Post harvest Engineering and Technology for Food and Nutritional Security

Showcase of CIPHET Developed Technologies

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Objectives

- To reduce post harvest losses to food produced
- To process the raw food to value added products for domestic use and export
- To generate gainful employment in this sector in catchment areas
- To give remunerative prices to farmers for their produce
- Provide leadership in PHET at national and international level

Horticulture production & post harvest scenario

- Agriculture contributes about 21% of GDP and sustains approx 67% of population
- Horticultural crops cover about 9 per cent of the total area in the country contributing about 24.5 per cent of gross agricultural output Fruits and vegetables losses estimated at 25-40%
- India produces about 53.1 and 91.6 million tons of fruits and vegetables and ranks second in world after Brazil in fruits and China in vegetables, respectively
- Low level of processing of fruits and vegetables at only 2%
- Food processing is employment intensive, creates 1.8 jobs directly and 6.4 indirectly for every 10 lakhs invested.

Present level of production of different types of food commodities and their estimated post-harvest losses

Type of food commodity	Present level of production				Post-harvest losses	
	Quantity Mt	Ave. price Rs/t	Value million Rs. crores	%	Quantity Mt	Monetary value Rs. Crores
Durable (cereals, pulses and oilseeds)	230	10000	230000	10	23	23000
Semi-perishables (potatoes, onion, sweet potato, tapioca)	40	3000	12000	15	6	1800
Perishables (Fruits, vegetables, milk, meat, fish and eggs)	210	15000	315000	20	42	63000
Total/Average	480	11604	557000	14.8	71	87800

Source: Kachru, 2005

Magnitude of losses

Loss equivalent to Rs. 63000 crores would be sufficient to construct 30 million sq. m. of floor area of scientifically designed warehouses and 1,800 cold stores of 50,000 tonnes capacity each.

Post harvest Managemnt infrastucture like Cold storages, IQF, Refrigerated vans are as important to reduce losses as that of good road for overall development of the country.

