



# Technology

टैकनोलॉजी फोकस



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## **FOOD PRODUCTS AND TECHNOLOGIES DEVELOPED BY DRDO**





## *From the Desk of Guest Editor*



The Defence Food Research Laboratory (DFRL) was established on 28th December 1961 under the aegis of Defence Research and Development Organisation (DRDO), Ministry of Defence, Government of India, at Mysore especially to cater to the strategic and operational requirements of defence services and to provide logistical support in the area of food supplies and meet varied food challenges of Indian army, navy, air force and other paramilitary and elite forces.

In operational situations, the soldiers are deprived of the fresh produce needed to sustain life processes. Even normal regime of cooking becomes extremely cumbersome and difficult. The R&D efforts at DFRL are aimed at designing and engineering lightweight, convenience pack rations for army, navy, air force and other paramilitary forces, which do not require any elaborate cooking or preparation at the consumer's end and remain shelf stable under varying climatic conditions for periods ranging from 6 to 12 months.

Prior to the inception of DFRL, the laboratory functioned as a Food Group within the precincts of Defence Science Laboratory, Delhi.

DFRL, through the dedicated efforts of its scientists and technologists, over the last five and half decades, has been engaged in R&D to conserve, preserve, stabilise, design, fabricate and engineer a vast array of food products of Indian dietary, which are not only shelf stable under all weather conditions but also deliver adequate nutrition and energy to keep the morale of Service personnel high at all times. Through enormous and substantive contributions, DFRL has developed a wide variety of food products of Indian dietary matching the mainframe palate tastes of the country. Many of the DFRL foods, born out of innovative state-of-the-art technologies, lend themselves eminently suitable to industrial scale commercial exploitation by enterprising entrepreneurs of different genre. DFRL has also produced many food products which are exports worthy.

The keys areas of work are:

- Conducting translational research in food science and technology for developing shelf stable food products in order to achieve targeted goals of combat feeding
- To undertake scaling up of innovative food processing technologies and limited scale production of platform/ terrain specific rations to meet diverse strategic requirements
- To develop energy efficient, nutritionally adequate, environment friendly state-of-the-art innovative technological solutions for the design, development and packaging of fresh and processed food
- Development of strategies and protocols for processing, storage and transportation of frozen/chilled foods for Services
- To develop laboratory based and field deployable rapid testing methods/kits for food safety requirements under varied operational conditions
- To plan and execute specialised on-site/off-site training courses and educational support for Services as well as limited scale production and supplies to armed forces

DFRL is also engaged in the development and evaluation of food products, appliances, packaging materials and field test kits to meet the requirements of service forces. To fulfill this mandate, the laboratory is closely working with academic institutions, R&D centres and other government agencies.

DFRL has more than 500 technology transfers to its credit, thus, contributing to employment generation, vendor generation for armed forces, and 'Make in India' initiative of the Government of India in food sector. Indigenous ingenuity is the hallmark of most of the technologies developed at DFRL. This issue of Technology Focus is discussing various food processes, products, packaging and preservation technologies developed in the laboratory.

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# Food Products and Technologies Developed by DRDO

## Ready to Eat Foods

### Preserved and Flavoured Chapatias

The technological measures employed to preserve and stabilise this popular Indian wheat-based staple includes certain preservatives and thermal treatment along with incorporation of some stable flavour principle. The product is suitable for use by the troops during operational and combat situations as well as for various expeditions and mission undertaken on land and sea.



Preserved and flavoured chapatias

### Spiced Potato Parathas

Incorporation of spiced potato mix into the dough and, thermal as well as preservative regimes of stabilisation process are key to the development of this immensely popular nutritious and flavourful wheat staple. The product can be used during breakfast, lunch, dinner or on any other occasion as snack food.



Spiced potato parathas

### Short-term Preserved Chapatias

Freshly baked chapatias have a shelf life of twenty four to forty eight hours. To extend the shelf life of chapatias upto fifteen days by using permitted preservatives and packaging material, short term preserve chapatias were developed by DFRL.

The product is eminently suitable for use during long journeys and institutional feeding/catering programmes being undertaken by railways and certain canteens and restaurant chains in cosmopolitan centres.



Short-term preserved chapatias

### Shelf Stable (No preservative) Chapatias

Freshly prepared chapatias have very limited shelf life. DFRL has developed preserved chapatias having a shelf life of more than one year, and retort process was used to preserve the taste and after taste both.



Short stable chapatias

### Fibre Rich Bisibele Bhath and Fibre Rich Vegetable Pulav

The presence of dietary fibres in food have physiological benefits. They give relief from constipation and haemolroidiate. The constant use of recommended dietary fibre levels or dietary fibre rich products in diet have positive health benefits right from teeth, to control normal levels of sugar, cholesterol, lipid metabolism, bile acid secretion to elimination of fecal waste.



Fibre rich bisibele bhath and fibre rich vegetable pulav

### Retort Pouch Processed Foods

Foods such as aloo choley, sooji halwa, fish curry, rice, dal curry, vegetable, and mutton pulav, etc., are processed in retort amenable special kind of flexible polymeric films to achieve commercial sterility. The products are in a Ready-to-Eat (RTE) form and can be eaten as such, straight out of the packs or, if facilities exist, can be warmed up by dipping the pack in hot water or keeping in hot air microwave before being consumed. Such foods have better consumer appeal and acceptability as compared to their canned counterparts. Convenience, ease of carrying and disposal after use are the special appealing features for the consumers.



Potato peas curry

Mutton pulav



Sooji halwa

Vegetable pulav

### RTE Whole Channa Masala

The channa or Bengal gram is widely consumed pulse and rich in protein and minerals. The channa curry is highly relished dish and consumed along with chapati or rice. The shelf stable (RTE) channa curry based on inpack sterilisation process was developed which can be shelf stable for a month at room temperature. The product is highly liked by the consumer with respect to sensory characteristics. The process of RTE channa curry is simple and cost-effective. The technology of the product has been given to the industry for dal-roti project. The product can be prepared on small scale/cottage industry within 10-15 lakhs capital investment for 100 kg/day production. The product is rich in protein, vitamins and minerals.



