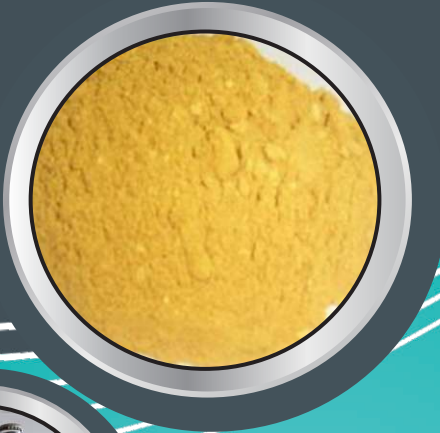


An Overview of Processes / Technologies Developed

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**College of Food Processing
Technology and Bio-Energy
Anand Agricultural University
Anand-388 110**

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 high-end 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:

The College of Food Processing Technology & Bio-Energy works with the aim to create strong human resource for the Indian Food Industries.

Mission and Mandates:

- To bring into being highly skilled and motivated Food Processing Professionals.
- Educate and train the students in the field of Food Processing Technology and Bio-Energy for producing highly skilled and competent manpower in the Food Processing sector.
- Basic, applied and adoptive research and development in the area of Agro-Processing, Food Technology, Food Engineering, Food Quality Assurance, Bio-energy and other relevant subjects.
- First line transfer of technologies and consultancy in different aspects related to Food Processing Industry.

Technologies Developed:

The college to its credit has good number of innovative processes, technologies & machines in the area of agro and food processing, bio-energy and other related disciplines. Many of the technologies have been licensed for commercialization to the industry and entrepreneurs. The complete technical know-how including the manufacturing drawings are supplied on payment of a nominal fee. A brief of the technologies, processes and machines developed by the college is given here under.

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Unripe Mango Beverage (Mango Panna)

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 non-uniform quality of product. A scientific technology has been developed for commercial production and packaging of Mango Panna.

Unripe and Mature Green Mango



Cooking



Pulping



Straining



Mixing of additives



Thermal processing



Addition of preservative



Filling in bottle/ Packaging



Storage



Salient Features :

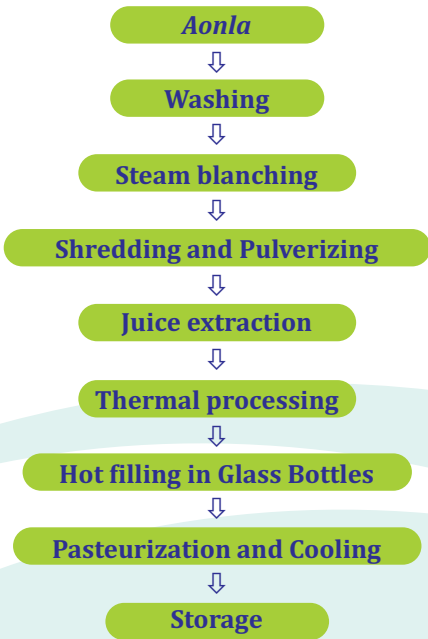
- High quality valued added drink.
- High medicinal and therapeutic values.

Economics :

For a small scale level of production of Mango Panna @ 10,000 lit/day, cost of Mango Panna per litre may come around Rs. 20.

Aonla Juice

Aonla juice is a tasty and nutritious drink. It helps in enjoying the maximum benefits and natural herbal qualities of *aonla*. Patients suffering from diabetes with side effects like skin allergy, blood pressure, can get cured by consumption of *aonla* juice. *Aonla* juice reduces unwanted fat, the levels of free fatty acids, reduces cholesterol and cholesterol induced atherosclerosis, thus making it a useful natural product to fight obesity. A mechanized technology for commercial production and packaging of *aonla* juice has been developed.



