

# An Overview of Processes / Technologies Developed

College of Food Processing Technology and Bio-Energy Anand Agricultural University, Anand-388 110 March-2025

### Introduction:

The College of Food Processing Technology & Bio-Energy is a modern institute established exclusively for imparting education and conducting research in the area of Food Processing Technology & Bio-Energy. The College offers various academic programs leading to the degrees of B. Tech., M. Tech. and Ph. D. The college has state-of-art laboratory and pilot plant facilities for conducting highend scientific research. Research in different disciplines is being implemented through highly trained and qualified scientists and engineers. The college has handled various research projects sponsored by World Bank, GoI, ICAR, GoG and other agencies.

### Vision:

Providing excellent food processing professionals to the industry.

### Mission

The primary mission of the college is to produce highly skilled, competent and motivated technical manpower for food processing and allied industries. The technocrats so produced will also be competent to handle all the aspects of Government Departments, research institutes, quality testing laboratories and other related agencies. Also, the college is concerned with the exploitation of novel techniques and technologies to maximize the use of food resources.

#### Goal

The goal of the college is to promote the integration of teaching, research and extension in the area of food processing and bio energy by serving as a premier educational and research institute in the State of Gujarat and in India.

# An Overview of Processes / Technologies Developed



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# Production Technology for Indian Gooseberry (Aonla) Murabba

Indian gooseberry fruit commonly known as aonla is the oldest minor fruit of India. The raw fruit, due to its high acidic nature and astringent taste, is unacceptable to consumers as a table fruit. Aonla were cleaned to remove adhering dust, dirt etc., and thoroughly washed to remove surface adhering extraneous material, insecticides, pesticides, contaminations and the other microbial load. The technology involves pre-treatments and design formulation of prepared murabba. The developed murabba can be stored safely for 180 days at the ambient condition.



# Production Technology for Bottle Gourd based Carbonated Beverage

Bottle gourd (*Langenaria siceraria*) has a high place in diet as it is rich and the higher source of nutrients. Pineapple fruit is rich in B-complex group of vitamins like folates, thiamin, pyridoxine, riboflavin and minerals. Pineapple has proteolytic activity due to a protease known as bromelin. Lime is an important medicinal plant of the family rutaceae and is rich source of dietary fiber, nutrients, phenolic components, lavonoids, citric acid, vitamin C and minerals. Beverages containing carbon dioxide products are becoming very popular nowadays. The sensations elicited by carbonated drinks are of mechanical origin, due to the bursting CO<sub>2</sub> bubbles stimulating mechanoreceptors on the tongue. The technology involves the formulation of the beverage of bottle gourd juice, pineapple juice, lime juice and sugar syrup followed by thermal processing and carbonation. The developed beverage can be stored safely for 90 days at the ambient condition.



Bottle gourd



Lime



Pineapple



Bottle gourd slices



Centrifugal juicer



Formulated Juices

### Production Technology for Defatted Pumpkin Seed Flour and Roasted Salted Seeds

Pumpkin is a versatile fruit and is used for various food processing applications. A Pumpkin seeds have high nutritional value, provides good quality oil, and are excellent source of protein and have pharmacological activities such as antidiabetic, antifungal, antibacterial and anti-inflammation activities, and antioxidant effects.

The technology involves sprouting of pumpkin seed followed by drying, grinding and defatting and flour. The flour can be stored up to 90 days at  $30^{\circ}\pm2^{\circ}C$ .



### **Production Technology for Pumpkin Powder**

Among all the nutrients Vitamin-A deficiency is much more pronounced in preschool children and adults, which is required for normal vision and of importance to human health. Only carrots and pumpkin carotenoids contain major portion of  $\beta$ -carotene. Carotene rich pumpkin powder gives new opportunity to explore the possibilities of using pumpkin as a novel source of carotenoids through incorporation in different food products to combat wide spread Vitamin-A deficiency. A technology for the production of pumpkin powder has been developed using appropriate process parameters.



#### Salient Features :

- · Carotene rich powder.
- Vitamin A enriched product especially for young children.
- No added chemical preservatives.