Whole channa masala

### RTE Soy Chunks

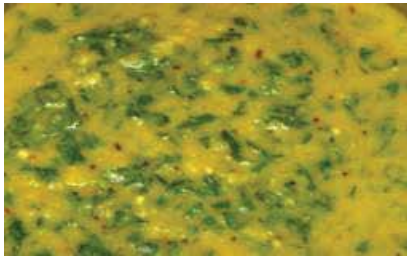
Pickles based on fruits and vegetables are presently available which contain no proteins. RTE soy chunks is the pickle prepared using texturised soy chunks for pickling. (The RTE soy chunks is the protein rich pickle) This is a unique RTE product rich in protein that can be used as an adjunct along with chapati or rice.



RTE soy chunks

### RTE Palak Dal Curry

The RTE palak dal curry which is stable at room temperature for one month was developed by inpack sterilisation process. The process is simple and



**RTE palak dal curry**

requires low capital investment of 10-15 lakh for 100 Kg/day production. The product is cost-effective and useful for the government feeding programme. The product can be warmed in the pack or the content of the pack can be transferred to a vessel and warmed for the consumption. The product is rich in vitamins, minerals, and protein as it is prepared by using green vegetable palak and pulses. The technology of the product has been given to the industry for dal-roti project.

### RTE and Shelf Stable Fried Chicken Leg Pieces

RTE non-vegetarian products are not available in remote areas. Moreover, the item could not be transported at ambient conditions for even a day or two. Thus, product innovation was made to deliver a protein rich convenient RTE product for all age groups with good quality characteristics in terms of microbiological standards, chemical stability and sensory attributes which is stable under ambient, refrigerated and freezing temperature conditions.



**RTE fried chicken leg pieces**

### RTE Frozen Peas 'N' Chicken Product

Freezing and frozen storage is one of the most important techniques for long term preservation of meat and poultry products but some wastage still takes place. Nevertheless, freezing commonly damages muscle protein, induces protein denaturation and results in loss of protein functionality.



**RTE frozen peas 'N' chicken product**

To prevent such changes, cryoprotectants such as glycerol were added to ensure maximum functionality of frozen poultry product. The use of glycerol as cryoprotectant protected the muscle proteins from denaturation, improved the textural quality, reduced the freezing and thawing losses and damages caused due to crystal ice formation.

Thus cryostabilisation could be achieved by using glycerol to prevent actions taking place in frozen stored poultry products and it has been found to be very useful in the development of more stable and nutritive frozen poultry products.

### Stabilised Green Chutney

Green chutneys made up of green tomato, coriander leaves and spices are delicacies which have huge market potential in the defence and civil sectors.

The chutney which is highly perishable and not suitable for long distance transportation, stabilised by hurdle concept for storage at ambient temperature. The process is based on combination of slight reduction in moisture, water activity, lowering of PH and thermal treatment.



**PP Pouch**

**PFP Pouch**

**Stabilised green chutney**



## Soy Shirkhand

The soy shirkhand is based on soyabean and it is rich in soya protein, cholesterol free fat as well as bioactive components with anti-cancer and other functional properties. The product is cost-effective and provides additional income to farmers through cottage industry. Usually the commercial shirkhand contains cholesterol to the level of 13 mg per 100 g and has no dietary fibre but soya shirkhand is free from cholesterol. It is a rich source of bifidous micro flora, which is good for digestion and sound gut health.



Soy shirkhand

## Hurdle Technology Preserved Fruits

Fruit slices are usually preserved by canning, dehydration or freezing process. These fruits undergo significant textural and taste losses during the processing and the technologies are as such capital intensive and difficult to be adopted in small scale/cottage industry.

Hurdle technology is a novel technique for the preservation of foods with emphasis on fruit slices and the low magnitude hurdles generated to minimise/avoid microbial proliferation resulting in shelf stable RTE fruit products with high moisture content.



Hurdle technology preserved fruits

The hurdle technology preserved fruits retain their fresh appeal as that of fresh fruits. The product remains microbiologically safe and has high acceptance. The process of preparing and processing these fruits is less energy intensive. These can be used in lieu of more expensive traditionally canned fruits. They can be consumed either as such or as part of various custard and porridge like preparations.

## Holibite

An instant energy health oriented RTE product for emergency use after exercises or for relaxation after exertion. This is an innovative product based on honey.

It is helpful in providing immediate energy to the body and provides 108 Kcals per 30 g capsule. Four to six capsules are good enough for managing emergency situations.



Holibite

## Sweet corn Products—Stabilised Kernels and Paste

Sweet corn products have gained increased popularity over the years. The laboratory has developed a minimal process for extending the shelf life of sweet corn kernels for a period of forty five and sixty days at ambient low temperature respectively. Sweet or salty taste was also developed using hurdle process.

The kernels in steamed and spiced form can be used for instant consumption as a snack food. The paste could be used as a sweet corn spread and for other preparation, i.e., dosa and some culinary preparations.



Minimally processed sweet corn



Control sandwich

Retort processed

## Nata-De-Coco

Bacterial cellulose produced by *Acetobacter xylinum* at the air liquid interface of coconut water is known as Nata-de-coco. *A.xylinum* uses the nutrients in the coconut water medium and forms a thin slimy, transparent layer of cellulose on the surface of the medium which thickens with age, forming a thick whitish sheet after fifteen to twenty days.

This sheet is cut into cubes, washed and boiled in water before cooking in sugar syrup. This unconventional product based on coconut water has immense potential because of the increasing awareness of the health benefits of fiber rich products and the possibility of using a cheap, commonly wasted by-product of the coconut industry to make a commercially value added product with export potential.



Nata-de-coco

## Shelf Stable, RTE Mutton Sandwich

Meat products are highly perishable. As of now there are not many RTE mutton based products available which are shelf stable upto twelve months at room temperature. This product has a longer shelf life, making RTE nutritious. Mutton based product much easily available at high altitudes as well.

## RTE Bars and Biscuits

### Albumin Bar

An egg based snack bar which is rich in protein and dietary fibre was developed to meet changing needs of consumers. The albumin bar has 10.3 per cent, protein 23.5 per cent, fat 1.2 per cent, carbohydrate 62.90 per cent and total ash 1.8 per cent. It provides energy of 360 Kcal per 100 g.

