

# **TECHNOLOGIES FOR POST-HARVEST VALUE ADDITION OF AGRI - CROPS**



**AGRO PROCESSING & TECHNOLOGY DIVISION  
CSIR- NATIONAL INSTITUTE FOR INTERDISCIPLINARY  
SCIENCE & TECHNOLOGY, THIRUVANATHAPURAM**

**2020**

## **FOCUS: AGRI FOOD SECTOR**

- ✦ Post-Harvest Technologies for value addition (Spices, Oil seeds & Agri crops)
- ✦ Functional foods & nutraceuticals (Formulated products)
- ✦ Herbals/ Ayurveda (Product development& validation)

## **THE TEAM**

- ✦ Food Technologists/Scientists
- ✦ Chemical Engineers
- ✦ Biochemists
- ✦ Chemists

## **HIGHLIGHTS OF POST-HARVEST TECHNOLOGIES**

### **Spice Oil/ Oleoresin industries:**

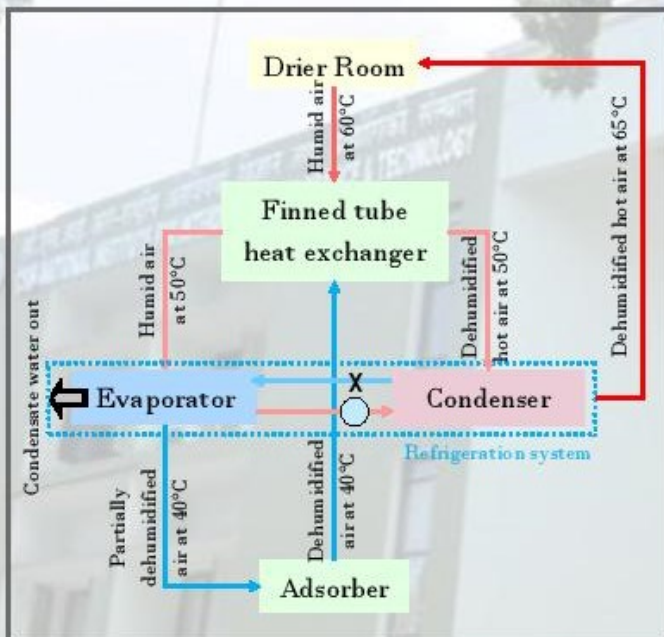
- 5 TPD fresh ginger processing plant in Manipur
- 7.5 TPD fresh ginger processing plant at Meghalaya
- 20 TPD fresh chili processing unit at Byadagi
- 7.5 TPD integrated spice processing plant at Sikkim
- 14 TPD fresh turmeric processing unit at Haryana
- 7.5 TPD ginger/ vegetable processing unit at Wayanad

### **Oil seeds sector:**

- Seven Commercial extraction units having 50-200 FFB capacity in AP, TN, Goa, Gujarat, Orissa
- Five Red palm oil refining units with 50 TPD capacity in AP, MP, UP
- Six Rice bran oil refinery units using the physical refining process developed by CSIR NIIST

## **DEHUMIDIFIED\_DRYER FOR AGRI CROPS**

- Multipurpose applications for fruits, vegetables, spices, flowers etc.
- Quality Product with maximum retention of nutrients
- Energy saving and suitable model for MSMEs
- Better value addition by export market



All on turnkey/consultancy basis



### TECHNOLOGY FOR WHITE PEPPER PRODUCTION

- NRDC technology Award
- WIPO Gold medal (2009)
- \* Zero discharge microbial process where fermentative de skinning of pepper takes places in 5-7 days
- \* NIIST bioprocess has been transferred to 22 customers, mainly in MSME sector in Kerala, Karnataka and TN.

