.e.f 06-09-2010 respectively.

Sh. Mohan Lal has been promoted from UDC to the post of Assistant w.e.f. 4th March, 2011.

Sh. Tarsem Singh has been promoted from UDC to the post of Assistant w.e.f. 4th March, 2011.

Sh. Harbhupinder Singh has been promoted from LDC to the post of UDC w.e.f. 4th March, 2011.

Sh. Iqbal Singh has been promoted from LDC to the post of UDC w.e.f. 4th March, 2011.

Sh. Sarup Singh has been promoted from Skilled Supporting Staff to the post of T-1 (Lab. Tech) w.e.f. 07/05/2010.

JOINING

Dr Deepak Raj Rai joined as Head (Transfer of Technology)

Dr. Deepak Raj Rai did B.Tech. (Agril. Engg.) from PAU, Ludhiana during 1987, did Master's from IIT, Kharagpur in 1989 and doctorate from PAU, Ludhiana in 2006. Dr. Rai joined ICAR as Scientist in January 1992 and joined CIPHET, Ludhiana in 1993. Dr. Rai has been involved in Research, Extension and Teaching at CIPHET, Ludhiana. He has expertise in food packaging and has worked at National Food Research Institute Japan and School of Packaging, Michigan State University, USA in the area of Food packaging. He has a number of publications in International journals of repute and has guided a number of undergraduate and post-graduate students in the area of food packaging. He assumed the charge of Head (Transfer of Technology) on August 25, 2010.

Dr. Sunil Kumar joined as a Sr. Scientist (Biochemistry-Plant Science) at CIPHET, Ludhiana on 23rd February, 2011. He did his graduation from Kurukshetra University, Kurukshetra. He accomplished his post graduation and Ph.D from CCS Haryana Agricultural University, Hisar. He has served as Assistant Professor at MPUAT, Udaipur and as Assistant Scientist at CCSHAU, Hisar. He has published more than 15 papers in journals of international and national repute, and contributed 3 book chapters and a training manual

Mr. Vijay Singh Meena has joined at HCP Division, CIPHET, Abohar on 22.04.2010 as scientist (Hort.). He is having B.Sc.Ag. (Hons) and M.Sc. (Hons.) in Horticulture from R.A.U., Bikaner (Raj.). In his P.G. research work he has worked on "Effect of ferrous sulphate and borax on yield and quality of Ber Cv.Gola"

Ms. Deepika Goswami joined Food Grains and Oilseed Processing Division of CIPHET. as a scientist (Food Science & Technology) on 23rd April 2010. She is on alumnus of Jawahar Navodaya Vidyalaya, Tarikhet, Almora. She obtained her B.Sc. & M.Sc. degrees from G.B. Pant University of Agriculture & Technology, Pantnagar. Before joining CIPHET, she worked in a company Bakers Circle (I) Pvt. Ltd, Kashipur for

nearly 2 years. She also did teaching in the Deptt. of Food Science & Technology, G.B. Pant University of Agri. & Technology, Pantnagar before joining ARS.

Ms. Monika Sharma has joined CIPHET on 26th August 2010 as Scientist in the division of Food Grains & Oilseeds Processing. Her ARS discipline is Food Science and Technology. She did her Bachelor's degree in Food Technology from Delhi University. She has done M.Sc. Food Technology from GB Pant University of Agriculture & Technology. Her M. Sc. thesis title is 'Studies on Preparation of Sev using Unripe Banana'. She had joined NDRI, Karnal in 2008 for pursuing Ph.D. in Dairy Technology.

Dr. Indu Karki has joined CIPHET on 27th August 2010 as Scientist in the division of Transfer of Technology. Her ARS discipline is Family Resource Management. She did her bachelor's degree in Home Science from G.B. Pant University of Agri. & Tech. Pantnagar. She did M.Sc from P.A.U Ludhiana and Ph. D. from G.B. Pant University of Agri. & Tech, Pantnagar. Her Ph.D thesis title was "Application of hospital ergonomics in working environment of nurses in health care industry of Uttarakhand state".