Agro Entrepreneurship

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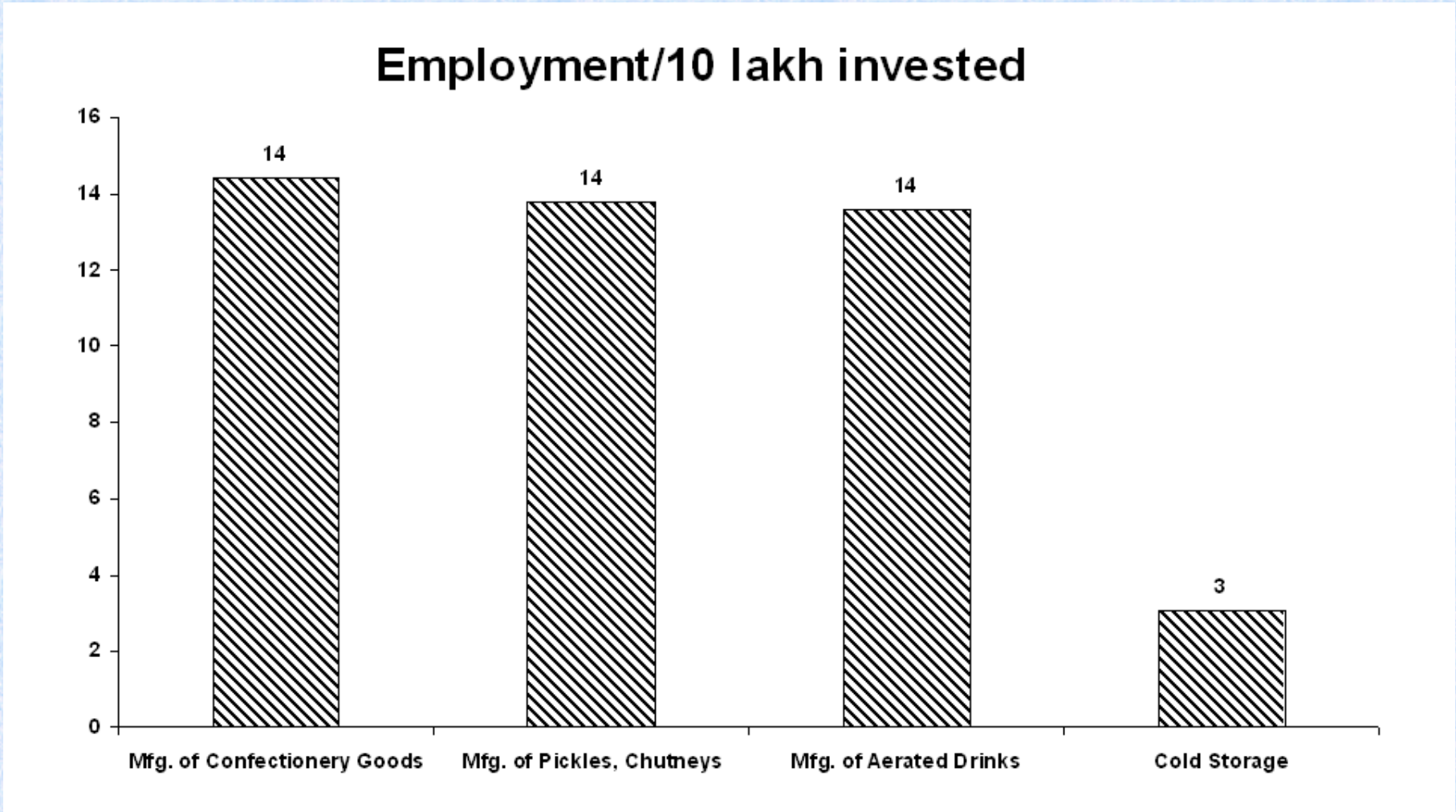
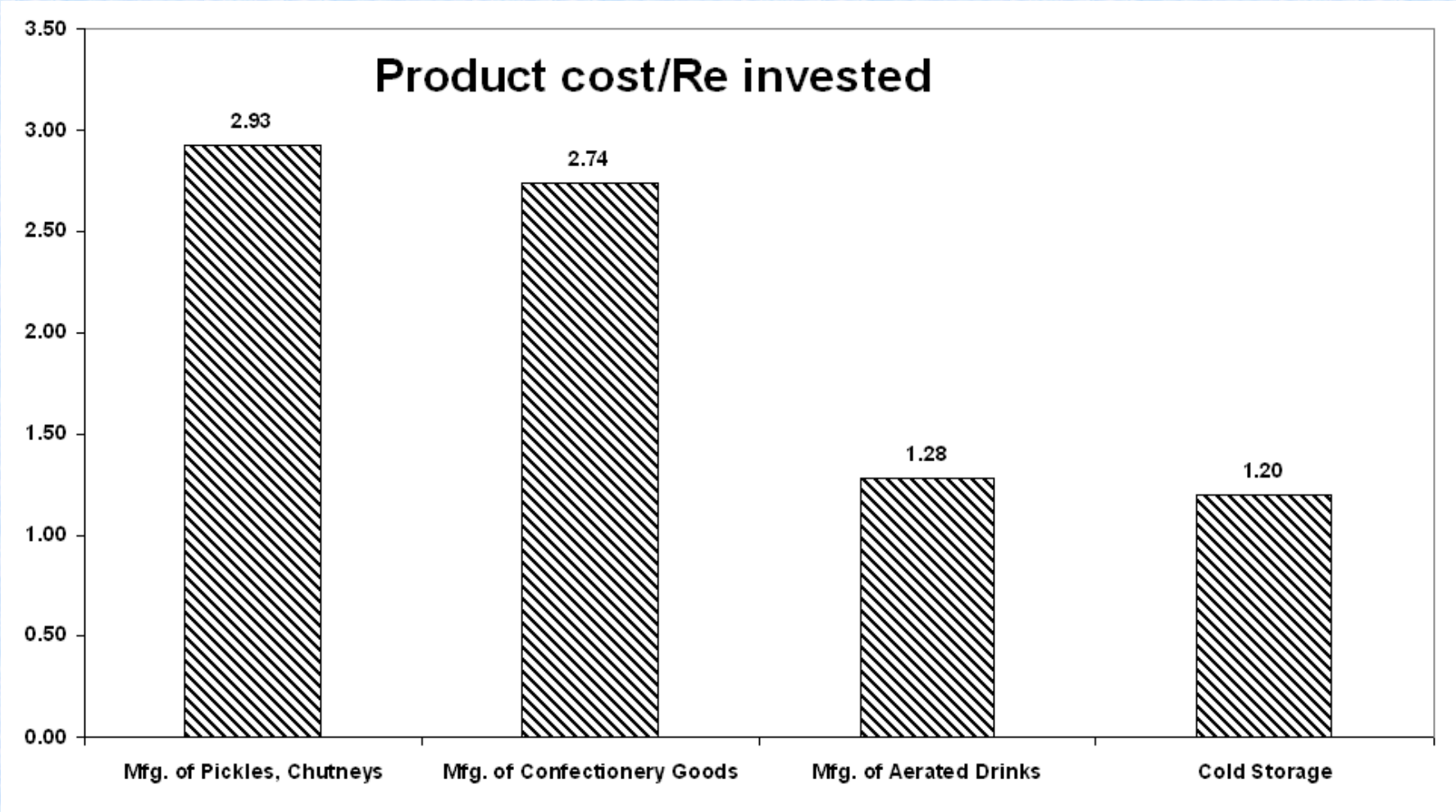


Agro Entrepreneurship



Future trends in agro processing technologies

Crops	Traditional	Newer trends, product, processes & technologies
Fruits	Fresh fruits, fruit chat, fresh fruit juices	Ready to serve beverages in tetra pack, novel product development from ethnic/traditional fruits, online fruit sorting for processing and packaging, cold chain infrastructure installation in production catchments
Vegetables	Raw vegetables	Minimally processed and MAP packaged, pre cooked canned vegetables
Medicinal and aromatic plants	Raw material for traditional medicine	Modern curing drying and process protocols for debittering and aniti nutrient removal. Efficient extraction of medicinal and aromatic substances

Reasons for losses

1. Handling of raw produce through many stages of middlemen.
2. Processing is mostly controlled by urban rather than rural entrepreneurs which leads to losses in valuable by products.
3. Non availability of adequate and efficient equipment and machinery to be used in catchment areas.
4. Low level of entrepreneurial urge in rural areas due to constraints of finance, assured market and proper training on technology

Higher the value addition better the PH management and lower will be losses

Post Harvest Infrastructure

- Post Harvest Management
  - –Harvesting
  - –Short term storage
  - –Collection
  - –Minimal Processing
  - –Packaging
  - –Transport