### RED PALMOLEIN (RPO) FOR COMBATING VITAMIN A DEFICIENCY



(CSIR Programme on S&T Interventions to Combat Malnutrition in Women and Children)

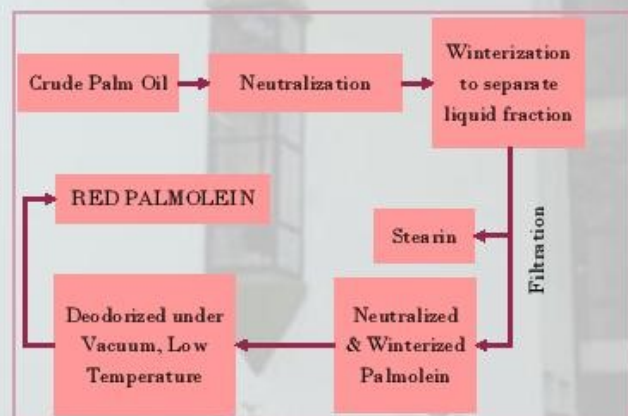


### De- tails of the product:

Functional Food	:	Red Palmolein (RPO)
Nutrients	:	$\beta$ -Carotene, Tocopherol and Tocotrienol 600-800 ppm
Functionality	:	Source of Vitamin A and Vitamin E
Status of product	:	Ready for distribution
Mode of Study	:	Dietary approach through blended oil

### Advantages of the product:

- Cost effective process
- More than 60% of the micronutrients are retained in the product even after refining
- The product is at par with international products in terms of carotene and tocopherol / tocotrienol contents

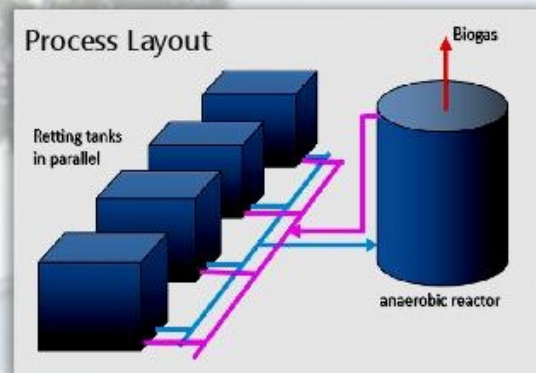


### Partners in this project:

- CSIR-CIMAP
- CSIR-IHBT
- Kerala State Nutrition Board
- Vivekananda Kendra Rural Development Group
- Achutha Menon Centre for Health Science Studies
- Medical Trust Hospital and Diabetic Centre

## BIOPROCESS FOR NATURAL FIBRE PRODUCTION FROM AGRO WASTE

- Better quality fibre
- Zero discharge process
- No environmental pollution
- Anaerobic technology based
- Biogas as value added by product
- Coir fibre can be extracted in one month (The existing practice take 10-12 months)
- Banana & pineapple fibre can be extracted in one week



## PILOT PLANT FACILITIES

- Deodorizer
- Crystallizer
- Spray dryer
- Freeze dryer
- Hydrogenation unit
- Thin film evaporator
- Multipurpose reactor
- Solvent extraction unit
- Membrane filtration unit
- Neutralizer cum bleacher
- Molecular distillation unit
- Fractional distillation column
- Scrapped surface Heat Exchanger

## Banana fibre quality



## ANALYTICAL FACILITIES

- FTIR
- GC-MS
- LC-MS
- Tintometer
- Flow Cytometer
- Texture analyzer
- Confocal microscope
- Gas chromatograph (2)
- Hunter LAB colorimeter
- UV visible spectrophotometer
- Differential Scanning Colorimeter
- Biology lab with cell line study facilities
- High Pressure Liquid Chromatograph (3)
- Supercritical Phase Equilibrium Analyser
- High Performance Thin Layer Chromatograph

## VALUE ADDITION OF FRUITS & VEGETABLES

### Activities:

- Scale up & optimization drying kinetics, energy calculation & costing
- Process development for dehydration of Jack fruits & banana
- Evaluation of end products and shelf stability



Dehydrated Raw Jackfruit



Banana based functional food products



Jackfruit preserves in honey

## Value added fresh ginger (Cleaned/ waxed ginger & dry ginger powders)

### Technology

Process for continuous / batch wise washing, cleaning, waxing, grading & drying of fresh ginger

### Application and use

Value added & shelf life enhanced fresh ginger for global market

### Salient features of Technology

The key operations involved are Continuous cleaning / washing of fresh ginger for removal of adhering mud, sorting for bigger and smaller sized ginger, Size reduction and mechanical dewatering for smaller ginger followed by drying & powdering for making ginger powder. The big size ginger will undergo waxing (optional), drying for market as superior grade