### **Production Technology for Canned Mango Slices**

Mango is the king among the tropical fruits and is greatly relished for its succulence, exotic flavour and delicious taste in most courtiers of the world. Apart from its delicacy, it is a nutritionally important fruit being a good source of vitamin A, C, fibers and minerals. Succulent juicy varieties are popular for dessert purposes and non fibrous fleshy varieties are largely used for processing. A technology has been developed for mass production of canned mango slices.









### Salient features:

- Shelf stable product upto 9 months
- No added chemical preservative
- Superior quality, taste and flavour

### **Production Technology for Unripe Mango Beverage**

Unripe Mango Beverage (Mango Panna) is a popular traditional product prepared and consumed in most households in India as a preventive and curative remedy for sunstroke, bilious, gastro-intestinal and blood disorders. The Mango Panna is appetizing, thirst quenching, highly refreshing, easily digestible and nutritionally far superior to many synthetic and aerated drinks. Traditional technology is slow, labour intensive, unhygienic and results in nonuniform quality of product. A scientific technology has been developed for commercial production and packaging of Mango Panna.







#### Salient Features :

- High quality valued added drink.
- High medicinal and therapeutic values.

# Production Technology for Osmotically Dehydrated Mango Slices

Mango is considered to be a fruit with tremendous potential for future. Mango is one of the few fruits which can be utilized in all stages of maturity. Osmotic dehydration allows development of new products that is storable without refrigeration with minimum energy input. Controlled equilibrated ratio of water removal and impregnation enhance natural flavour and colour retention in fruit products. A technology has been developed for mass production of Osmotically Dehydrated Mango Slices.



### Salient features:

- Shelf stable product upto 6 months
- No added chemical preservative
- Superior quality, taste and flavour

# Production Technology for Moringa Pulp Extraction and Preservation

Moringa is an underutilized vegetable crop in India and almost all parts of the tree are edible. The pulp can be extracted from pod and preserved for direct consumption or can be further processed to formulate value-added products. The manual separation of pulp from peel (pod skin) is not commercially possible due to laborious, tedious, time consuming and unhygienic practices. A brush type pulper is commercially utilized for various fruits and vegetables. Extracted pulp packed and processed in retort for extension of shelf life. This pulp can be utilized in various food products to enhance nutritional and functional characteristics.



### Salient features:

- Shelf stable product upto 12 months
- No added chemical preservative
- Superior quality, taste and flavour

# Production Technology for Whey Based RTS Beverage from Muskmelon and Lime

Milk whey is one of the highly nutritious by-products obtained from the dairy industry. Musk melon (*Cucumis melo L.*) juice is wonderfully delicious with rich in flavor, and is very low in calories and fats. The fruit is an excellent source of Vitamin A and C. Lime juice have lower pH values and are famous for excellent quality with pleasant flavor, rich in vitamins 'C' and minerals. Preparation of whey and fruit based beverage is utmost important now a days to utilize dairy whey and under-utilized fruits. Design expert software was used for optimization of the beverage. For sweetening, sugar and for flavouring, mint extract was added. The beverage filled in glass bottles, sealed and thermally processed to extend shelf life. The technology involves formulation of ingredients and thermal processing of prepared beverage. The develop beverage can be stored safely for 3 months at the ambient condition.



#### Salient Features :

- Whey beverage remains stable and microbiologically safe during storage.
- Utilization of underutilized muskmelon, lime
- Superior quality, taste and flavour

### **Production Technology for Moth Bean Malt Flour**

Moth bean is an important arid pulse crop of India. It is an excellent source of easily digestible protein with low flatulence. It is consumed as dhal, bean sprouts, noodles, green beans and boiled dry beans. Moth bean is rich source of protein (23%), digestible carbohydrates, minerals (iron, calcium) and exhibits fairly high levels of crude lipids.

A technology has been developed for the production of moth bean malt flour. The technology involves soaking and germination of moth bean for 12 h and 36 h respectively, followed by drying at 60 °C and milling. This moth bean malt possesses goodness of assimilable nutrients (proteins, carbohydrates and minerals) and reduced anti-nutrients.