  Cold storages, IQF, Refrigerated vans
- Value addition
  - –Minimal Processing
  - –Intermediate processing
  - –Ready to eat convenience foods
  - –Health foods

  Food factories

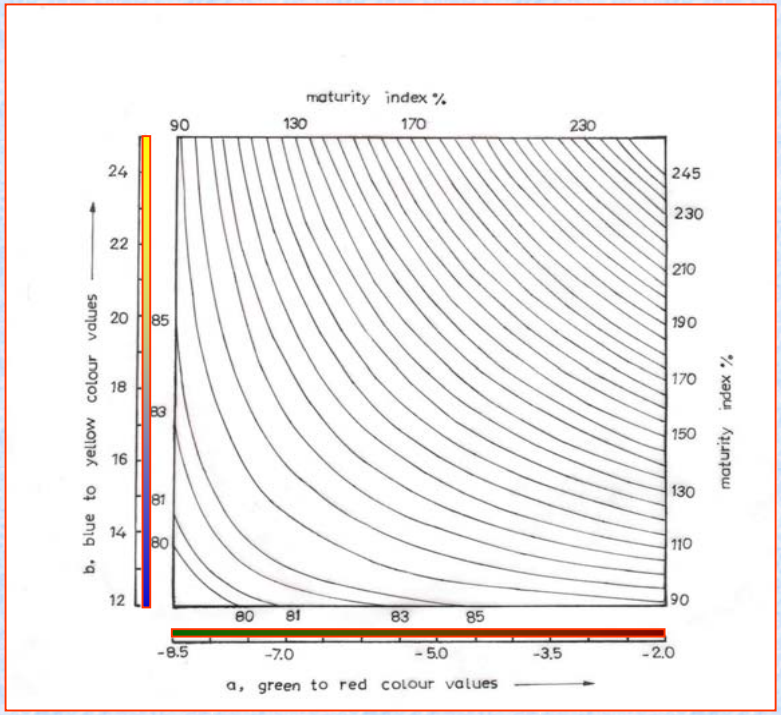
Processing at production catchment

- To enhance the processable character of farm produce and to achieve the quality and safe raw material for processing.
- To provide better income to the farmer,
- Less losses in transport to urban areas for processing
- Use of processing by product at farmers level
- Creation of gainful employment at rural level.

CIPHET developed agro processing equipment

Method of determining maturity of mango in tree

- Eating quality and postharvest shelf life of ripe mango depends on its maturity at harvest
- Change of peel color and total soluble solids (TSS) are indicative parameters to measure maturity of mango.
- A maturity index was defined based on TSS and colour values.
- The model was developed to predict maturity using colourimeter
- Colour and maturity index chart were also developed to determine maturity
- This technique can be employed to sort the mangoes at export port, big *mandies* and in processing plant.



Capacity

About 100 mangoes per hour

Harvesting Tools

Strawberry Clipper

Banana Comb/Hand Cutter

It is an useful to de-stem the comb/hand from the banana bunch. It replaces the use of sickle, which was much labor and time consuming. It is safe for human and banana hands and can be used for faster work.

Fruit Saving Gadgets

After plucking from tree, fruit is thrown in the trough of fruit saver and collected in a box/container.

The fruits are graded on size basis at appropriate places. Smallest grade fruit is collected first and largest grade is collected in last

Minimal Processing of Vegetables

CIPHET Tomato Grader

- The tomatoes roll down the pipes due to gravity and fall immediately wherever they find the space of their diameter.
- Grades 3: 25-40 mm, 40-55 mm, 55-70 mm and > 70 mm
- The collector is inclined at 10° so that the tomatoes slide directly in crates.
- The important feature of grader is its ability to adjust the gap between the pipes and inclination of grading table and hopper.
- It can also be used for other round fruits and vegetables.

Capacity: of 325 kg/hr
Overall grading efficiency: 66%.
Cost: Rs.15000.00

Lac scrapper cum grader

- The machine is capable to scrap from 3-4 lac sticks simultaneously crush and grade the scrapped lac in to three grades.
- Eliminates any chances of mixing of the sticks and wood particles with scrapped lac
- Non-uniform lac encrustations are crushed by means of a pair of crushing rolls.
- The crushed lac is graded in to three fractions by their grain sizes.
- 21.4 kg of lac sticks in an hour for lac sticks of Kusum host plant at a moisture content of 3% (d.b.), after two passings through this machine.

Power: 1.5 kW electric motor, **Manpower:** One, **Investment:** Rs. 40,000/-, **Capacity:** 20kg/h

High Capacity Lac scrapper cum grader

- capability for 10 sticks through the use of bigger scrapping rollers.
- Non-uniform lac encrustations are crushed by crushing rollers
- The crushed lac is graded in to three fractions their grain sizes.
- This high capacity lac scrapper cum grader is meant for use at community level or for a group of 2-3 lac growers.

Power:3 kW electric motor, **Manpower:** One, **Investment:** Rs. 70,000/-, **Capacity:** 50kg/h

Groundnut pod grader

Purpose Cleaning of pods and its grading based on weight, thickness and size.