**Cost of production** : Rs.12/kg

**Status of Commercialization** : Commercialized through establishment of units in North East India and currently at Wayanadu

**Minimum Economic Unit Size**: 1000 kg/day



## Essential oils from spices & aromatic plants

### Technology

Technology for the recovery of flavour (essential oil) from various spices & aromatic plants

### Application and use

Value addition and scope for global market

### Salient features of Technology

Kerala is famous for major spices like ginger pepper cardamom and also for aromatic plants bearing essential oils for perfumery/ medicinal applications. Some examples are betel leaf, curry leaf, davana flowers, kacholam roots and also minor spices like cinnamon, clove etc. In Kerala, the essential oil manufacturing sector is mainly in hands of large and medium scale manufacturers of spice oils and oleoresin industries. But on establishment of a small scale multipurpose distillation facility can facilitate the production of essential oils from such rare plants in

economically viable manner through income generation to farmers.

### Equipment, machinery and other facilities

Essential oil distillation vessel, boiler, size reduction equipments.

**Raw materials** Aromatic Plants

**Cost of production** : Depends on the nature of spice/ botanical selected

**Status of Commercialization** : Commercialized

**Minimum Economic Unit Size**: 500- 2000 Kg /



## Drying of nutmeg/cardamom etc. for value addition

### Technology

Dehydration Process for production of superior quality of spices like nutmeg, cardamom etc. for maximum retention of colour, flavour and free from aflatoxins.

### Application and use

Value addition for export market

### Salient features of Technology

Nutmeg and mace exported from the country often faced several quality constraints in global markets due to aflatoxins. Conventional drying resulted in the oozing out of essential oil from the spice. A new drying unit is developed with less energy consumption which is able to produce moisture & aflatoxin free spice for global market. The machine can also be effectively used for drying of other agro produces like cardamom

for maximum retention of its green colour and volatile oil.

### Equipment, machinery and other facilities

Drying unit for spices, conveyers & transport devices.

**Raw materials**: Nutmeg/Cardamom

**Cost of production** : Drying cost : Approx. Rs. 12/ Kg dried spice

**Status of Commercialization** : Commercialized

**Minimum Economic Unit Size**: 100-2000Kg/ day



## Ready to cook dehydrated unripe jackfruit

### Technology

Ready to cook dehydrated unripe jackfruit

### Application and use

Process for production of Ready to cook dehydrated unripe jackfruit

### Salient features of Technology

The process is developed in such a way that it retains the freshness of the product after rehydration and cooking. The product is stable for one year under room temperature without any added preservatives, under vacuum package in flexible polyethylene bags. The technology is extendable to dehydrated tender jackfruit which can be used for curry preparation after dehydration.

**Raw materials:** Unripe matured jackfruit/ tender jackfruit

### Equipment, machinery and other facilities

Drier, Slicer, steamer, conveyors, packing machine etc

**Cost of production :** Rs.180/kg

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 kg/ day



## Dehydrated ripe jackfruit in honey

### Technology

Dehydrated ripe jackfruit preserved in honey

### Application and use

Ripe jackfruit is dried to optimum moisture level and preserved in honey

### Salient features of Technology

Ripe Jackfruit is dehydrated using novel drying methods to the optimum water activity so as to retain the fresh and natural flavors of jackfruit. The product has a shelf stability for one year under room temperature without any added preservatives, under vacuum package in standalone polyethylene bags.

**Raw materials:** Ripe jackfruit, Honey

### Equipment, machinery and other facilities

Drier, Slicer, steamer, packing machine, stirred tanks etc.

**Cost of production :** Rs.250/kg

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 kg/ day





## Seasoning mix from spices for preventive health management

### Technology

Seasonings are the blend of herbs/spices/ medicinal plants with antidiabetic and cardiovascular protection properties

### Application and use

Ready to constitute seasoning can be use for salad dressing, soups, topping for pop corn, and as a seasoning mix for ready to eat and ready to cook foods.

### Salient features of Technology

Seasoning mix were formulated with various herbs and spices based on there biological activity Developed products were evaluated for its antioxidant, antidiabetic and cardiovascular protection studies and were blended in unique proportion to ensure the health benefits.