Bar was analysed for amino acid profile and found rich in tryptophan (18.58 mg, which acts as a precursor for the biosynthesis of serotonin, a contributor to feelings of well being and happiness), aspartic acid (12.8 mg), tyrosine (8.3 mg) and threonine (8.25 mg) per 100g of the product. Product comes as 25 g packet servings and is stable upto 12 months under 5 °C, 10 months at room temperature and 8 months under 37 °C.



Albumin bar

### Barley Bar and Fibre Enriched Bar

Changes in life style and eating habits have considerably decreased the intake of fibre in everyday diet. The laboratory has developed bars with soluble and insoluble fibres using barley grains as well as oat and wheat brans to provide high fibre content.



barley bar

## Coco-Cocoa Delight Bar

The highly liked chocolate bar has been prepared using desiccated coconut and antioxidant rich substances like cocoa butter and cocoa powder along with sugar and binder to provide variety in operational ration packs. Cocoa butter and cocoa powder were used as they are rich sources of flavonoids.



Coco-cocoa delight bar

## Ergogenic Bar

The ergogenic bar was prepared using jaggery, walnut, cinnamon, pepper, ginger, turmeric powder, etc. for use in high altitude regions. Ergogenic bar contains ingredients which warms up the body during extreme cold and enhances performance ability by boosting up the energy.

## Composite Cereal Bar

Composite cereal bar has been prepared using composition of different cereal ingredients. The bar contains soya, wheat, maize, barley, etc., to provide balanced protein in the diet. This energy bar provides



Ergogenic bar

Composite cereal bar

all essential amino acids in a balanced amount. The bar helps in alleviating protein energy malnutrition, particularly in children as well as sports persons.

## Composite Tasty Bar

Armed forces have to operate under various difficult circumstances. During emergency, survival situations and long route patrolling troops need continuous supply of energy with adequate nutrition. Therefore, a protein rich nutritious energy bar was developed to cater to the requirement of armed forces.

This bar is rich in protein, light-weight, easy to carry and provides sufficient energy during emergency and survival situations.



Composite tasty bar

## Omega-3-Rich Bar

Omega-3-rich bar has been developed by using walnut and flax seed as a source of omega-3-fatty acids. Generally in the market, omega-3-fatty acid rich products are available based on non-vegetarian





**Omega-3-rich bar**

source of omega-3-fattyacids. The bar developed is based on vegetable source. The bar can be used as a substitute for food containing non-vegetarian source of fatty acids.

### Protein Rich Mutton Bar

The protein rich mutton bar is a good source of protein ( $35.31 \pm 0.36$ ), carbohydrates ( $38.98 \pm 0.15$ ) and a moderate source of fat ( $10.14 \pm 0.01$ ) and provides 391 Kcal per 100 g. The product exhibited good microbiological safety throughout the storage periods at all temperatures. Mutton bar stored at 450 °C exhibited a shelf stability of three months in terms of physicochemical and sensory attributes. Mineral analysis of the product revealed a good source of zinc ( $155.2 \mu\text{g/g}$ ) and iron ( $46.2 \mu\text{g/g}$ ).



**Protein rich mutton bar**

### Nutri Food Bar

Due to the change in lifestyle and long working hours, there is a feeling of tiredness which necessiated the need of calorie dense foods. Nutri food bar is ideally suited for these purposes and also there is a physiological feeling of fullness when



**Nutri food bar**

eating these compressed bars. This chewy calorie dense nutritionally rich compressed bar is prepared from readily assimilable and digestible sources of carbohydrates and proteins. This food bar serves as a meal substitute or supplement and forms a part of packed rations.

### Flaxoat Tasty Bar

Flaxoat tasty bar was prepared using flax seed and oat as a source of soluble fibre to provide a fibre rich diet to the consumers with better nutritional value. Flaxoat tasty bar provides both soluble and insoluble fibre in the diet for consumers.



**Flaxoat tasty bar**

### High Energy Bar

The convenient RTE high energy bar contains 9 per cent protein, 10.5 per cent fat, 70 per cent carbohydrates and delivers energy of 400-410 K cal per 100 g. The storage study (sensory, chemical and microbial) of the product was carried out and was found to be acceptable upto 9 months at  $27 \pm 20$  °C and 12 months at  $-180$  °C respectively.



**High energy bar**

Each bar weighs around 45-50 g packed in a suitable packaging material which can be easily carried or handled. The bar has been supplied to CRPF, Meghalaya Police and Assam Task Force.

### Soy Fortied Oat Bar

The different types of energy bar available in the market are usually prepared by partially roasted or unroasted ingredients which lack pleasant roasted aroma which is not suitable to the Indian palate.

The bar developed has a long shelf life of fifteen months. The balanced amino acid present in soya and beta glucan fibre content of oat provides maximum health benefits to the consumers.



**Soy fortified oat bar**

### Sweet and Sour Tasty Bar

Generally energy bars are sweet in taste and part of various survival/energy rations. To provide change in taste, sweet and sour tasty bars have been



**Sweet and sour tasty bar**

developed which contain salt, chilli powder, sugar, different nuts and other ingredients of choice.

### Chicken Bar

This is based on compression technology and contain chicken solids and other ingredients. It is good source of micro and macro nutrients like vitamins, minerals, amino acids and essential fatty acids in compact form. It provides 20.49 per cent protein, 13.29 per cent fat, 49.16 per cent carbohydrates and 390K cal per 100 g energy. Its shelf life is nine months.



**Chicken bar**

### Groundnut Burfi

Groundnut burfi is a sweet product relished by all segments of population having a limited shelf life. Groundnut burfi is not only nutritious, but is calorie dense and has a shelf life of more than five to six months.



**Groundnut burfi**

### Egg Protein Biscuits

Protein rich egg biscuits have been developed from real egg solids in three flavours, viz., vanilla, pineapple and orange. The biscuits have 20 per cent protein and deliver 475 Kcal per 100 g. These nutritious, flavoursome and tasty biscuits were highly accepted among the armed forces.