Salient Features :

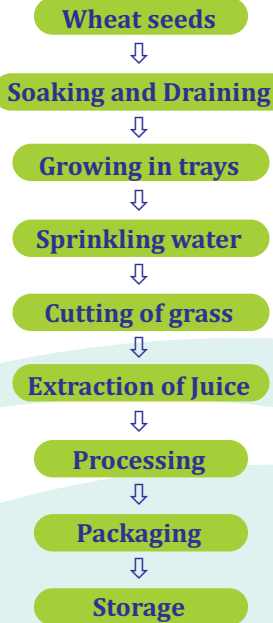
- Higher retention of ascorbic acid.
- Longer shelf life.
- No added chemical preservatives.

Economics :

At small scale level for production of aonla juice @ 2,000 litre/day, cost of aonla juice may come around Rs. 25-30/ litre.

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.

Economics :

Recovery of wheat grass juice is about 60%. The production cost of 1 litre wheat grass juice may come around Rs. 120.

Bottle Gourd Juice

Bottle Gourd (*Dudhi*), a rich source of nutrients like calcium, phosphorous, dietary fibre and is available at cheaper rate. Bottle gourd has a high place in Indian diet. A 100 g of edible portion of bottle gourd contains 12.0 mg ascorbic acid, 87.0 mg potassium, 12.0 mg calcium, 37.0 mg phosphorous and 0.3 mg niacin. The juice has cardioprotective, cardiotonic, general tonic, diuretic, aphrodisiac, antidote to certain poisons, alternative purgative, and cooling effects. A glass of juice taken daily is considered to prevent premature graying of hair. The technology has been developed for commercial production of bottle gourd juice in packed form.

Bottle Gourd



Washing



Peeling



Blanching



Shredding



Pulping



Bottling



Pasteurization



Storage



Salient Features :

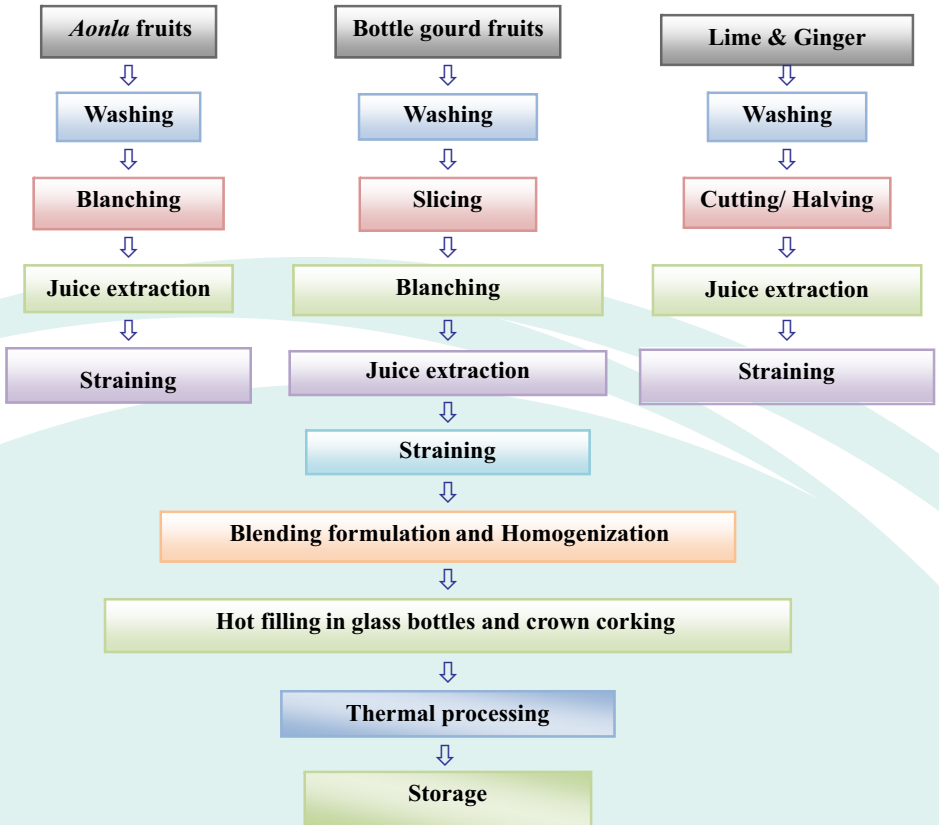
- Rich in nutrients.
- Longer shelf life (up to 20 days at 30 ± 2 °C and 35 days at 7 ± 2 °C with good organoleptic quality).
- No added chemical preservatives.