#### Salient Features :

- Goodness of assimilable nutrients.
- Reduced anti-nutrients

### **Production Technology for Wheat Grass Juice**

Wheat grass juice is a quite popular product prepared from vegetative portion of wheat seedlings and consumed in most households in India as a preventive and curative remedy for most of disorders. Wheat grass has three most therapeutic roles in blood purification, liver detoxification and colon cleansing. Contrary to so many health benefits, the problem persists is the shorter shelf life of the wheat grass juice. It is usually prepared fresh and consumed within 3-4 hours. A scientific technology has been developed for mass scale production and packaging of wheat grass juice.



#### Salient Features :

Using above technology, wheat grass juice can be preserved for longer shelf life of around 10 days at refrigerated temperature with the maximum retention of nutrients.

### Cryogenic Grinding Technology for High Value Spices and Herbs

Spices are important agricultural commodities due to their high unit price. They are ground either for direct use or making value-added products and volatile oil extraction which have vast industrial applications. Traditional grinding methods result in generation of heat which is harmful for the volatile and aromatic compounds. Therefore, a new grinding technology for high value spices and herbs like cumin, coriander, cardamom, ajwain, clove, etc have been developed to retain better aroma, flavour and volatile oil.

### Process Technology :

Liquid nitrogen at -195.6°C is used to pre-cool the spices and maintain the desired low temperature by absorbing the heat generated during the grinding operation. Cryogenic grinding reduces the loss of volatile oil and moisture to yield a product of superior quality.

### Salient Features:

- Extremely fine grinding.
- Retardation of oxidation of spice oils.
- · Cryo-ground product is considerably more stable.
- Higher retention of aromatic, volatile and flavour compounds.

S. No.	Spice	Volatile oil content (%)		Retention of volatile oil content (%)		
		Seed	Conventional Grinding	Cryogenic Grinding	Conventional Grinding	Cryogenic Grinding
1	Cumin	3.70	2.03	3.03	57	84
2	Coriander	0.640	0.133	0.607	21	93
3	Cardamom	6.6	3.0	5.8	45	87









### Supercritical Fluid Extraction (SFE) of Essential Oil and Oleoresins from Spices and Herbs

When a compound is compressed and heated to its critical point, it enters a phase that is referred to as its supercritical phase. Supercritical Fluid Extraction(SFE) is one of the exclusive unit operations in food processing industries, which uses supercritical fluids as solvents for extraction of essential oils, oleoresins, various bioactive constituents, heat sensitive materials, flavor components etc., from the food matrix. This technique offers a number of advantages, such as high mass transfer rate, ease of product separation from residual solvent, selective product separation and better product The sample is exposed to the supercritical fluid (CO2) under the controlled conditions of time, temperature, and pressure that allow dissolution of the oil/ fat from the sample in to super critical fluid. The dissolved essential oil/ compound will be then separated from the supercritical solvent by a significant drop in solution pressure. Therefore, a technology has been developed to extract the essential oil and oleoresins from spices and herbs using supercritical fluid extraction method.



#### Salient Features :

- SFE technique is solvent and chemical free.
- High recovery of volatiles.
- Selective extraction of desired compounds.

### Gamma Irradiation Technologies

Gamma irradiation is recognized as a technically feasible method for reducing postharvest food losses, ensuring the hygienic quality and preservation of food, extending its shelf life and facilitating wider food trade. The technology can be used to inhibit sprouting, delay ripening, shelf-life extension, insect disinfestation, control of moulds, microbial decontamination, reduction of microbial load, sterilisation, elimination of pathogenic microorganisms and quarantine applications.



chilli, insect disinfestation of pigeon pea and peanut (ground nut) kernel have been developed. Properly irradiated packaged food

developed. Properly irradiated packaged food products have shown batter shelf life and keeping quality.





#### Salient features:

- Highly effective
- Non-residual effect
- Cold process
- Longer shelf and keeping quality









### Drying and Dehydration : Drying of Guava Leaves

Fresh guava leaves are rich source of phenol, flavonoid and having antioxidant properties and used as folk medicine. Guava leaves tea helps in modulation of blood-sugar level. Essential oil possesses antimicrobial, antioxidant and antiptoliferative activities because of having compounds like -pinene, caryophyllene, limonene, veridifloral and nerolidol. Hot air drying technology developed for drying of fresh guava leaves at some controlled temperature for maximum retention of total phenolic compound, flavonoid content and anti-oxidant properties.