**Raw materials:** Spices/herbs/medicinal plants

### Equipment, machinery and other facilities

Sorter, slicer, hammer mill, drier, blender, packing machine etc

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 kg/ day



## Functional beverages

### Technology

Juices from tropical fruits microencapsulated with extracts of herbs/spices/medicinal plants with antidiabetic and cardiovascular protection properties

### Application and use

Ready to constitute health drink by encapsulating the active ingredient in combination with other bioactive rich plant materials

### Salient features of Technology

Juices from tropical fruits such as jamun and pomegranate formulated with various herbs and spices were evaluated for its anti-diabetic and anticancer properties and were blended in unique proportion to ensure the health benefits.

**Raw materials:** Spices/herbs/medicinal plants

### Equipment, machinery and other facilities

Stirred tank vessels, slicer, pulper, hammer mill, spray drier, packing machine etc

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 kg/ day



## Spice based tea bag dips

### Technology

Green tea- spice bag dips were developed using green tea blend with herbs/spices/medicinal plants having antidiabetic properties

### Application and use

Ready dip green tea bags with herbs and spices by encapsulating the active ingredient with antidiabetic potential

### Salient features of Technology

Tea bags were formulated with green tea and various spices were evaluated for its antidiabetic properties and were blended in unique proportion to ensure the health benefits.

**Raw materials:** Spices/herbs/medicinal plants

### Equipment, machinery and other facilities

Stirred tank vessels, slicer, pulper, hammer mill, drier, packing machine etc

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 kg/ day



## Endophytic Bacterial Formulation – Plant Tonic

Excessive and repeated use of synthetic compounds brought undesirable changes to the present day agricultural practices and consumers health. It has not only affect the growth, biomass and productivity of the cultivated crops but also deteriorated the soil fertility by killing the non-targeted beneficial microflora.

Microbial organisms, particularly endophytic organisms, residing inside the different plant part like root, stem and leaves are recently identified as a potential alternative because as they reside inside the plant will have an advantage over the rhizoplane/ rhizosphere bacteria to promote the plant growth, biomass, yield and disease management besides. Therefore, we exploited the endophytic microbial flora from Kuttanad region for this purpose and a successful formulation is developed.

This formulation, is a consortium of three endophytic strains isolated from rice plants. The formulation enhances plant growth, biomass and yield besides soil fertility improvement. The technology developed will

have a direct impact on the farmers, particularly from rural areas to remold their agricultural strategies for better plant health and productivity management with low investment, which will result high returns to their produce through green cultivation.

### Main Advantages

- Enhanced crop growth, biomass and yield
- Control of fungal and bacterial diseases
- Improved the soil fertility,
- eco-friendly & cost effective .



## Millet based RTE porridge (pearl millet, little millet, banyard millet, kodo millet, foxtail millet etc)

### Technology

The grits of millets processed by pressure steaming and convert to make it as RTE food with balanced nutritional composition

### Application and use

Instantly available by mixing the product with warm milk or water.

### Salient features of Technology

Delivering the nutrient rich mix by conversion into a palatable form by optimized process conditions, drying & formulation of the porridge with nutrients and flavour for better consumer acceptance

**Raw materials:** Different types of millet seeds, and arrow root powder

**Equipment, machinery and other facilities:** Size reduction devices, milling unit, boiler, drier, mixer etc.

**Cost of production :** Depends on type of millet

**Status of Commercialization :** Ready to commercialize

**Minimum Economic Unit Size:** 100Kg/batch



## Dehydrated coconut gravy

### Technology

Developed a ready to constitute coconut gravy with a mix of spices using a developed drying technology

### Application and use

Dehydrated coconut gravy can be used after constituting with warm water

### Salient features of Technology

Bringing the traditional Indian dish to available in a minute with retaining utmost flavour of spices and coconut using technology developed drier

**Raw materials:** Coconut, Chilli, turmeric, Mango, cumin and jeera.

### Equipment, machinery and other facilities

Size reduction devices, mixer, RADD and packaging unit.

**Status of Commercialization :** Ready to commercialize

**Minimum Economic Unit Size:** 25 Kg/batch



## Osmo – dehydrated dry fruits

### Technology

Combination of Osmotic dehydration & Dehumidified drying helps to deliver the product with high quality

### Application and use:

Direct consumption as a snack, can be used as toppings in ice creams and confectionaries.