Dr Rahul Kumar Anurag joined as a Scientist (Food Science & Technology) in ASEC Division, CIPHET Ludhiana on 18th Sep 2010. He has completed his Master and Doctorate from G B Pant University of Agriculture and Technology, Pantnagar in 2004 and 2008 respectively. He worked on optimization of ripe mango powder using vacuum and freeze drying. He has also served in Centre of Food Science & Technology, Institute of Agricultural Sciences BHU, Vanarasi, UP.

Sh. Rajiv Sharma joined the post of T-3 (Lab Tech) on January 25th, 2011at CIPHET, Ludhiana. He has copmpleted his Bachelors and Masters in Food Technology. He has research experience of about six years and authored more than forty international and national publications. Previously, he was involved in National Agricultural Innovation Project (NAIP) on nondestructive quality evaluation of mango and Technology Mission on Oilseeds Pulses and Maize (TMOP & M).

TRANSFER

Dr. V. K. Bhargav, Scientst (SS) (FMP) to CIAE, Bhopal on 27-11-2010.

Sh. Tej Ram SAO to IGFRI, Jhansi w.e.f. 18-3-2011.

Sh. J.S. Paul, Assistant Administrative Officer to CIPHET, Abohar w.e.f. 21-09-2010.

AWARDS AND HONOURS RECEIVED

Central Institute of Post Harvest Engineering and Technology (CIPHET) has participated in Zonal Sports Meet (Zone-IV) held at IIPR Kanpur under leadership of Dr. S. K. Nanda, Chief De-Mission for the period from 6th to 9th April 2010. 18 participants (15 Man and 3 Women) have particpated in various activities such as: Volleyball smashing (Team Leader: Dr. Anil K. Dixit), Volleyball shooting (Team Leader: Mr. Pardeep), T.T., Caram, Badminton, and Athletics (throw(s) and race(s): 100 m and 200m, relay race, etc.). Mrs. Sunita Rana won 2nd prize in 200 m race (women) and Mr. Hardev Singh stood at 3rd position in 100 m race (men). Overall the participants enjoyed this tournament, and extended sincere thanks to the host institute for comfortable stay arrangement, and for providing excellent ground and other sports facilities at IIT Kanpur campus.

CIPHET employees receiving the honors during the ICAR sports meet held at Kanpur

PERSONAL

Name	Designation
Dr. R.T. Patil	Director (AS&PE)
Dr. S.K. Nanda	PC (PHT) (AS&PE)
Dr. P. R. Bhatnagar	PC (APA) (S&WCE)
Dr. S.N. Jha	Head, AS&PE
Dr. Deepak Raj Rai	Head (TOT)
Dr. Sanjeev Kumar Tyagi	Pr. Scientist (Chem. Engg.)
Dr. Dilip Jain	Sr. Scientist (AS&PE)
Dr. Devinder Dhingra	Sr. Scientist (AS&PE)
Dr. K. Narsaiah	Sr. Scientist (AS&PE)
Dr. (Mrs.) Mridula Devi	Sr. Scientist (F&N)
Dr. S. Balasubramanian	Sr. Scientist (AS&PE)
Dr. Harinder Singh Oberoi	Sr. Scientist (Microbiology)
Dr. (Mrs.) Sangeeta Chopra	Sr. Scientist (Elect. Engineering)
Dr. S.N. Bhowmik	Sr. Scientist (Micro-Plant Science)
Dr. Suresh K. Devatkal	Sr. Scientist (Livestock process Tech.)
Dr. Anil Kumar Dixit	Sr. Scientist (Agril. Economics)
Dr. Deep Narayan Yadav	Sr. Scientist (Food Science& Tech.)
Dr. (Mrs.) Pranita Jaiswal	Sr. Scientist (Microbiology-PS)
Dr. Dattatrya M. Kadam	Sr. Scientist (AS&PE)
Dr. M.R. Manikantan	Sr. Scientist (AS&PE)
Dr. (Mrs.) S.K. Aleksha Kudos	Scientist (SS) (AS&PE)
Dr. Pradyuman Barnwal	Scientist (SS) (Mech.)
Er. (Ms.) Manpreet Kaur Grewal	Scientist (AS&PE)
Dr. Gaikwad Nilesh Nivrutti	Scientist (AS&PE)
Dr. Manjunatha M.	Scientist AS&PE)
Dr. Yogesh Kumar	Scientist (LPT)
Dr. Tanbir Ahmad	Scientist (LPT)
Dr. Deepika Goswami	Scientist (FST)
Ms. Monika Sharma	Scientist (FST)
Dr. Indu Karki	Scientist (Home Mgmt)
Dr. Rahul Kumar	Scientist (FST)
CIPHET, Abohar	
Dr. R.K. Gupta	Head, HCP (AS&PE)
Dr. Dinesh Kumar Bharti	Sr. Scientist (Agril. Eco.)
Dr. Jitendra Singh	Sr. Scientist (Agril. Ento.)
Dr. Ramesh Kumar	Scientist (SS) (Hort.)
Er. Rajesh Kumar Vishwakarma	Scientist (SS) (AS&PE)
Dr. D.D. Nangare	Scientist (SS) (S&WCE)
Er. Eyarkai Nambi, V.	Scientist (AS&PE)
Sh. Vijay Singh Meena	Scientist (Hort.)
Dr. Sunil Kumar	Sr. Scientist (Bio-chem.Plant.Sci)
Technical	
Sh. V.K. Garg	T-9 (Technical Officer)
Sh. Mahipal Singh	T-6 (Technical Officer)