### Drying and Dehydration : Microwave Drying of Senna Leaves

Senna leaves contains sennosides, hence responsible for its laxative, cooling and anti-bacterial properties and considered as a "cleansing" herb being used in pharma companies. Traditional practice of drying is lengthy (6-7 days) results in degradation in sennoside content and also contamination, appearance and affect quality. Proper and quick drying is very helpful to retain sennoside content. Continuous microwave drying technology developed which takes less time. The developed drying technology involves continuous drying of senna leaves at desired pulse setting ratio which retains about 85% of the sennosides present in the fresh leaves.







# Drying and Dehydration : Microwave Drying of *Moringa Oleifera* (Drumstick) Leaves.

One of the greatest disadvantages of the conventional methods of drying foods and biological materials is time consuming and unhealthy with loss of quality. Microwaves drying novel drying system and gives superior quality product with better retention of aroma and colour, and reduction in drying time as compared to the conventional drying process.

The technology involves continuous microwave drying of moringa leaves at desired pulsating ratio. It results in good quality dried moringa leaves which retained more than 80% of the Vitamin Cacid present in the fresh sample.



# Process Development for Nutritive Extruded Snack Utilizing Amaranth Grain

Amaranth grain (*Amaranthus hypochondriacus L.*), also known as Rajgira in Hindi is a highly nutritional pseudocereal with a superior amount of proteins when compared to true cereals. It is a reasonably well-balanced food ingredient with functional properties that have been shown to provide medicinal benefits. So, a nutritive snack item produced using extrusion processing can be a healthy and tasty food option.

The technology involves the blending of coarse flours of amaranth, rice and maize followed by moisture conditioning. This flour blend is passed through the extruder and the extruded snack is further dried. This product contains 12.2% protein, 4.8% fat, 4.9 mg/100 g iron, 65.0 mg/100 g calcium, 3.9 mg/100 g zinc and 469.3 mg/100 g phosphorus. The product remains acceptable up to 90 days at ambient temperature.



## Process Development of Flaxseed Meal for Value Added Product

Flaxseed is one of the richest vegetarian source of -linolenic acid (omega 3 fatty acid) and contains about 40% oil. The meal obtained after oil extraction is an overlooked by-product commanding very little premium despite its potentially rich nutrient composition and is suitable for applications in human foods. Utilization of meal into food products could be an excellent vehicle for enhancing the utilization of flaxseed protein in the diets of malnourished people in developing countries. Flaxseed flour produced from meal blends easily enhances or enriches the nutritive value of wheat and other flour.

Technology involves roasting and grinding of flaxseed meal at 150 °C and 15 min followed by preparation of cookies by adding 20% flaxseed meal flour. The cookies can be packed in metalized polypropylene bag and can be stored for 120 days at ambient condition  $(30\pm2^{\circ}C)$ .



# Development of High Fibre Low Sugar Muffins

### Salient features:

- Orange peel extract prevent the breast, skin, liver, lung, pancreatic, colon and stomach cancers.
- Citrus fruits provide vitamin-C, folic acid, potassium and pectin and have most of active phytochemicals in ample quantity.
- Erythritol is a low-calorie sweetener. It's natural, doesn't cause side effects and has almost similar tastes as sugar without the calories.
- The World Health Organization (WHO) approved the food use of erythritol in 1999, and the FDA did the same in 2001.
- Erythritol has no effect on glucose or insulin levels in human.

### Advantages:

- A technology developed for the production of high fibre low sugar muffins.
- Water retention and sensory score for color and appearance was more in developed muffin as compared to control muffins.
- Muffins prepared from developed formulation were remained softer for longer period as compared to control muffins.
- Shelf life of muffins increased to 21 days with addition of erythritol and orange peel powder.