### Salient features of Technology:

Make seasonal fruits available throughout the year. Combination of osmotic dehydration and drying increases the eating quality of the final product.

### Equipment, machinery and other facilities:

Jacketed Kettle with agitation, RADD, vacuum packaging machine, Hand Refractometer

**Raw materials:** Raw fruit & sugar syrup

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100g pack



## Dehydrated leafy vegetables (amaranth, spinach, coriander, fenugreek, mint)

### Technology

Ready to cook dehydrated leafy vegetables

### Application and use

Dried vegetables can be used directly by soaking in hot water for 2-3 minutes, could be used as vegetables and as ingredients for other food products

### Salient features of Technology

The technology developed aims in extending the shelf life of vegetables which are highly perishable and also helps to reduce the loss of material and even economical loss.

### Equipment, machinery and other facilities:

Jacketed Kettle with agitation, RADD, vacuum packaging machine

**Raw materials:** Vegetables

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100g pack



## Ready to cook dehydrated vegetables (carrot, raw banana, yam, snake guard etc.)

### Technology

Ready to cook dehydrated vegetables

### Application and use

Dried vegetables can be used directly by soaking in hot water for 2-3 minutes.

### Salient features of Technology

The technology developed aims in extending the shelf life of vegetables which are highly perishable and also helps to reduce the loss of material and even economical loss.

### Equipment, machinery and other facilities

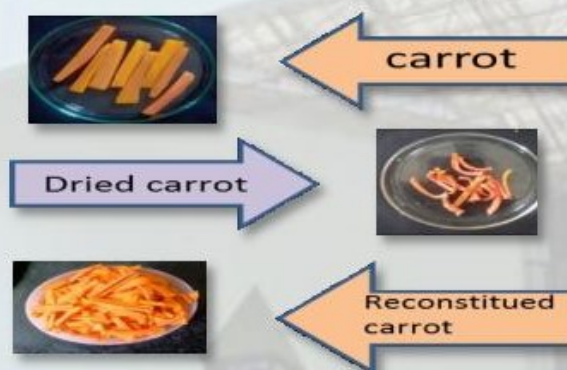
Jacketed Kettle with agitation, RADD, vacuum packaging machine

**Raw materials:** Vegetables

**Cost of production :** Depends on the type of product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100g pack



## Banana based products for health management

### Technology

Processes for development of dehydrated / powdered raw banana, functional breakfast mix based on banana etc.

### Application and use

Value addition for banana

### Salient features of Technology

Green banana pulp contains up to 70-80% of starch which has potential both for its digestive properties and functional properties specific to low-glycemic products in the diabetes management. So a variety of products can be developed as functional food for potential health benefits.

**Raw materials** Green banana

**Equipment, machinery and other facilities**  
Size reduction devices, milling unit, boiler, drier, mixer etc.

**Cost of production :**Rs 250/ kg product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 200g pack



## Dietary fiber from coconut residue

### Technology

Process for recovery of dietary fiber from the coconut residue ( by product of virgin coconut oil industry)

### Application and use

Process for production of high value dietary fiber Value addition & better utilization of industrial by product through innovative product development

### Salient features of Technology

The major focus of the work is on the spent coconut residue an industrial by product for recovery of dietary fiber. This residue is an enriched source of the dietary fiber and protein which are the major nutritional components present in raw coconut. Through appropriate processing of oil removal and other pre-treatment operations the enriched fiber

is produced

**Raw materials:** Coconut residue, organic solvents

### Equipment, machinery and other facilities

Solvent extraction unit, Drier, jacketed vessel, boiler, packing machine etc

**Cost of production:** Needs to work out

**Status of Commercialization :** Bench level process is ready, need to scale up before commercialization

**Minimum Economic Unit Size:** 200 gm



## Syrup from coconut / palm sap

### Technology

Process to produce syrup

### Application and use

Direct consumption as a sweetener, can be used for preparation of cakes and similar product and for confectioneries, for preparation of traditional coffee and any situation where Palm ghur /Jaggery has been conventionally used.

### Salient features of Technology

The syrup is prepared by concentration of sap of any coconut or palmyrah palm. The Syrup can be used without melting and filtration unlike conventional palm ghur. Uniform quality is retained.