Economics :

Juice recovery from bottle gourd is around 70 %. From 1 litre plain juice, 5 litres of diluted drinks can be prepared. Production cost of plain bottle gourd juice is approximately Rs. 80-90/lit.

Bottle Gourd Based Blend Juice

Bottle gourd (*Lagenaria siceraria*) popularly known as *Lauki*, *Ghia* or *Dudhi* in India, is rich in nutrients like calcium, phosphorous and dietary fibres and available at a cheaper rate. The production of bottle gourd juice is one way to process the bottle gourd. Bottle gourd juice is mostly produced manually in the household and cottage level, which is less hygienic with high chances of degradation within few hours. Thus, optimized processing and long term storage under ambient condition is required. As bottle gourd juice is not preferred directly, blending the bottle gourd juice with other vegetable or fruit juice can be the solution to dilemma of choosing between health and taste. Therefore a processing technology has been developed for blended bottle gourd juice with *aonla*, lime and ginger.



Salient Features :

- Utilization of underutilized bottle gourd, *aonla*, lime fruits.
- Longer shelf life of blended juice.
- Nutritional benefits of bottle gourd, *aonla*, lemon and ginger in single juice at a cheaper rate.
- Superior quality, taste and flavour.

Economics :

For a small scale level production of bottle gourd based blend juice @ 2000 lit/day, the cost of juice may come around 70-80 Rs./lit.



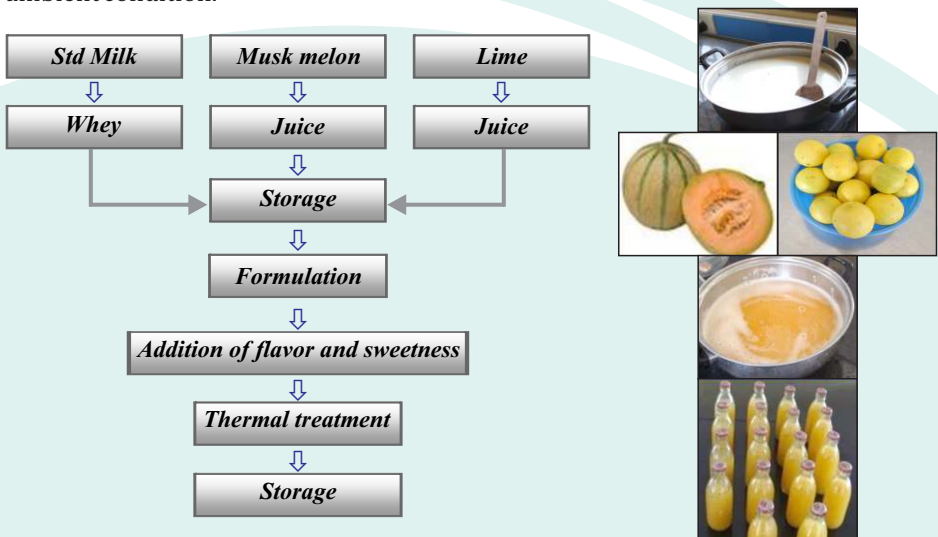
Whey based RTS beverage from muskmelon and lime

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.

Technology Developed:

Milk whey was prepared from standard milk. Ripe and firm musk melons (cv. Punjab sunehri) were procured from the local vegetable market. The musk melons were de-skinned, cut into small pieces, fed into mixture-cum- grinder with 50% potable water and water extracted juice was prepared. Limes were cut into two halves and juice was extracted by squeezing and strained through muslin cloth and prepared for blending. Using design expert software; based on numerical technique was used for optimization of the beverage. For sweetening, sugar and for flavouring, mint extract was added in optimized beverage. The beverage filled in glass bottles, sealed and thermally processed to extend shelf life. Thermally processed whey beverage remains stable and microbiologically safe during storage in line with FSSRs standards.

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.