- Power: 3 kW electric motor
- Manpower: Two
- Investment: Rs. 2,00000/-
- Output Capacity: 650 kg/h

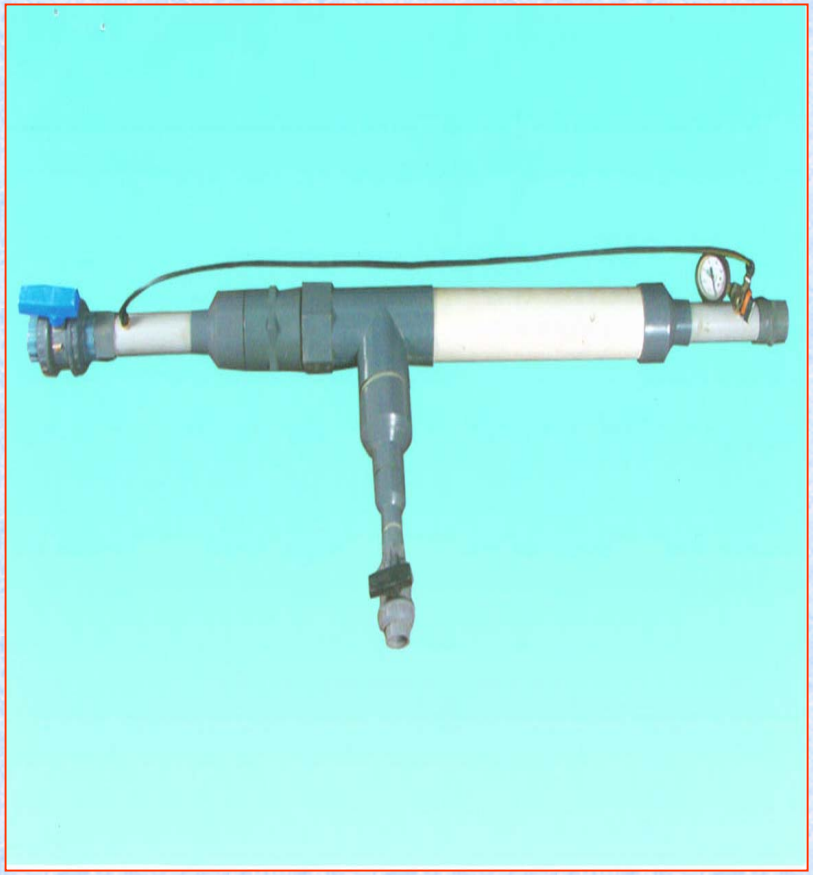
Groundnut Pod Decorticator

A composite unit of ground nut decorticator was developed especially for producers of value added products from whole kernel. The unit consists feed hopper, decorticating drum, aspirator, and sieve grader to grade kernel in two grades. The capacity of the unit is 60 kg/h and price is Rs 65,000. The dehulling efficiency is 87% with no breakage of the kernel.

Technology has been licensed (Fee Rs. 60,000) to M/s OSAW Agro, Ambala for commercial production.

Low cost filter for micro irrigation

- Cost effective and suitable for micro irrigation in green house
- Easy to fabricate by local artisan
- Performs better with sand filter
- Improved efficiency without head loss
- Effective for low head drip irrigations system (1.2 m)



Cost: Rs. 780 compared to Rs. 1200-1500 conventional filter
Size of aperture: 80 mesh, **Operating pressure:** 1.5 kg/cm^2

CIPHET castor decorticator

- Zero damage to caster capsules
- Suitable for all variety of caster,
- Deppoding and decortication can be done simultaneously

CIPHET rotary maize cob sheller

- Negligible drudgery
- Suitable for all varieties of maize.
- Zero damage to grains during shelling
- No cleaning of grains required.
- Most suitable for seed producing agencies.
- Seed shelling almost 100 percent

Capacity: 65kg/hr

Novel Technology for Refined Sorghum

Cleaned and graded sorghum is conditioned to certain moisture content and then dehusked by compression and shear followed by polishing by abrasion. The hulls, germ, bran are totally and effectively separated with this process to get refined sorghum flour to be used for value added functional/designer foods

Sunflower dehulling mill

Consists of Feeding mechanism, centrifugal type dehuller, aspirator for separation of hull from dehulled product and grading unit, which separates whole, broken and unhulled kernels.

Capacity: Dehulling of 400-500kg of sunflower seeds per hour.

Pilot Plant for Kinnow Processing

The pilot plant consists of feed conveyor, washer, shifter/diverter, grader, waxing unit, hot air dryer and shrink-wrapping machine.

Chili Processing Plant

Capacity: 300 kg/day Cost: 11.0 Lakh

Tomato Processing Plant

Capacity: 0.5 T/day, Cost: 10.0 Lakh

A low cost extruder at CIPHET for snacks

A low cost collet extruder, 25 kg/h and 10 HP motor for production of ready to eat snacks from cereals, millets and other ingredients

Mobile Agro Processing Unit suggested for pulping, waxing, shrink wrapping etc.

Cost: Rs. 2.00 –3.00 Lakh

Equipment: As per requirement of the region

CIPHET developed novel value added food products and processes

Porous Bricks

- Lower dry weight
- Higher water absorption capacity
- Better rate of evaporation from its surface

Plant & machinery: Brick kiln, **Power :** Coal, **Manpower:**100 Bricks per person, **Capacity:** Same as that of Brick Kiln, Raw materials: Brick earth, Crop Residues, Water

Mustard Sauce –A Delicious Product

•A low cost process for production of pure vegetarian Mustard Sauce has been developed at CIPHET, Ludhiana.