**Egg protein biscuits**

### Chicken Biscuits

Chicken is a good source of readily digestible protein and contains all the essential amino acids and fatty acids as well as supplies vitamin B, minerals such as Cu, Zn, Na, K, Fe and P. Various type of biscuits are available in the market but most of them with vegetarian ingredients only.

Hence a high protein biscuit are developed which can deliver essential amino acids, fatty acids and iron. It can cater to the needs of armed forces and civilian sectors and can also be used to rectify the protein calorie malnutrition in children as it is a high protein snack.



**Chicken biscuits**

### Seabuckthorn Based Biscuits

The first step towards the development of degenerative diseases in human is the onset of oxidative stress. The seabuckthorn based baked foods, viz, biscuits, rusks, cakes, bread, etc. developed using seabuckthorn leaves extracts reduce the oxidative stress as it is rich in antioxidants.

The product is found to contain fibre, polyphenols and flavonoids. The shelf stability is found to be more than eight months.

The baked foods are unique as no other technology/product is available for baked food rich in antioxidants. The baked foods are antioxidative in nature and hence the consumption of these foods can reduce the incidence of chronic diseases.



**Seabockthorn biscuits**

## RTE Appetisers, Munches and Jam

### RTE Appetisers

Prolonged exposure to high altitude and certain pathological situation leads to loss of appetite. To overcome this problem of appetite loss, spice based appetisers have been developed. To provide convenience to consumers, these were developed in a RTE form with shelf life of ten months. Active components present in the appetiser promotes secretion of juices from several glands and improves the appetite. The convenience of RTE product and longer shelf life are added advantages. They can be consumed either as such or as part of various custard and porridge like preparations.

### Karpuravalli Munch

Karpuravalli munch is a RTE appetiser based on spice combinations. It is sweet and sour in taste with Karpuravalli juice extract. Karpuravalli which is having medicinal effect and distinct flavour helps in relieving the cough and cold. It helps in digestion and thereby improve the appetite. It has a shelf life of twelve months.



Karpuravalli munch

### Ajwain Munch

Ajwain munches influence the appetite by increasing the saliva secretion and digestible enzymes. It is based on ajwain, ginger and other essential ingredients. It secretes digestive juice, hence helps to consume food for children, adults and the soldiers who works at high altitude. It improves the gastric responses at the normal stimulation and also helps in relieving flatulence. The product shelf life is twelve months.



Ajwain munch

### Anti-ulcerative Aloe Vera Based Fruit Spread

Aloe vera gel (AG) is composed mainly of water as well as mono and polysaccharides (25 %) of the dry weight of the gel. The most prominent monosaccharide in AG is mannose-6-phosphate, and the most common polysaccharides are gluco-mannans. Novel anti-inflammatory compound, C-glucosyl chromone, has been isolated from AG. It also contains lignin, salicylic acid, saponins, sterols and triterpenoids. The fresh gel contains proteolytic enzyme carboxypeptidase, glutathione peroxidase, as well as several isozymes of superoxid dismutase.

The gel also contains vitamins A, C, E, B12, thiamine, niacin and folic acid as well as the minerals like sodium, potassium, calcium, magnesium, manganese, copper, zinc, chromium and iron. Edible portion of aloe vera plant has been used in the preparation of a fruit spread. The product is shelf stable for more than six months, organoleptically acceptable.



Anti-ulcerative aloe vera based fruit spread

The product has been evaluated for the anti-ulcerative effect in rats. In the experiment, gastric ulcer was created to rats by oral administration of acetic acid and the same has been reduced significantly by feeding the aloe vera based fruit spread (Patent filed: No. 1493/DEL/2012 dtd 12 June 2012).

Aloe vera gel is reported to possess antiviral and antitumor activity, protection from lung cancer, reduction of blood sugar in diabetes, wound healing, etc.

### Tamarind Jam

A low cost product to fight anemia problem was prepared from tamarind and other easily available sources of minerals. The product is rich in vitamin C and iron content meets RDA requirements for iron. Consumption of tamarind jam (50 g) quantity used over two bread sandwiches meets about 45 per cent RDA for adults.



Tamarind jam

## Instantised Foods / Mixes

### Instant Cooking Rice

Cooking of rice is a time consuming process and requires elaborate cooking facilities like pressure cooker, cooking vessels, gas, etc. The preparation becomes much more difficult and requires a long time at high altitude areas where boiling point of water is less than 1000 °C. The cooked rice has a limited shelf life of twelve to twenty four hours at ambient condition.

The laboratory has developed the instant cooking rice by pressure cooking and conditioning to particular moisture content, flaking to a specified



Instant cooking rice

thickness and drying in a through flow dryer such that it retains porous structure with low density which helps in faster rehydration during reconstitution. Instant rice does not require cooking. The rice can be prepared for consumption by just adding in hot water of about 80-90 °C within 5 to 10 minutes.

### Instant Cooking Pulses and Dal Flakes

The cooking of dal is a time consuming process and requires elaborate cooking facilities like pressure cooker, cooking vessels, gas, etc. The cooking of dal like red gram dal requires 45-60 minutes in open cooking or about 20-40 minutes in pressure cooking and subsequently requires seasoning time for the preparation of dal curries.

Cooking of dal becomes much more difficult and requires longer time in high altitude areas where boiling point of water is less than 1000 °C. The prepared dal curries have a limited shelf life of twelve to twenty hours at ambient conditions. The dal or pulses are naturally associated with hard to cook characteristics due to highly dense grainy structure and Pectin, Calcium, Magnesium and Phytin (PCMP) content.



Instant cooking pulses

The cooking time of dal can be reduced by increasing the surface area of grain by flaking and breaking the PCMP complexes by cooking and drying in suitable dryer to less than 6 per cent moisture content.

### Instant Sooji Halwa

Halwa made from sooji (semolina) and sugar and further embellished with cashew kernels and flavours is a very popular dish of Indian dietary. Its rich roasted flavour and excellent taste endears it to young and old alike.