Pumpkin Powder

Among all the nutrients Vitamin-A deficiency (VAD) is much more pronounced in pre-school children and adults, which is required for normal vision and of importance to human health. Only carrots and pumpkin carotenoids contain major portion of β -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 and commercially available.

Pumpkin



Washing



Peeling & Cubing



Blanching



Pulping



Sulphitation



Drying



Grinding



Packaging



Storage



Salient Features :

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

Economics :

Cost of carotene rich pumpkin powder may come around Rs. 200/kg.

Ready-to-Puff Rice

Puffed rice is traditional breakfast product. Puffing of rice is an important unit operation for conversion of pre-gelatinized milled rice into ready-to-eat snacks. The technique is extensively employed for the domestic and industrial purposes. Microwave heating leads to faster heating rate and shorter processing time compared to conventional heating. A technology has been developed for commercial production of Ready-to- Puff Rice. It is a pretreated packaged rice which can be puffed using microwave as and when desired.

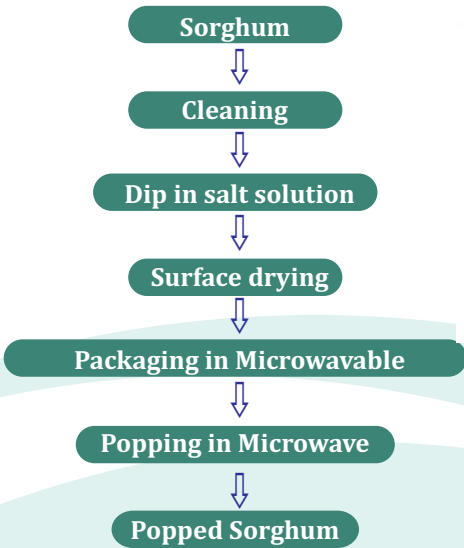


Salient Features :

- Ready-to-Puff and eat type of snack food product.
- Very short processing time of 2-3 minutes in domestic microwave oven.
- Minimum loss of nutrients due to low generation of heat.

Ready-to-Eat Popped Sorghum

Popped sorghum is a traditional breakfast product. Like microwavable popcorn, sorghum can be tempered to optimum moisture content and coated with different ingredients as pretreatments in order to increase the number of popped kernels and improve their sensory quality. The popping characteristics of cereal grain also depend upon the microwave process parameters. A technology has been developed for commercial production of microwavable popped sorghum. It is a pretreated packaged sorghum which can be popped using microwave as and when desired.

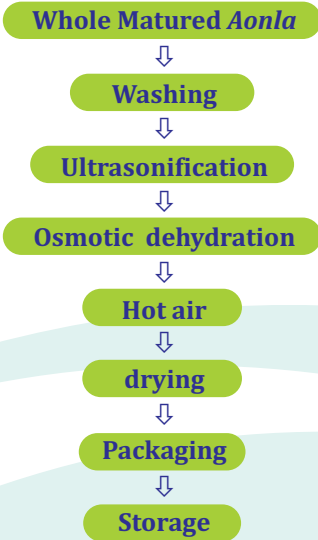


Salient Features :

- Ready-to-Pop and eat type of snack food product.
- Very short processing time of 2-3 minutes in domestic microwave oven.
- Minimum loss of nutrients due to quick and low generation of heat.

Dehydrated Whole *Aonla* Fruit

Aonla fruit has medicinal values and helps in fighting several diseases such as bronchitis, diabetes, fever, diarrhea, jaundice, dyspepsia, cough, etc. but fresh *aonla* fruit is not popular due to its high astringency, less storability and perishable in nature. Ultrasound-assisted osmotic dehydration, as an alternative pretreatment associated with drying procedures offers advantages like reduction of drying time and consequently processing costs. A technology has been developed for efficient dehydration of whole *aonla* fruit to obtain Ready-to-Eat delicious and nutritious item.



Salient features:

- Fruit is intact during processing and storage
- Less oxidation losses during material handling, processing and storage
- Ultrasound-assisted osmotic dehydration helps in reduction of drying time and, consequently, processing costs

Economics:

Cost of production of dehydrated whole *aonla* fruit may come around Rs. 100/kg.