•Process consists of production full fat edible quality mustard flour using unique CIPHET process. The condiments, citric acid, vinegar, and plant based emulsifier, spices, salt are used in preparation of sauce in either sour taste and in sweet taste. The product meets International standard with preferred taste, colour, appearance and viscosity. CIPHET mustard sauce cost Rs 80/kg whereas conventional sauce cost Rs 250/kg. CIPHET mustard flour cost Rs 40/kg whereas imported mustard flour cost Rs 300/kg.

Technology has been licensed to Mrs Bectors Food Specialties, Phillour, Punjab at Rs. 2.65 lakhs along with the process for production of edible quality mustard flour for Rs. 3.80 lakhs

Method to prepare dried garlic slices

- The cloves are separated, peeled and sliced across the length.
- Slices of 3mm thickness are dipped in 0.5% sodium metabisulphite solution for 15 min at ambient temperature and dried to 6% moisture content (db) in a fluidized bed dryer at 60^0C air temperature.
- Slices thus obtained should be immediately packed in airtight containers.

Plant & machinery : Stainless Steel knives, Fluidised bed dryer, Work tables, Dipping tanks etc., **Manpower :**10-15 kg raw garlic / person for 8 h, **Investment:** 2 lakhs approx., **Capacity:**10-15 kg dried garlic slices / day.

Ginger Powder

Process

- **rhizomes washing, peeling, slicing with rotary ginger slicer to thickness of 3-4 mm.**
- **Tray drying upto 6% moisture content (wb).**
- **Pulverizing in a hammer mill to pass through US standard sieve no. 70 .**
- **Packaging in airtight glass bottles.**

Manpower: 200 kg /person (fresh),

Finished produce cost : Rs. 125-150/- kg

Investment : Rs. 2.5 lakhs**, Capacity :** 500 kg fresh ginger/day

Sunflower based confectionery products

- Sunflower-sesame kernel confection *Chikki* is an improved traditional product and prepared taking jaggery, sunflower kernel and sesame kernel
- Sunflower based ready to eat sweetmeat with ingredients like sugar, jaggery, sunflower kernels, liquid glucose and honey.

Process Technology for making Aonla Beverage

- Composition of **aonla juice (20 %), sugar syrup (70 % - 25 ^{0}B), other fruit juices (guava, pineapple juice, etc) (10 %)**
- Other ingredients: Black salt, white salt, black pepper, *amchur* powder and dhania
- The final mixture is bottled and sterilized in hot water before storage.

Raw material: Aonla, sugar, pineapple, spices
Plant & machinery: Aonla shredder, utensils (SS)
Manpower:one**, Investment:**Rs.1,00,000/-

Process Technology for Guava Bar

- Guava is perishable in nature and cannot be stored for more than two days during peak season.
- Guava can be processed into a number of products like fruits bar and beverage
- Fruits, which are rich in nutrients can be blended to improve its acceptability and flavor
- Guava bar acceptable even after 6 month of storage

Composition: Moisture: 15%, **Vitamin C:** 120 mg/100g**, Acidity:** 1.08%, **Reducing sugar:** 14%, **Non-reducing sugar:** 46%, **Weight of each bar:** 5-10 g**, KSM:** 0.2%

Process technology for *Anardana* and its powder

- Desirable acid sugar ratio, retains maximum quality parameters (sugars, TSS, vitamin C and minerals) up to six months of storage.
- Maximum colour values especially for red.
- Product found best for making allied products like chutney, digestive churan, tablets etc.
- Microbial load under limit.

Raw material: Wild pomegranate, **Machinery**: Steel trays, Cabinet flow drier, Heavy duty grinder, Pouch making machine, sealer **Power**: 12KW, **Manpower**: 4 per day, Land: 250 $m^{2,}$ **Investment:** 10.0 Lakh, **Capacity:** 50-60kg/hour

Process technology for pomegranate Jelly and Granadine

- Jelly is excellent in appearance, colour, nutritionally rich in vitamin A and minerals, good keeping quality with natural flavour.
- Under microbial load.
- Can be stored for 4 months under ambient conditions and 6 months in cold storage.

Raw material: Pomegranate (Mridula and Ganesh), sugar, citric acid, lemon, pectin, **Machinery:** Kettle, pulper/juicer, steel utensils, glass containers, Jel meter, corking machine, **Power:** 12KW, Manpower: 2 persons, **Land:** 250 m^2, **Investment:** 8.00lakh, **Capacity:** 50-60kg/hour

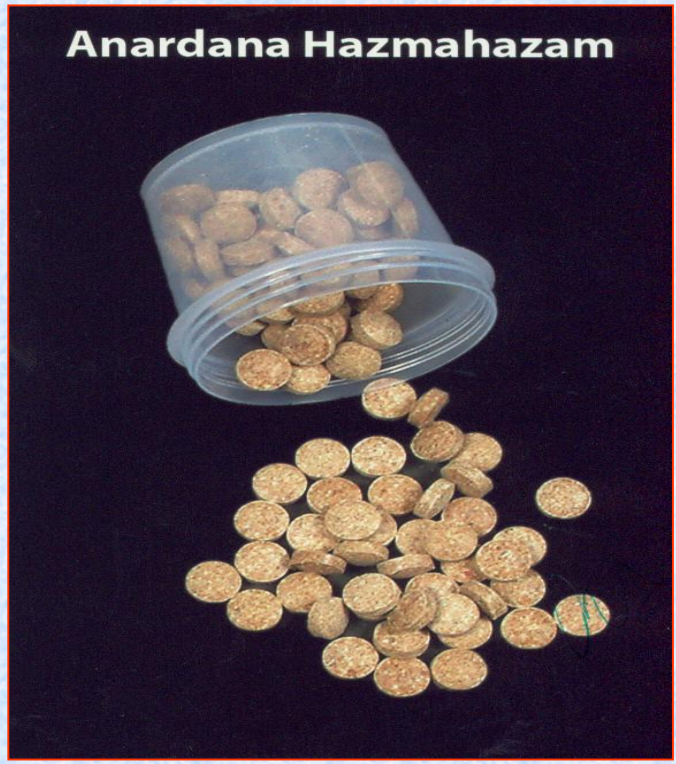
Process technology for Ber preserves

- Excellent natural color
- Very good texture
- Rich in Vit. C
- Rich in minerals
- Least enzymatic browning