Name	Designation
Sh. Om Prakash Moondan	T-5 (Technical Officer)
Dr. Mukund Narayan	T-5 (Agril. Structure)
Sh. Gurdeep Singh	T-4 (Lab. Asstt.)
Smt. Davinder Bhan Chadda	T-I-3 (DEO)
Sh. Hardev Singh Sekhon	T-3 (Driver)
Sh. Beant Singh	T-3 (Driver)
Sh. Chaman Lal	T-3(Lab. Asstt.)
Sh. Lakhwinder Singh	T-2 (Fitter)
Sh. Bhajan Singh	T-2 (Fitter)
Sh. Jaswant Singh	T-2 (Welder)
Smt. Sonia Rani	T-2 (DEO)
Sh. Hardeep Singh	T-2 (Turner)
Sh. Jaswinder Singh	T-2 (Machinist)
Sh. Jagtar Singh	T-2 (Electrician)
Sh. Vishal Kumar	T-3 (DEO)
Sh. Pradip Kumar	T-1 (Field Asstt.)
Sh. Yashpal Singh	T-1 (Field Asstt.)
Sh. Satwinder Singh	T-1(Lab. Technician)
Sh. Sarup Singh	T-1(Lab. Technician)
Sh. Rajiv Sharma	T-3 (Lab. Technician)
Sh. Bhupender Kumar	T-3 (Workshop)
CIPHET, Abohar	
Sh. V.K. Saharan	T (7-8) (Technical Officer)
Sh. Prithvi Raj	T-5 (Technical Asstt.)
Sh. Rajesh Kumar	T-5 (Technical Asstt.)
Sh. Ganpat Ram	T-2 (Driver)
Sh. Devinder Kumar	T-2 (Fitter)
Sh. Dalu Ram	T-2 (Fitter)
Sh. Pawan Kumar	T-2 (Electrician)
Administrative	
SAO	
Ms. Aruna Sharma	FAO
Sh. Manni Lal	AF&AO
Sh. B.C. Katoch	AAO
Smt. Jasvindar Kaur	PA
Sh. Kunwar Singh	Assistant
Sh. Avtar Singh	Assistant
Sh. Tarsem Singh Purba	Assistant
Sh. Gurdial Singh	UDC
Smt. Jasvir Kaur	UDC
Sh. Harbhupinder Singh	UDC
Sh. Iqbal Singh	UDC
Sh. Ashwani Kumar	LDC
Smt. Sunita Rana	LDC
Sh. Ajay Kumar Tandon	LDC
Sh. Ram Khelawan Yadav	LDC
Sh. Sohan Lal	LDC
Sh. Sanjay Kumar Gaur	LDC

Name	Designation
CIPHET, Abohar	
Sh. J.S. Paul	AAO
Sh. Pawan Kumar	Assistant
Sh. Mohan Lal	Assistant
Sh. Rajinder Kumar	LDC
Supporting	
Sh. Sukhbir	Skilled Support Staff
Smt. Viran Bali	Skilled Support Staff
Sh. Shalikgram Dwivedi	Skilled Support Staff
CIPHET, Abohar	
Sh. Surinder Kumar	Skilled Support Staff