Dehydrated *Aonla* Flakes

Aonla contains very high amount of Vitamin-C (600-1000mg/100g of *aonla* pulp). Owing to rich source of Vitamin C, *aonla* has a high demand in food, pharmaceutical and other allied industries. However, Vitamin C compounds are highly volatile and susceptible to heat. Because of its heat sensitivity, the *aonla* is very difficult to dry without loss in its nutritional quality. The *aonla* flakes available in market are sun dried. Therefore, mechanical drying method has been developed to produce highly nutritious dehydrated *aonla* flakes on commercial basis.



Salient Features:

- Superior quality powder product in terms of taste, appearance, color and overall acceptability compared to traditional sun dried *aonla* flakes.
- Higher retention of Vitamin C.

Impact of Technology:

- Useful for the food processing industries and potential entrepreneurs.
- Good remuneration to growers as well as consumers to get nutritive product throughout the year.

Economics:

Cost of production of dehydrated *aonla* flakes using above technology may come around Rs. 80/kg.

Dehydrated Leafy Vegetables

All leafy vegetables are very nutritious but highly perishable and therefore, cannot be stored safely in normal conditions for a long time. The availability and prices of leafy vegetables fluctuate considerably due to seasonal glut and scarcity. Dehydration is one of the best methods of preservation for such high moisture vegetables. Dehydration facilitates the availability of the good quality product throughout the year and maintain uniform price.

A complete package of appropriate technology for the production of dehydrated products from leafy vegetables like spinach, fenugreek and coriander has been developed.

Technology:

It involves standardization of process parameters for harvesting at appropriate maturity stage, chopping to a particular size and specific pre-treatment prior to dehydration to maintain its nutritional and organoleptic quality. The mechanical drying is carried out for specific time under the controlled environment with optimized air temperature, air flow rate and relative humidity.



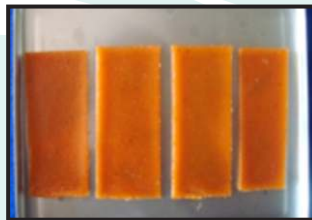
Salient Features:

- Dried leafy vegetables look like fresh after rehydration.
- Comparable nutritional, organoleptic, biochemical and rehydration quality to that of fresh leafy vegetables.

Fruit Bars

Fruit bar is a high calorie food and a rich source of the vitamins and minerals. Fruit bars being primarily made out of fruit pulps and form a good nutritional supplement. A standard recipe and process conditions of mixed fruit bars with mango, banana, pumpkin and papaya pulps with other ingredients and additives has been developed.

The technology involves addition of whey protein concentrate, maltodextrin, pectin and citric acid to selected fruit pulp mix, cooking, drying and packaging of final product.



Salient Features :

- Tasty and highly nutritious (rich in protein) product for all age groups.
- Low cost nutritious natural mixed fruit bars, replacing chocolates/energy bars.

Economics :

For a small scale level of production of mixed fruit bars @ of 100 kg/day , total cost of bar may come around Rs. 150/kg.

Sesame spread

Sesame (*Sesamum indicum* L.) is one of the world's important and oldest oilseed crop known to man that plays an important role in human nutrition. It has very good nutritional value and very easily digested and also stable to oxidative stress. Sesame not only contains "good" fat (monounsaturated and poly-unsaturated fat) but also high in a variety of helpful antioxidants that protects the human being from the damaging effects of free radicals.

Sesame seeds are good source of proteins, complex carbohydrates and some minerals. Additionally iso-flovenes and sesamin also play a role in the reduction of the development of chronic diseases such as cancer, diabetes, and coronary heart diseases. Sesame seeds are used in the preparation of a number of food products like edible oil, paste, cake, flour and confectionery purposes. Sesame paste is of a high nutritive value and it is rich in lipids 54–65%, proteins 7–27%, carbohydrates 6.4–21%, dietary fiber 9.3%, niacin, thiamin and some minerals such as calcium, iron and phosphorous.