Can keep well up to 6 months

Process Technology for making *Anardana* Hazmahazam (Tablets)

- Formulation had better taste, flavour, rich in nutrition, minerals.
- Digestive in nature,
- Has better binding characteristics.
- Can be stored up to six months when packed in 200g MPP



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Sorghum-Soy-Blended Biscuit

- Biscuits are convenient and one of the most popular and widely consumed processed food products
- The quality of protein can be enhanced by fortifying locally available protein rich foods like soybean.
- Millets like sorghum are good source of dietary fibre and complex carbohydrates.
- Glucose biscuits, prepared from wheat flour, sorghum flour and fortified with soybean were developed at CIPHET, are rich in protein and dietary fibre.

•Composite flour containing 70% wheat flour, 20% pearled sorghum flour and 10% soybean flour.

•Biscuits provide 47% more proteins, 8.3 times more fibre and 38.98% more minerals than the commercial biscuits

Use of Amla in Confectionary developed at CIPHET

Value added products from green chili

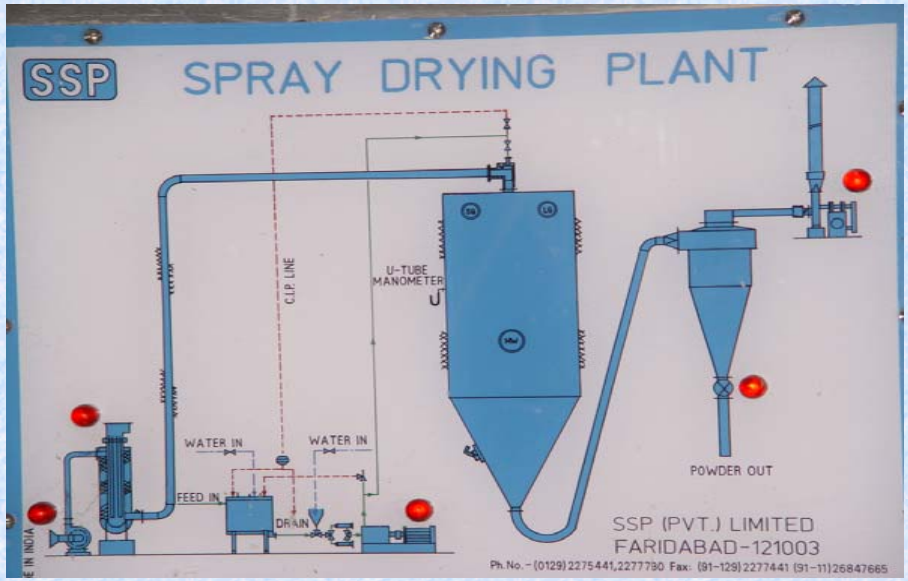
Debittering of kinnow juice by using indigenous adsorbent resin

- Raw materials :Stored kinnow juice
- Plant & machinery: Centrifuge, stainless steel storage tank, debittering columns
- Power: 12 kw
- Manpower: 4 per day
- Land: 250 m^2
- Investment: 15 lakhs
- Capacity: 250 litres of juice/hr

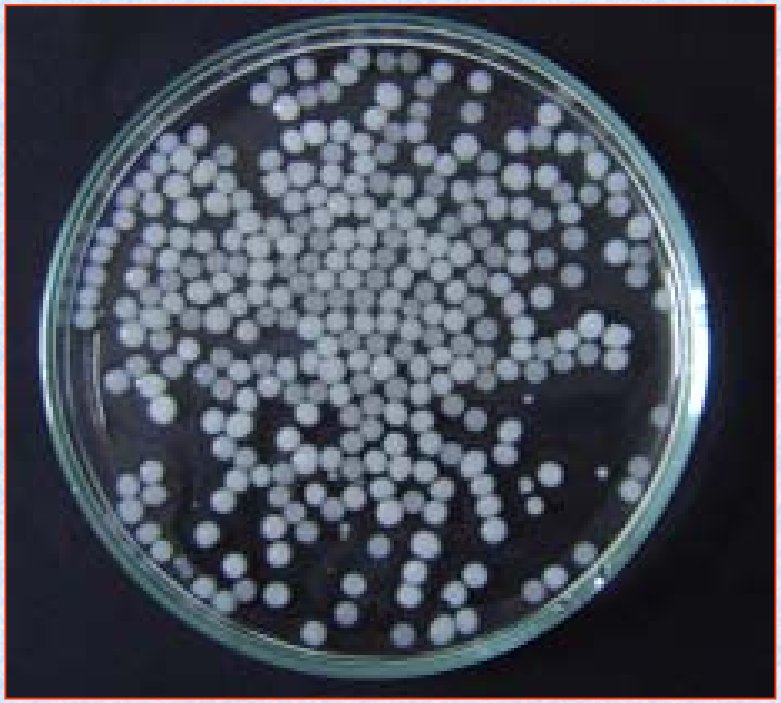
Bitterness in stored Kinnow juice was removed using indigenously available food grade resin. The pulp was separated from juice and bitter juice serum was passed through the pretreated resin. The debittered juice serum was again blended with pulp to get palatable juice. The juice was acceptable up to 74 days. Technology can be used to treat the juice for its later use for production of concentrate and powder.