# Development of Sorghum Based Multigrain Biscuits

In recent times, the demand for composite flour-based health-oriented baked products are in high among consumer. Baked products are widely consumed staple food and the most suitable carrier of dietary fibre and antioxidative compounds in the diet. Most of the multigrain products like bakery items are prepared with or without wheat flour along with various cereal grains as well as oil seeds. Oats, corn, soy, barley, rye, rice, amaranth, triticale and buckwheat are most regularly utilized cereals in multigrain bakery products to enhance structure, flavour, texture, nutritional variety and consumer acceptability. These cereal grains are the vital resource of carbohydrates, protein, dietary fibre, vitamin-B and minerals. Multigrain products are gaining interest for an increasingly health-concerned society and may be especially relevant for obviating or delaying a number of age-cognate diseases. Sorghum is a gluten free cereal suitable for persons suffering from celiac disease (CD), an immunological response to gluten intolerance is on the rise.

The technology involves formulation of sorghum flour, oat flour and soybean flour. This product contains 11.69 % protein and 2.57 % fibre. The biscuits packed in aluminium laminates are acceptable up to 60 days at ambient temperature ( $30\pm1^{\circ}$ C).



# Development of High Fiber Cookies Supplemented with Pomegranate Seed Flour

### Salient features:

- Pomegranate seeds contain higher amounts of nutritionally valuable and biologically active components.
- The rapid urbanization and rising consumer need make high consumption of cookies.
- The technology developed involves incorporation of 15% of pomegranate seed flour (PSF) in the formulation of cookies.
- The cookie packed in aluminium laminates has 75 days of shelf life at ambient temperature.
- The fibre content in control cookies is 0.77% which increases to 5.82% in developed cookies by addition of 15% pomegranate seed flour.
- Cookies prepared from 15% PSF has 75 days of shelf life with 5.82% fibre, optimum baking quality and organoleptically more acceptability

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### **Banana Shelf Life**

Banana (*Musa sapientum*.) is the second most important fruit crop in India next to mango. Hot water treatment is a type of heat treatment used to inactivate the enzymes, had been proven effective in terms of extending commodities shelf life without causing significant adverse effects towards the quality attributes of treated commodities. The technology involves dipping the mature banana in hot water (55°C) for 5 minutes. This results in increasing the shelf life of banana by 6 days over ambient water dipping.





# Edible Coating Technology for Shelf Life Extension of Tomato

#### Function:

- Edible coating is known to protect perishable food products from deterioration by retarding dehydration, suppressing respiration, improving textural quality, retaining volatile flavor compounds and reducing microbial growth.
- Edible coatings/films can be formed as food coatings and free-standing films and have the potential to be used with food as gas aroma barrier. Tomato is highly perishable in the fresh state leading to wastage and losses during the harvesting periods.
- Consumers increasingly desire high quality (visual and nutritional) tomatoes for a longer shelf life, within convenient prices in both domestic as well as export markets. Edible coating will reduce spoilage and wastage level of tomato through processing and preservation.





#### Salient Findings:

- The technology enables storage of tomatoes in ambient conditions (27±3 °C). The coating formulation contains bee wax, oleic acid, sodium hydroxide, glycerol mono-stearate as per suggested proportions and by adopting the coating technique, shelf life of tomatoes has been extended up to 24 days.
- For low temperature storage of tomatoes at (15±2 °C) the shelf life of tomatoes has extended by 15 days compared to non-coated tomatoes.
- 1 litre coating emulsion is required for coating of around 50-60 kg of tomatoes and cost for that may come around Rs. 150.

# IoT Based Low-Cost Storage Parameters Monitoring System for Tomato

The task of a control and monitoring systems is to keep an eye on particular thing or activity and to make sure that it stays in the desired manner

The Internet of things (IoT) is a concept built on the assumption of the omnipresence of a multitude of objects which, through wireless or cabled connections and unique addressing schemes, can interact and collaborate with other objects, creating new services and applications

Monitoring can be achieved using various electronic sensors. The data obtained from sensors can be uploaded to cloud server.

Entrepreneurs associated with real time monitoring of respiratory parameters of Tomato are recommended to use IoT based system developed by Anand Agricultural University, Anand.

In this system, monitoring of respiratory parameters like measuring of temperature, mixed gas concentrations and relative humidity inside the chamber (acrylic) of 1 cubic foot under the ambient condition can be done along with assessing the data in personal computer and the server.