Dehulled Sesame



Roasting



Cooling



Grinding



Mixing



Packaging



Storage



Salient Features:

- Sesame is rich source of anti-oxidants, iso-flovenes and sesamin
- Sesame Plays a role in the reduction of the development of chronic diseases such as cancer, diabetes, and coronary heart diseases.
- Nutritious, healthy and cholesterol free butter analogue

Economics:

- Cost of production of sesame spread may come around Rs. 300/kg.

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 flour possesses goodness of assimilable nutrients (proteins, carbohydrates and minerals) and reduced anti-nutrients.



Salient Features:

- Goodness of assimilable nutrients.
- Reduced anti-nutrients

Economics:

For a small scale level of production of Moth bean malt, approximate cost/kg may come around Rs. 80/-.

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.

Fresh basil



Blanching/Slicing



Drying



Grinding



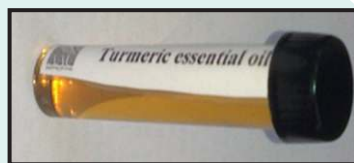
Sieving



SFE



Essential oil



Salient Features:

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

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 |

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.

Complete package of appropriate irradiation technology for sterilisation of chilli, insect disinfestation of pigeon pea and peanut (ground nut) kernel have been developed. Properly irradiated packaged food products have shown better shelf life and keeping quality.

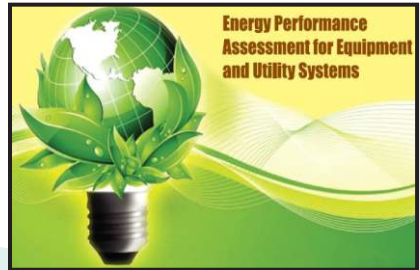
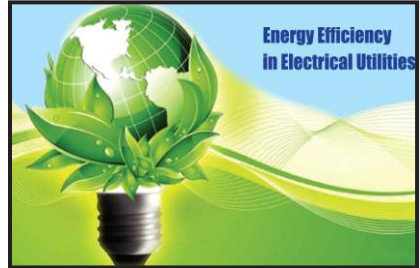


Salient features:

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

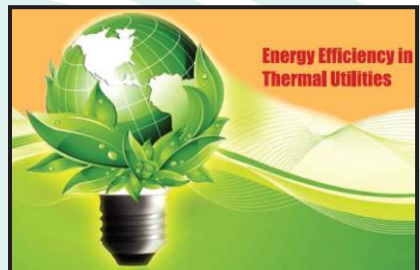
Energy assessment and auditing of food processing plants

The cost of production largely depends upon the use of commercial energy. Dehydration, bakery products and chocolates production facilities have been assessed for energy uses in various operations. Energy audits of these units have shown good scope of electrical energy saving by about 36%. Therefore, units which manufacture food and agro products are advised to carry out energy audit of their plants periodically for possible conservation of electrical and thermal energy. Thereby, minimizing production cost and use of resources.



Salient features:

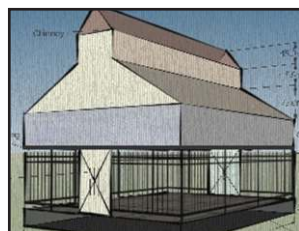
- Base line data of various unit operation and respective equipment in the processing plant.
- Energy resources utilization and specific energy consumption.
- Identification of operations and equipment incurring energy losses and possibility of savings.



On-Farm 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% |
| Cost | Approx. Rs. 50,000/- |
| 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.

Low Cost Evaporative Cooling Structure for Storage of Perishable Commodities

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 :

| | |
|-----------------------|-------------------------------------|
| 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 |
| Relative humidity | 85-93% |
| Shelf life of product | Almost double |
| Cost | Approx. Rs. 10,000/- |



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.

Evaporative Cooling Transportation System for Perishable Commodities

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 |
| Cost | Approx. Rs. 40,000/- (without van) |

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.

Solar Powered Eco-Friendly Fruits and Vegetables Vending Cart

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.



Salient Features:

- 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
- Storage Volume: 0.4 cu. m. (14 cu. feet)

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 .



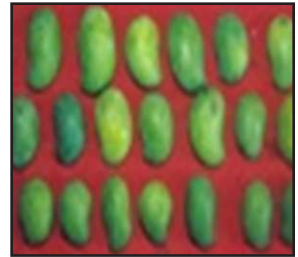
Salient Findings:

- 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.