Soy milk powder protocol

•Soymilk powder retains its nutritional properties after reconstitution and could be converted into instant beverages, tofu, yogurt etc.
•It provides about 35% proteins, 16% fat, and 5% ash content. Nozzle pressure is kept at around 80 to 100 kg/cm^2 and hot air of temperature 180 -190^{o}C The outlet temperature of the air is maintained around 85^{o}C. Around 15 litre soymilk of 13% solid content is required for making 1 kg of soy powder.



Microencapsulator for encapsulation of probiotic micro-organism



Alginate microcapsules

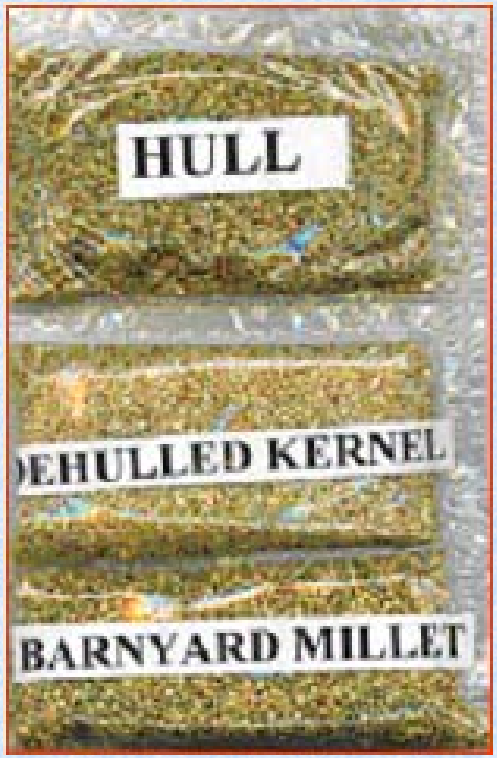
Set up

Dehulling guar gum seeds

A novel method of effective removal of guar gum seed has been developed evolving a specific pretreatment and use of combination of mechanisms to remove the bond between husk and cotyledons. The recovery of dehulled grain was maximum with no contamination with the gummy cotyledons.

A patent has been filed by CIPHET on this innovation

Dehulling of millets and coarse grains



A novel method of effective removal of husk and bran from these seeds to get refined endosperm has been developed evolving a specific pretreatment and use of combination of mechanisms to remove the husk and bran. A patent is bening developed by CIPHET on this innovation and a composite millet mill based on this research is being jointly taken up by CIPHET and Kisan Krishi Yantra Udyog

Environment Control Technologies

Two Stage Evaporative Cooler

- The cooler is portable and 1.5m x 1.0m x 2.0m in length, breadth and height
- The developed two stage evaporative cooler could be able to drop the temperature up to the wet bulb depression and to 90 % relative humidity.
- The effectiveness of the two stage evaporative cooler ranged from 1.1 to 1.2 over the single evaporation.
- The hourly cooling capacity of TSEC ranged from 2125 to 4500 W

Mobile cool chamber

Developed for short duration storage and transportation of fish for retail marketing. The insulated box was designed such that it could hold 8 plastic crates of size 540x360x295 mm in two layer of four each for keeping fish. The total capacity of storage was 150 kg of fish with 80% filling of each plastic crates and 1:1 ratio of ice and fish. It costs around Rs. 18,000-20,000/- and can be used for fruits and vegetables also.

Seven units were distributed to various fisheries institute (CIBA Chennai, CIFT Cochin, NBFGR Lucknow, CIFA Bhubneshwar, CIFRI Kolkatta, CIFRI Guwahati and CIFE Mumbai) for field trial

Evaporatively cooled room for storage of fruits and vegetables

•An evaporatively cooled (EC) room (3x3x3m. size) was developed for on-farm storage of fruits and vegetables.
•The summer temperature inside the EC room was 5-8C lower than that inside the ordinary room and winter temperature was 5-8 C higher than that inside the ordinary room.

Compared on the basis of 10% physiological loss in weight (PLW) the shelf life inside the room was 34 days for early kinnow, 23 days for late kinnow, 11 days for cauliflower and 4 days for spinach as compared to 21, 11, 5 and 2 days respectively in an ordinary room at the same time.

The cost of the chamber is Rs. 50000 and capacity is 2 tonnes. This technology has been transferred to 3 farmers for on farm use.

CIPHET Evaporative Cooled Storage Structure

- Storage of fruits and vegetables
- Evaporatively Cooled Structure (ECS) maintains a moderate low temperature and sufficiently high relative humidity for short term storage of fresh fruits and vegetables.
- **Advantages**
  - Low level consumption of electricity
  - Less initial investment
  - Negligible maintenance cost
- **Features**
  - Special design of roof, orientation
  - Uses wetted pad as cooling medium
  - 20^{o}C below the outside temperature
  - An ECS of about 5 -7 tonne storage capacity may cost about Rs. 1.5 – 1.8 lakh.