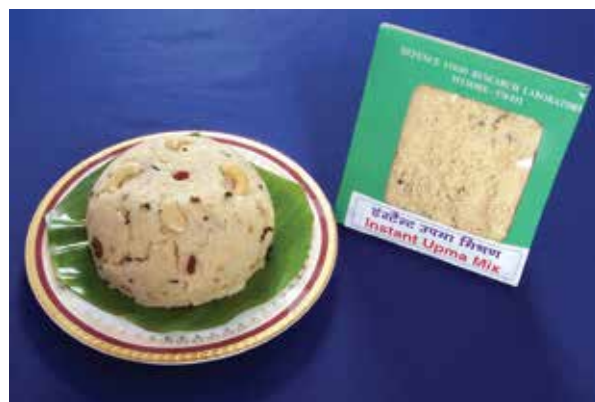
The convenient halwa mix can be served within four minutes of simmering it in water and bringing the mix to boil with occasional stirring. The product scores very high on the consumer acceptability scale. The process of manufacture is fairly straight, simple and easily adaptable at commercial level.



**Instant sooji halwa**

### Instant Upma Mix

This semolina made savoury preparation is relished at breakfast and as an item of snack at any other time. The mix is reconstituted by simmering in water and bringing the ingredients to a boil with occasional stirring. The product can be served hot within four minutes of its reconstitution and provide the consumer with all the characteristic taste and flavour that everyone looks forward to.



**Instant upma mix**

### Instant/RTE Idli Sambar

Idlis are highly perishable traditional south Indian delicacy relished all over the country and should be consumed within the same day of preparation. Attempts were made to develop instant/RTE idlis capable of reconstituting by mere mixing with hot water within 3-5 minutes. Efforts were also made to stabilise idlis in RTE form. Proximate composition, mineral content and scanning electron microscopic studies were carried out. Evaluation of shelf life of idlis and sambar mix stored at ambient condition at 37<sup>o</sup> C in Polypropylene (PP) and Metallised Polyester (MP) pouches revealed that the product was stable for more than six months for instant idlis, whereas 40 days for RTE idlis.



**Instant RTE/idli sambar**

### Instant Wheat Porridge Mix

Supply of fresh food to troops engaged in combat operations at inaccessible terrains is almost difficult.



**Instant wheat porridge mix**

Hence troops have to survive on RTE foods or convenience foods which should be less in weight, with longer shelf life and should provide adequate calories.

The laboratory has developed instant wheat porridge dalia mix capable of reconstitution in four to five minutes in hot water as well as in cold water and provides 435 Kcal per cent 100 g.

### Instant Dal Curries by Freeze Thaw Dehydration Process

The cooking of dal is a time consuming process and requires elaborate cooking facilities like pressure cooker, cooking vessels, gas, etc. Also they have limited shelf life of twelve to twenty four hours at ambient condition.

The cooking time of dal can be reduced by cooking the dal grains and drying in a suitable dryer to less than 6 per cent moisture content. In the technology developed, dal grains are cooked under pressure, conditioned to low temperature and dried under high



**Instant dal curries by freeze thaw dehydration process**

air velocity through low dryer such that grains retains its shape and size of grains with porous structure and minimum density. These products when added to hot water gets reconstituted within two to three minutes.

The product has more than one year shelf life and forms complete meal along with rice, chapati or paratha. It is useful during traveling, expeditions, institutional feeding and during odd times at home.

### Instant Coconut Chutney Mix

Coconut chutney provides a definite tang to many of the traditional south Indian delicacies such as idli, dosa, urd dal, vada, bonda, etc. Without the seasoning effect of coconut chutney, many of these products stand to lose their traditional appeal. The mix developed by the laboratory contains coconut gratings, tamarind, green chilli, coriander leaves, ginger, salt, spices and oil besides curry leaves and mustard seeds as essential ingredients. The product reconstitutes almost instantly on addition of water.



**Instant coconut chutney mix**

### Instant Carrot Halwa

‘Gajar ka halwa’ and ‘Gajar pak’ are extremely popular amongst a host of Indian and subcontinental consumers. Traditional carrot halwa and gajar pak preparations are very elaborate and far too cumbersome.

Moreover the freshly prepared carrot halwa has limited shelf life of two to three days at room temperature and about one to two weeks in refrigerated condition. The development of instant carrot halwa is intended to solve these problems.



The instant mix reconstitutes within minutes of mixing with hot water and provides an ideal alternative besides meeting off-season demands for carrot. The innovated process is based on precooking and drying under controlled conditions which gives instant carrot halwa which can reconstitute by boiling in water within five minutes and has similar sensory quality as freshly prepared carrot halwa. The instant carrot halwa has got shelf life of more than twelve months at room temperature and can be useful during traveling, expeditions, institutional feeding, food for natural disaster victims and for operational rations of armed forces.



Instant carrot halwa

### Instant Rava Idli Mix

Rava idli mix are traditional products which are routinely consumed. These products have been in convenient form of dry mixes which can be reconstituted or cooked in three to five minutes. Rava idlis are popular food items at breakfast as well as other times. The product is especially liked for its characteristic taste, besides its soft and fluffy texture. The product is prepared from semolina with or without vegetables. Although its method of preparation is quite cumbersome, To provide



Instant rava idli mix

convenience to consumers, RTE formulation which has all the essential ingredients akin to rava idlis. The product has excellent domestic as well as export potential.

### Insta Neutro Cereal Mix (Bisibelebath Mix)

The laboratory has developed traditional south indian spiced delicacy which is an admix of cooked cereals, pulses and vegetables. This calorie and protein rich product is especially liked and savoured for its rich blend of flavour and taste. It is a wholesome nutritious product liked by majority of the population. This product remains stable for one year and can be reconstituted in three to four minutes in boiling water.



Instant neutro cereal mix

### Instant Vermicelli Kheer Mix

This convenient mix contains good quality vermicelli, milk solids, sugar and flavours to suit Indian palate. Roasting, pre-cooking of vermicelli and hot air dehydration are intrinsic to processing of this kheer mix. The product requires to be simmered in hot water for 5-6 minutes with occasional stirring to yield tasty vermicelli kheer.