**Raw materials** Palm / Coconut Sap or Akhani, Liquid Glucose, Packaging Materials

### Equipment, machinery and other facilities

Baby Boiler, Jacketed Kettle with agitation, Filling Machine, Lug cap sealer, Bottle Sterilization and drying unit, Hand Refractometer

**Cost of production :**Rs 350/ kg product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 200g pack



## Spices fortified syrup from coconut / palm sap

### Technology

Process to produce spices fortified syrup

### Application and use

For preparation of traditional instant coffee, soothing cough, improving digestion

### Salient features of Technology

The syrup is prepared by concentration of sap of any coconut or palmyra palm and fortifying with spices

**Raw materials** Coconut Sap / Palm or Al-chani, Liquid Glucose, spices, Packaging Materials

### Equipment, machinery and other facilities

Baby Boiler, jacketed kettle with agitation,

crusher, centrifuge, filling machine, lug cap sealer, bottle sterilization and drying unit, hand refractometer

**Cost of production:** Rs. 1000/ kg product

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 100 gm pack



## Technology Know-how for Trikatu Syrup

CSIR-NIIST Transferred technology for making Trikatu syrup to Trivandrum-district Palm products development Cooperative Federation Ltd., Parassala

The Trikatu syrup developed in CSIR-NIIST has advantages of being more palatable and gives the richness and medicinal properties of Palm neera or unfermented palm tree sap.

**Trikatu** is used in Ayurveda for treating respiratory tract infections, asthma, immunomodulation, gastric and abdominal disorders, diarrhoea, asthma, cough, bronchitis. It is also used in the preparation of several classical Ayurveda formulations used in the treatment of for common cough and cold, respiratory disorders and digestive disorders. Trikatu is also reported to increase the bioavailability of nutrients, herbal, and pharmaceutical drugs

### Trikatu syrup

**Ingredients:** Palm Neera, Dry ginger, pepper, long pepper

**Best before:** 3 months from manufactured date Refrigerate after opening

**Instruction for use:** Can be consumed as such or dissolve 1 tsp in 50 mL of hot water and consume hot



## Raw banana grits for porridges

### Technology

Processes for development of dehydrated / powdered raw banana, functional breakfast mix based on banana etc.

### Application and use

Value addition for banana

### Salient features of Technology

Green banana pulp contains up to 70-80% of starch which has potential both for its digestive properties and functional properties specific to low-glycemic products in the diabetes management. So a variety of products can be developed as functional food for potential health benefits.

**Raw materials** Raw banana

### Equipment, machinery and other facilities

Size reduction devices, milling unit, boiler, drier, mixer etc.

**Cost of production:** 300/kg

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 200g pack



## Raw Banana – cereal based instant drinks

### Technology

Processes for development of raw banana – cereal instant drinks

### Application and use

Value addition for banana

### Salient features of Technology

Green banana pulp contains up to 70-80% of starch which has potential both for its digestive properties and functional properties specific to low-glycemic products in the diabetes management. So a variety of products can be developed as functional food for potential health benefits.

**Raw materials** Raw banana

### Equipment, machinery and other facilities

Size reduction devices, milling unit, boiler, drier, mixer etc

**Cost of production :** 300/kg

**Status of Commercialization :** Ready for commercialization

**Minimum Economic Unit Size:** 200g pack





## Raw Banana Composite Mix

### Technology

Processes for development of raw banana-composite mix

### Application and use

Value addition for banana

### Salient features of Technology

Green banana pulp contains up to 70-80% of starch which has potential both for its digestive properties and functional properties specific to low-glycemic products in the diabetes management. So a variety of products can be developed as functional food for potential health benefits.

**Raw materials** Raw banana

### Equipment, machinery and other facilities

Size reduction devices, milling unit, boiler, drier, mixer etc

**Cost of production** : 300/kg

**Status of Commercialization** : Ready for commercialization

**Minimum Economic Unit Size**: 200g pack



## Raw Banana Peel Powder

### Technology

Processes for development of raw banana peel powder

### Application and use

Value addition for banana

### Salient features of Technology

Green banana peel is rich in fiber and bioactive phytoconstituents. So a variety of products can be developed as functional food for potential health benefits.