Low cost polyhouse for higher benefit: cost ratio

Tomato 90 t/ha & Capsicum 75 t/ha yield of compared to 20-25 T/h Flowers Gladiolus significantly better than outside in spike length and number of florets and flower one month early.
Cost of construction is about Rs. 70/m^2 compared to Rs. 500/m^2

Shrink Packaging of Fruits and Vegetables

PREPARATION OF KINNOW FRUITS FOR SHRINK WRAPPING

Commodity	Storage life			
	Ambient		Cold store	
	Shrink wrapped	Unwrapped	Shrink wrapped	Unwrapped
Kinnow	27	13	70	41
Tomato	19	10	39	23
Capsicum	25	4	46	21

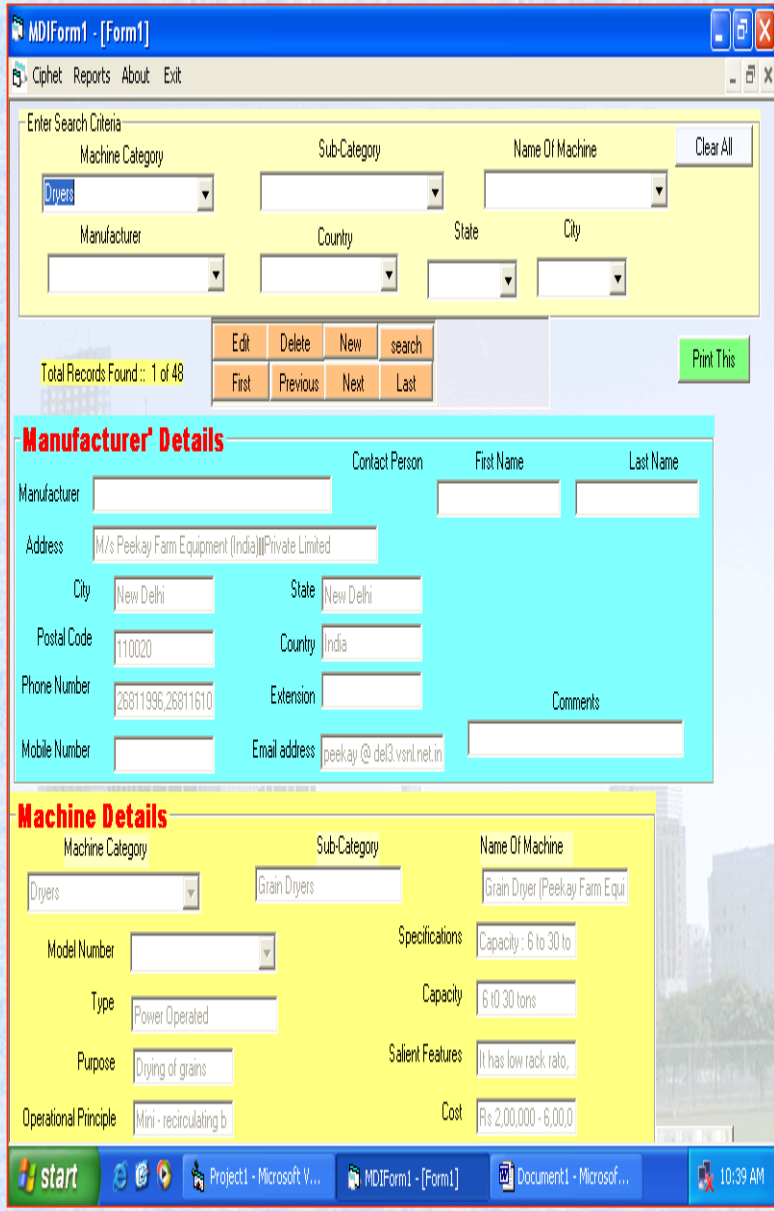
Other Technologies

Database for Post Harvest and Agro Processing Equipment

The database on 700 machines/ equipments of post harvest and agro-processing under different categories

1. Cleaning and separating machines (100);
2. Dryers (97)
3. Graders (80)
4. Milling machines (129)
5. Packaging machines (165)
6. Storage equipment (38)
7. Processing machines (133) and
8. Miscellaneous machines (68)

Manufacturer's complete address,
Machine category, sub-category,
Name of machine, Model number, Specifications, Capacity, Purpose, Operational principle, Salient features and cost.



Entrepreneurship Development Programmes

- Grading and shrink packaging of fruits and vegetables for urban market.
- **Fruits and vegetables purees and powder manufacturing technology.**
- Modern dal milling techniques.
- Modern mechanical oil expression and refining technology.
- Modern dehydration technologies for dairy analogs and its residue and okara.
- **Processing and utilization of sunflower seeds and its products.**
- Evaporatively cooled structure and its application for off-season crops and storage.
- **Construction, operation and management of covered cultivation structures for high value crops.**

Entrepreneurship Development Programmes

- **Processing and utilization of kinnow for juice and other products**
- Processing and utilization of pomegranate.
- Processing and utilization of mustard for food and industrial uses.
- **Processing of guava into novel value added products**
- Processing of ber into novel value added products
- Processing of chillies into dried chillies, chili powder and paste
- Processing of Amala into novel value added products
- Minimal processing of fruits and vegetables for urban markets

Let us work together to process our unique agricultural wealth in to value added products and bring prosperity to rural (real) India

Thanks !!!