Pre-Cooling Technology for Extension of Shelf-Life of Fruits and Vegetables

Function:

- Post-harvest life and quality of horticulture produce are highly affected by temperature and respiration rate. Quality losses after harvesting occur as a result of physiological and biological processes. Removal of field heat from fruit after harvest may greatly reduce metabolic rates and prolong its storage life.
- Precooling involves rapid removal of heat from freshly harvested fruits and vegetables for further storage and transportation.
- Technology for precooling by various methods have been standardized for extension of shelf life of various fruits.



Salient Findings:

- Retention of nutritional quality throughout the shelf life is higher than the conventional storage.
- Farmers can store fruits during glut and sell them when the prices are high or when fruits are vanishing from the market.
- Precooling of fruits increases shelf-life of the fruits. Maximum shelf life achieved by pre cooling of some fruits is shown below:

| Sr. No. | Fruit | Maximum shelf life achieved (days) |
|---------|--------|------------------------------------|
| 1 | Tomato | 39 |
| 2 | Banana | 24 |
| 3 | Mango | 36 |
| 4 | Aonla | 41 |

Biodiesel Processing Plant

Purpose:

- An integrated totally mechanized plant for processing Jatropha and other seeds for the production of biodiesel has been designed and developed. The unit includes seed dehulling subsystem, oil extraction sub system , trans-esterification and other unit operations



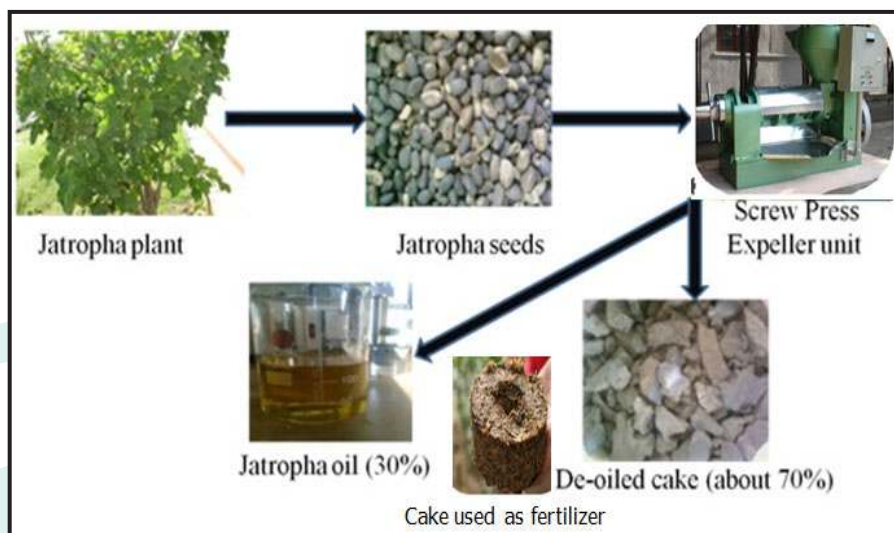
Salient Features:

- The technology is beneficial to the biodiesel production industry by way of efficient processing and increasing the recovery of superior quality product.
- Capacity of plant: 1000 lit of biodiesel/day.
- The investment incurred is expected to be recovered in a very short time by way of higher production efficiency and separate recovery of all the valued by-products.

Oil Extraction Technology from Jatropha Seeds

Function:

- Jatropha seed has high oil content (30-35%). The oil is rich in “Octane” which makes it suitable as fuel oil and also as lubricating oil.
- The oil is also suitable for manufacturing of soaps, paints, varnish, dyes, and cosmetics items. The de-oiled cake can be used as organic manure to improve soil fertility.
- Jatropha seed oil/cake can also be used in the manufacturing of organic pesticides.



Process Technology:

A technology has been developed for efficient extraction of oil from Jatropha seeds using a standard screw type oil expeller.

Salient Feature:

The technology gives high oil recovery and low residual oil content in the cake with low energy consumption.



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