**Raw materials** Raw banana

### Equipment, machinery and other facilities

Size reduction devices, milling unit, boiler, drier, mixer etc

**Cost of production** :Depends on the type of product

**Status of Commercialization** : Ready for commercialization

**Minimum Economic Unit Size**: 200g pack



## Millet based functional food formulations

### Technology

Processes for development of traditional millet based and indigenous vegetable-based products - Ready to prepare soup mix/ porridge/upma

### Application and use

Value addition for traditional grains

### Salient features of Technology

Traditional grains were sprouted and dehydrated using appropriate dehydration methods, milled and formulated to various health foods with functional properties and with improved nutritional properties. The products are rich in dietary fiber and bioactive phytochemicals hence associated with prevention and management of lifestyle associ-

ated diseases. So, a variety of products can be developed as functional food for potential health benefits.

### Raw materials

 Millets

### Equipment, machinery and other facilities

Size reduction devices, milling unit, drier, mixer, blender, packaging unit

**Cost of production** : Depends on the type of product

**Status of Commercialization** : Ready for commercialization

**Minimum Economic Unit Size**: 200g pack



## Wheat bran based biodegradable cutleries and plates

### Technology

Wheat bran based biodegradable cutleries and plates

### Application and use

A novel method for wheat bran based biodegradable cutleries and plates

### Salient features of Technology

As an alternative to single use plastic cutleries, like plates, cups, spoon, fork, take away units etc. This can be used by anyone, who care environment. Products to be used comfortably and safely at home, on a picnic, in public functions, during the open-air event or in the restaurant. Since plates and bowls are made from clean edible wheat bran, within 30 days it will degrade.

**Advantage of Technology** Low cost single user products, Easily biodegradables, good

water retention and heat resistant, Good strength, and stiffness, Microwave friendly

**Raw Materials** Wheat bran, binders

### Equipment, Machinery and other facilities

Compression machine, Injection mold, Ball mill, Kneading Machine, Hydraulic Press and Texture analyzer

**Cost of production**: 2.5 Rs per plate

**Sate of Commercialization**: Ready for transfer technology

**Minimum Economic unit size**: 500kg per day



## TBIC IN AGRO-PROCESSING:

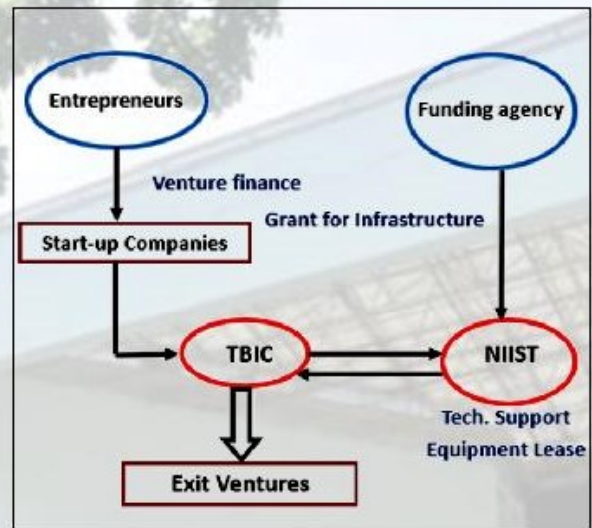
### A JOINT INITIATIVE OF CSIR-NIIST & GOVT. OF KERALA

#### Services Offered:

- Process /product development
- Establishment of technical feasibility
- Samples for market evaluation
- Analytical services
- Facility to try out new concepts by entrepreneur

#### Technical consultancy:

A specialized facility, where essential infrastructure, technical expertise and consultancy services, are available



#### Industrial collaborators



## **WE OFFER**

- ✦ Technologies for value addition of Agri produces
- ✦ Recovery of flavour, extracts, active principles from spices
- ✦ Technology for extraction & refining of vegetable oils
- ✦ Process development (Bench Scale) and Scale up in pilot plant
- ✦ Process Engineering & execution of commercial projects
- ✦ Product formulations for functional foods, nutraceuticals and Ayurvedic products
- ✦ Validation of products by chemical & biological studies
- ✦ Technology up gradation & troubleshooting

### **Contact Details**

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