Instant vermicelli kheer mix

### Soy Fortified Instant Sooji Halwa and Upma Mix

Various instant food mixes are developed which get reconstituted within four to five minutes with





**Soy fortified instant sooji halwa mix**



**Soy fortified instant sooji upma mix**

long shelf life. Instant mixes developed using soya bean or soya sooji which are very good sources of all essential amino acid and are known to improve the protein efficiency ratio.

### Instant Tamrice Mix and Instant Urad Rice Mix

The mixes can be boiled in hot water for 3-4 minutes and the product is ready to serve. The products are very tasty. The instant tamrice mixes are based on unique blend of spices and technology. The mixes are having more useful minerals, vitamins, carbohydrates and relishes the hunger and easily digestible. The shelf life of the mixes is twelve months.



**Instant tamrice mix**



**Instant urad rice mix**

### Thermally Stable Whole/Split Legumes based RTE Curry Concentrate

Preparation of legume based delicacies begins with washing, soaking and then cooking with sub-constituents. Hydration/soaking of pulses before cooking usually extends the total processing/preparation time.

Most of the thermally processed foods undergo excessive heating abuse which results in significant loss of the vital nutrients like vitamins, minerals, etc., resulting in less acceptable product with reduced keeping quality. Thus it would be desirable to devise a method for whole/split legumes based curry concentrate which is



neither time not energy intensive. The laboratory has developed a ready to constitute thermally processed whole/split legumes concentrate with fat based spice mix. The process is exclusive and innovative in terms of delivering a product with enhanced uniform quality, better control during processing, energy efficiency and economically reasonable.

The reason for the above said claim is that the entire recipe components are taken initially with minimal thermal pretreatment.

### Flax Chapati Mix

The convenience flax seed chapati mix can be made to dough by adding water for preparation of chapaties. The product is ready to serve and rich in omega fatty acids and provides soluble fibre that can help to lower cholesterol. The shelf life of the product is six months.



**Flax chapati mix**

### Flax Sweet Mix

It is a RTE product. Flax seed is rich in omega-3 fatty acids. This is one of the rare sweet products based on flax seed. The product is a good source of protein and essential fat. The mix is easily digestible and liked by all age groups especially children. The shelf life of the product is six months.



**Flax sweet mix**



## Flax Cookies Mix

Flax seeds are a rich and the only source of omega fatty acids in plant origin and are good toxins for brain functioning. Flax seeds are also a rich source of dietary fibre and protein.

Flax seed based products provide vitamins and minerals besides fibre and omega fatty acids. Consumption of two TSP/day is good for health for all ages and is promising for improved brain functioning and cardiac health. Since the consumption of seeds is not feasible, many products using flax seeds have been developed. The clinical studies have provided the support for scientific evidence of benefits.



Flax cookies mix

## Flax Tamrice Mix

It is a ready to reconstitute, instant food product. The product is ready to serve by boiling the mix for 3-4 minutes. The shelf life of the product is eight months. Flax seed is rich in omega-3 fatty acids. It gives a pleasant taste and flavor.



Flax tamrice mix

## Dehydrated Curry Mix Cauliflower-Potato/Peas/Potato-Peas

Development of the curry mix involves different dehydration techniques and pretreatments, inclusive of additive treated cauliflower for subsequent cabinet drying, colour fixed green peas for high temperature



Dehydrated curry mix

short time dehydration and diced potato processing by HTST/cabinet dehydration/deep fat frying techniques. The spice mix is in stabilised form to facilitate preparation of wholesome curry and the reconstitution time is approximately ten minutes. When reconstituted with hot water, this preparation of Indian culinary gives characteristic aroma, taste and texture of freshly prepared curry.

## Puff and Serve Chapaties

These partially-baked chapaties are stabilised by incorporating certain antimycotic, antistaling and softening agents. Baking over a flame or a hot plate puffs them and makes it ready to be served as hot phulkas. The process is fairly simple and adaptable by any small scale entrepreneur. A paraphernalia of operations entailing traditional kitchen drudgery stand eliminated in the preparation of a phulkas, when making use of this kind of chapati. An ideal preparation for any housewife, short on time and energy.



Puff and serve chapaties

### Naan Premix

Preparation of naan is a tedious and time consuming process which requires at least ten to fourteen hours for fermentation. Naan premix developed requires just two to three hours for fermentation and it is fortified with necessary vitamins and minerals as per RDI requirements



Naan premix

### Millet/Ragi Based Products

Ragi based products developed to provide high calcium and dietary fibre in the diet. The specific millet called finger millet (ragi) is an antidiabetic too. The product provides high convenience such as RTE or cold water reconstitution. These products are good for skeletal health because of high 200-300 mg calcium content. Also good for easing constipation problem, controlling lipid profile because of 20 per cent dietary fibre content. Its constant use helps diabetic patients in controlling their disease.

### Millet Dhokla and Millet Bhatura Mix

There are no convenient mixes available for fermented and millet products. These mix are handy and convenient for consumers. The products, dhokla and bhatura need fermentation time of three to five hours for their preparation to begin. However, the convenience mixes developed can be prepared within half an hour.



Millet dhokla and millet bhatura mix

### Ready to Reconstitute Soup/ Beverages/Juice Powder Mixes

The ready to reconstitute convenient appetiser mixes have been developed to address the problem of loss of appetite. The pungent and active component present in these mixes, on reconstitution, generates pleasant aroma and their consumption leads to secretion of juices in digestive tract and glands which in turn improves appetite. Various spices responsible for appetite improvement have been incorporated in the product. The shelf life of the products is six months.

### Appetising Mix, Ready to Reconstitute in Cold Water

Appetite loss is a general symptom at high altitude areas and under certain medical conditions. The product developed is a convenient mix to tackle the problem of lack of appetite. Being a ready to reconstitute, it is an excellent and easy to use product. The spices present in the product solve the problem of appetite as well as stomach upset. The curd based multifunctional product helps in brain soothing. The product is cold water reconstitutable and has a shelf life of six months. The product consumption improves the appetite and has been proven in human clinical trials.



Appetising mix

### Moringa Products—Soup Mixes and Beverages

Moringa is popularly known as drumstick and the leaves and pods are extremely nutritious in terms of vital nutrients and minerals. The commodity has potential health benefits and therefore are very popular as a delicacy besides the health benefits.