Advantages:

Entrepreneurs associated with real time monitoring of respiratory parameters of Tomato are advised to use IoT based system.

In this system, monitoring of respiratory parameters like measuring of temperature, mixed gas concentrations and relative humidity inside the chamber of 1 cubic foot under the ambient condition can be done along with assessing the data in personal computer and the server.



# Development of Multi-chamber Temperature and Humidity Controlled System for Measurement of Respiration Rate of Fruits and Vegetables

Respiration rate of fruits and vegetables is an important factor for the designing of storage facility. Knowledge of carbon dioxide production and oxygen consumption rates is necessary for the design of controlled atmosphere (CA) storage and modified atmosphere packaging. Based on respiration rate the CA system is designed for the amount of oxygen to be supplied and the amount of carbon dioxide to be removed.

Refrigeration engineers interested in designing cold/low temperature storage facilities foe fruits/vegetables are advised to use the data on respiration rate and heat of respiration for various temperature and relative humidity.





### **On-Farm EC Post-Harvest Activity Hut**

#### Function:

To provide appropriate working atmosphere and suitable environment for the growth of produce, to reduce post harvest losses as well as to enhance the comfort for persons working in, a post harvest activity hut has been designed and developed.



#### Salient Features :

Size	15 X 10 ft
Capacity	15-20 tons
Temperature drop	12-15 °C
Humidity maintain	90-95%
Electricity required	No

#### Structure Description :

- Post harvest operations like cleaning, sorting, grading, packing of harvested produce can be done at the farm level under "On-Farm Post Harvest Activity Hut", which reduces post harvest losses and increases shelf life of produce.
- Useful for short-term (3-7 days) storage.
- It can be fabricated easily and no commercial energy is required for operations.
- Produce can be safely stored, as no bird, mouse, squirrel, animal can enter inside.
- It can be installed at APMC and other institutional places.

### EC Storage Structure for Fruit/ Vegetables

#### Function:

For intermediate short duration storage of perishable products such as fruits and vegetables by a farmer on his farm or by a trader at his market place with zero energy consumption.



#### Salient Features :

l	Size of structure	1440 X 820 X 660 mm	
	Raw material	M.S., coconut coir, drippers, water	
	Storage capacity	100 kg	
	Temperature drop	12-15 °C below ambient	-
1	Relative humidity	85-93%	
	Shelf life of product	Almost double	

#### Structure Description:

- It consists of a double walled MS structure having G.I. and net wrapped around. Coconut coir as pad material is filled in annular space, which is kept wet continuously with drippers.
- When ambient air comes in contact with the wet pad it gets cooled while entering the chamber. It provides cooling effect to the materials stored inside. The temperature inside the storage is lowered with some rise in relative humidity, and longer shelf-life for fruits/vegetables can be achieved.
- The developed structure helps to increase the shelf-life of stored products without use of conventional source of energy i.e. electricity.

### EC Transportation System for Fruits/Vegetables

#### Function:

- To reduce the post harvest losses during transportation and increase the shelf life of the product.
- To maintain the storage atmosphere .



#### Salient Features :

System components	Frame structure, pad holder, air duct, water distribution system
Raw material	M.S., celdek pad material, water pump, water
Storage capacity	100 kg
Temperature drop	15-17 °C below ambient
Relative humidity	85-90%
Shelf life of product	Longer than normal

#### Salient Findings:

- The developed system can be easily fitted on any goods transporting vehicle & removed when not required i.e. in rainy and winter season.
- Freshness of fruits/vegetables is preserved at the end of the transportation as compared to that of traditional system.
- Physiological loss in weight and shelf-life of fruits and vegetables can be greatly minimized by lowering temperature and increasing relative humidity during transportation.

### EC Vending Cart for Fruits and Vegetables

Most of the post harvest losses incurred on fruits and vegetables in developing countries are due to lack of adequate low temperature storage and transportation facilities. In most part of India hot and dry weather prevails for a significant part of the year, the high temperature is responsible for the rapid deterioration of perishable produce. The present traditional system of handling fruit and vegetables by street venders causes high losses due to lack of cooling arrangement which needs thorough improvement. Solar powered eco-friendly based on two-stage evaporative cooling system vending cart has been designed and developed for vending of different fruits and vegetables at reduced temperature.