**Drumstick soup**

The technology involves processing of leaves and pods and formulation of a soup mix with suitable thickening agents and spicing. The reconstitution is instant in warm water and the product is shelf stable for a period of six months under ambient conditions.

## Freeze Dried Grape Juice Powder with Whey Protein

Freeze dried high protein grape juice powder was developed with incorporation of Whey Protein Concentrate (WPC) as functional ingredient to cater to the increased protein requirements of soldiers in combat environment and to facilitate post exercise recovery. The freeze dried mix on reconstitution had a protein content of 6 g per 100 ml. The powder had anthocyanin content of 95 mg per 100 g and vitamin C content of 140 mg per 100g and energy value of 83.6 Kcal per 100 ml.

The product is easily digestible and is a good source of branched chain amino acids. It is a unique combination of fruit based antioxidants and vitamins with dairy based protein in the form of a readily reconstitutable, refreshing, fresh tasting beverage mix with good colour.

The product is stable for a period of ten months under ambient conditions and for eight months at 370 °C.



## Freeze Dried Mango Milk Shake

Freeze dried fruit drinks serve as a natural source for delivering functional components. The techniques employed for processing fruit and vegetables often result in significant loss of colour, flavour and nutrients. Freeze drying technology eliminates the need for synthetic colouring and flavouring and also provides functional components.

Considering these, the laboratory developed ready-to-reconstitute freeze dried mango milk shakes which can deliver the RDA level of ascorbic acid and 61538-carotene. This fruit and milk based product provides the micro and macro nutrients which are essential for troops deployed at high altitudes. It provides ascorbic acid and 61538-carotene which is necessary for the physiological and psychological well being of the troops located at high altitudes.



**Freeze dried mango milk shake**

## Beet Root Juice Powder Mix

The vegetable juices are good source of minor nutrients and functional properties with higher assimilation into the body. The colour of the beet root juice is very native and it has a good flavour. But the juice as such shows colour degradation, while in dehydrated form the colour remains stable for twelve months. It is a cold water reconstituted product.

The improved grade of haemoglobin in human subjects has been proved through clinical trials.



## Ready to Drink Juices and Beverages

### Tender Coconut Water

Tender coconut water is much valued for its delicate taste, aroma and flavour apart from the minerals and other nutrients that it delivers. The laboratory has developed an innovative state-of-the-art technology to preserve and stabilise tender coconut water in flexible polymeric pouches and aluminium cans.

The technology enables retention of all the natural goodness and delicate flavour of tender coconut water and has been developed in collaboration with Coconut Development Board (CDB) Kochi.

The product has a shelf life of six months in standup packs and aluminium cans under ambient conditions. The shelf life can be further extended by three more months under refrigerated storage. The use of mild heat treatment and a biopreservative are key to this promising technology and ideal for domestic as well as export markets.



Tender coconut water

### Tender Coconut Water Blended with Fruit Juices

Tender coconut water blended with different fruit juices, i.e., lemon, mango, pineapple, blue grapes, apple, pomegranate, etc. to increase the palatability as plain tender coconut water has bland taste. The products were found highly acceptable with a shelf life of nine months under packed conditions at ambient temperature. The products have gained a national status and has tremendous commercial potential.



Tender coconut water blended with fruit juices

### Tender and Mature Coconut Water Beverage with Suspended Kernels (Lemon Flavoured)

Tender/mature coconut water beverage with and without suspended kernels were developed. The levels of lemon juice and Total Soluble Solids (TSS) were optimised. The product was found to be stable for six months under ambient storage conditions. The beverage was packed in standup pouches as well as in bottles. The kernels were treated to remain in suspended form as well as to avoid discolouration in the coconut water.



Tender coconut water with suspended kernels

### Aloe Passion Drink

Anxiety is debilitating state of mind. It has emerged to be a common psychiatric manifestation of modern day lifestyle. Herbal anxiolytes as curative agents promise to alleviate anxiety and other psychiatric disorders with minimal adverse side



**Aloe passion drink**

effects. *Passiflora edulis var flavicarpa* commonly called passion fruit is relished for its taste throughout the world and has been attributed as good food for health. The aloe passion drink developed has anxiolytic and sedative properties.

## Antifatigue and Neuro-protective Brahmi Drink

Brahmi Herbal Drink (BHD), an anti-fatigue and neuroprotective has been developed from the herb *Bacopa monniera*. The major active components present in the drink are bacosides. Pre-clinical studies conducted showed the ergogenic efficacy of BHD is due to adaptogenic and antioxidant potency of bacosides. The drink facilitates learning, improves consolidation of learned behaviour and cognitive-enhancing propensity by modulating the expression of acetylcholine esterase activity, brain derived neurotropic factor and muscarnic M1 receptors.



**Ginger based brahmi drink**

## Low Calorie Aloe Vera Juice

Natural antidiabetics without toxicity and less cost are necessary to reduce side effects of allopathic drugs. Low calorie aloe juice reduces blood sugar, enhances nutrient absorption, heals wounds very fast, is anti-inflammatory and anti-microbial in nature. The juice has many complex polysaccharides that reduces blood sugar and has many bioactive compounds and amino acids that inhibit arthritis problems, enhances wound healing, stimulates blood circulation, induces sleep and reduces urination at nights.



**Low calorie aloe vera juice**

## Performance Enhancement Drink

Aloe vera is known since ages for its health benefits. It is known to increase the blood circulation, helping supply of nutrients to cells, and thus enhancing the nutrient absorption across the endothelial cells to blood stream. These two properties have been utilised for developing aloe vera-based pomegranate/pineapple drink to enhance the physical performance. The product has been tested for its performance enhancing properties in rats, which were allowed to swim until exhaustion, and has been found to reduce lactic acid accumulation in muscle, thereby reducing the muscle catch during heavy exercise.



## Vegetable Juice

The vegetable juices are rich in variety of nutrients. The vegetable juice consumption provides the vital nutrients and fibre to the body apart from energy, thus helping in health maintainance by fulfilling the bodily requirement of micronutrients.

Ashgourd juice is rich in B-series vitamins and souble fibre. Ashgourd juice consumption has proved the benefits of mineral balance, antigastric through clinical trials. Cucumber juice provides both soluble fibre and digestiveness.