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- Eco-Friendly
- No electric energy required
- No-operational cost
- Cooling system is powered by Solar Energy(SPV) with battery backup
- Battery can also be charged by electricity (optional)
- Also useful for storage of agriculture produces
- Dust proof
- Helps to reduce fruits and vegetables losses at retailer level, preserves freshness
- The shelf life of leafy vegetables was almost doubled in vending cart
- The Physiological Loss in Weight of vegetables is low with vending cart as compared to control storage.
- The average temperature and relative humidity inside the storage chamber was maintained 22 27°C and 80-82% during summer season respectively
- Storage chamber dimensions: 1180x720x600mm (Volume: 0.4 cu. m.)

# EC Technology : Cool Supply Chain for Fruits/Vegetables

India is the second largest producer of fruits and vegetables in the world. In the traditional supply chain, F&Vs reaches the consumers after being passed through various post-harvest handling, transportation and storage. The entire supply chain of F&V in country is laden with the major issue of post-harvest losses and wastages due to lack of cool space at various levels. Due to lack of cost-effective cool supply chain, post-harvest losses are high in horticultural produce particularly in fruits and vegetables. An evaporative cooling technology based lowtemperature cool supply chain have been designed and developed for fruits and vegetables. The cool chain includes; on-farm pre-cooling and storage, vehicle for transport of produce from farm to market, storage at wholesale level, retailer level and street vending cart.

The developed technology is eco-friendly, low cost, efficient and can be very useful to farmers, traders and vendors.



### Post-harvest Processing Machinery : Aonla Shredding-cum-Stone Extracting Machine

### Utility of Machine :

To extract stone from mature aonla fruits and simultaneously obtain aonla shreds at relatively lower costs and without health hazards.



#### Salient Features :

Size of machine	1370 x 330 x 650 mm
Capacity of machine	60-70 kg. <i>aonla /</i> hour
Recovery	Shred 97-98%, Stone 93-94%
Power	1hp, 3 phase electric motor
Man power	1 worker

#### Machine Description :

- A continuous flow power operated machine has been designed for extracting stone from aonla fruits and simultaneously obtain thin aonla shreds.
- Aonla is fed into hopper from where it enters the drum chamber and goes into the space between roller and concave.
- Aonla gets scraped continuously by the rotating roller, against the concave and shreds are obtained.
- Aonla stones are conveyed forward along with roller being scrapped and are finally discharged separately at the other end.

### Post-harvest Processing Machinery : Tomato Seed Extractor

#### Function :

To obtain quality seeds from ripe tomato with minimum seed loss, high efficiency and reduced cost.

An indigenous technology has been developed to extract seeds from tomato.

### Salient Features :

Size of machine	1580 X 1000 X 900 mm
Capacity of machine	45-60 kg/ hour
Seed recovery	98%
Juice recovery	80%
Power	1.5 hp, single phase electric motor
Man power	2 workers





#### Machine Description :

- Tomato fruits are crushed in a crushing assembly and goes in to a separator where the seeds and juices are further separated using vibratory sieve mechanism and collected separately.
- The seed, juice and skin are obtained separately at three separate outlets.
- The mechanical process is quite cheaper and convenient than the manual method.

### Post-harvest Processing Machinery : Brinjal Seed Extractor

#### Utility of Machine :

To conveniently extract quality seeds from whole ripe brinjal fruit with minimum seed loss, higher capacity and at lower cost.





#### Salient Features :

Size of machine	1000 x 610 x 1640 mm
Capacity of machine	200 kg brinjal / hour
Seed recovery	97%
Power	1.5 hp, 3 phase electric motor
Man power	2 workers

#### Machine Description :

- Whole brinjal fruits are fed into hopper to cut by a cutting device and then crushed in a crushing assembly.
- It goes into a separator that separates the seed skin.
- The seed and brinjal pieces are separated by use of water spray jet inside the separating chamber.
- Seeds with water go into separating tank, from where seeds are collected at the bottom outlet of the tank while brinjal pieces are collected at separate outlet.





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