Ashgourd pudina juice



Bottleground pudina juice



Cucumber juice

## Ginger Beverage, Ajwain Beverage and Karpurvalli Beverage

Loss of appetite is one of the major problems faced at high altitudes. In addition the problem of nausea and flatulence is also persistant to overcome these problems, The laboratory has developed these products that are refreshing and have a shelf life of six months. At high altitudes, liquid form of carbohydrate based drinks are preferred. These products serve as beverage and also satisfy appetite.

The active components present in the beverages will act on the digestive juices thus helping in improvement of appetite. These are complete preservative chemical beverages with six months stability.

## Food Preservatives

### Keep Fresh Salt

The peroxidation of lipid/fat in processed food is the main cause for the development of off-flavour which is the limiting factor in determining the shelf life of the products, though the nutritive value remains same, to the acceptable level. Addition of permitted synthetic antioxidants to delays the onset of rancidity but their efficacy depends on frying temperature, duration, volatility and their carry over properties. At high temperature of processing, antioxidant loss takes place due to degradation to take care of the onset of rancidity and volatility which results in batch to batch variation in the concentration of antioxidant. The laboratory has developed this salt, coated with antioxidant which could be used at 2 per cent level which is sufficient to take care of the onset of rancidity.



Keep fresh salt

### Preservative Mixture

Chapaties are perishable and get spoiled within 24-48 hours due to microbiological spoilage. Thus, a preservative mixture, formulated with permitted preservatives has been developed By using these preservatives chapatis shelf life can be extended for 10 to 15 days.



## Detection Kits

### Meat Testing Kit for Detection of Cold Slaughtered Meat and Microbial Quality

Simple test based on the colour reaction between haemoglobin and malachite green was standardised and a field test kit was developed to detect cold slaughtered meat within 5 minutes. The test kit contains the dye coated strips, screw capped bottle/tubes, small knife and forceps.

One dye coated strip is added in to the bottle containing about 10 ml of potable water and a small piece of meat to be tested (approx 1-2 gm) and shaken well. In 2 minutes colour of water changes from blue to olive-green (dirty green) which changes to colourless and finally pink when kept for long period, if the meat is from dead or dying animal due to some infection or disease.



Meat testing kit

This test could be performed under field conditions requiring no lab facility and skilled/trained worker.

### Milk Testing Kit for Detection of Adulteration and Microbial Quality

Strip based testing kit to detect the presence of added adulterants like urea, boric acid, pulverised soap, detergents, hydrogen peroxide, starch and neutralisers. It also provides strips to detect the microbial freshness of milk to screen spoilage index.

Use of the test strip is very handy and never raises the problem of spilling of chemical or reagents



Milk testing kit

on the users. It has the ease of application from house hold to field level use of services. Test results are easily distinguishable by observing the colour change in the samples. Most of the test strips can detect an adulteration level at less than 1.0 per cent and are stable up to one year at room temperature conditions.

### Frozen/Chilled Mutton/Chicken Testing Kit

The laboratory has developed frozen/chilled mutton/chicken testing kit to check microbial freshness. The test strips has been standardised for frozen chicken and mutton separately, for the screening of samples based on their microbiological quality within 30 minutes.

These tests are based on the visual colour change and useful for field conditions. These tests are simple, rapid, inexpensive, easy to conduct, give clear cut results and can be performed by unskilled persons.

### Microbial Detection Kit for Salmonella Species, Shigella Species, Escherichia Coli Group and Proteus Species

It is rapid, reliable and low cost identification of important enterobacteriaceae organisms, namely, *Salmonella*, *Shigella*, *E. coli* and *Proteus* species. The kit involves specific monoclonal antibodies and a few easy to do biochemical tests. It is also independently evaluated in three different medical colleges located in various parts of Karnataka with satisfactory reports. The time taken is 3 hours instead of 3-5 days by the conventional procedures.





# Feedback for Technology Focus

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## Process/Other Technologies

### Minimally Processed Vegetables in Precut and Packaged Form

Minimal processing protocols for fourteen types of vegetables, i.e., carrot, cauliflower, cabbage, potato, radish, capsicum, etc., are included in the technical package. The additive based technology, with nil to minimal use of heat processing, yields fresh like products with a shelf life of two weeks under ambient and six to eight weeks under low temperature conditions.

The products minimise kitchen drudgery besides reducing the packaging and transportation costs due to the elimination of incredible portions. The products as a result of inbuilt ability to withstand ambient temperatures, offer marketing flexibility under varied temperature conditions at the retail outlets. The energy saving technology is suitable for small scale/rural industry.



Minimally processed vegetables

### Breathable Films for Packing Fresh Produce

Traditionally, the quality and shelf life of fresh produce were enhanced by enclosing them in films that modified or controlled the atmosphere surrounding the product. The use of MAP/CAP for fresh produce was a natural progression once packaging technology had advanced to include the breathable materials.

This technology will help food industry which is currently facing constraints like non-availability of adequate critical infrastructural facilities like cold chains and packaging.



Breathable films for packing fresh products

The laboratory has developed breathable films keeping in view the need for such films which are cost effective in production and have good mechanical properties. The primary function of the breathable film is to provide barrier properties, being tough with high tensile and tear strength. A significant advantage of this approach is that the strengthened/breathable films can be used as packing materials.

### Standardisation of Process for Making Milk Paneer and Enhancement of its Shelf Life

This process has been developed to enhance the shelf life of paneer with respect to standardisation of paneer preparation and to study the physico-chemical, microbiological and sensory attributes and raw material treatment with different hurdle treatments.

Different treatments were given to paneer, like addition of preservatives, salt and sorbic acid, surface drying, vacuum packing and inpack pasteurisation. In most of the treatments, a combination of all the above were given to establish the shelf life enhancement.

### Stack Encapsulation Technique

Sugar and salt are highly hygroscopic in nature, and if not packed or preserved properly absorb moisture and start drifting/dripping especially in coastal/high humid region. Similarly cereals and pulses, if not stored in proper way, absorb moisture and get infested leading to tremendous loss and becomes unacceptable.



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