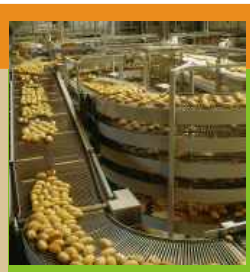
Compendium of

Food Technologies

DRDO-FICCI Accelerated Technology Assessment and Commercialization Programme



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DRDO-FICCI Accelerated Technology Assessment and Commercialization (ATAC) Programme

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ABOUT THE PROGRAMME

The DRDO-FICCI ATAC programme aims to create a commercial pathway to deliver technologies developed by DRDO for appropriate commercial markets for use in civilian products and services. This programme is first of its kind to be undertaken by DRDO in association with FICCI to actively spinout several of DRDO's technologies for appropriate commercial markets both nationally and internationally. In the very first year of operation of the programme as many as 26 DRDO labs across India are participated and over 200 technologies were assessed under this programme by FICCI. The technologies that are currently being assessed are from sectors as diverse as food technologies, life sciences, electronics, robotics, advanced computing and simulation, avionics, optronics, precision engineering, special materials, engineering systems, instrumentation, acoustic technologies, disaster management, information systems, etc.

Under a unique process of technology assessment and commercialization, FICCI has identified a few technologies which were initially only exposed to the defence sector. FICCI is now exploring civilian applications for the same.

The programme process comprises the following steps :

Technology Assessment:

- High Level Quantitative and Qualitative Evaluations
- Extensive Interviews and Analysis
- QuickLook Scan

Business Development:

- Business Development Plan
- Identifying Business Partners
- Industry Interface via Visits, Calls and Follow-ups
- Licensing Agreement

PROGRAMME PARTNERS

1. FEDERATION OF INDIAN CHAMBERS OF COMMERCE AND INDUSTRY

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence and its subsequent emergence as one of the most rapidly growing economies globally. FICCI plays a leading role in policy debates that are at the forefront of social, economic and political change. Through its 400 professionals, FICCI is active in 44 sectors of the economy. FICCI's stand on policy issues is sought out by think tanks, governments and academia. Its publications are widely read for their in-depth research and policy prescriptions. FICCI has joint business councils with 79 countries around the world.

A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry. FICCI has direct membership from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 83,000 companies from regional chambers of commerce.

FICCI works closely with the government on policy issues, enhancing efficiency, competitiveness and expanding business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for sector specific consensus building and networking.

Partnerships with 77 countries across the world carry forward our initiatives in inclusive development, which encompass health, education, livelihood, governance, skill development, etc. FICCI serves as the first port of call for Indian industry and the international business community.

FICCI CENTRE FOR TECHNOLOGY COMMERCIALIZATION

FICCI has set up a Centre for Technology Commercialization with the aim of assisting innovators across India, both in public and private sector, to take their technology ideas to the market. Towards this end, FICCI has launched a number of technology commercialization programmes with the aim of identifying, assessing and commercializing competitive technologies from India into the global marketplace.

While focusing on accelerating innovative Indian technologies, FICCI initiated India Innovation Growth Programme in March 2007. The India Innovation Growth Programme is the only programme of its kind, because of its focus on teaching and using world-class commercialization strategies. FICCI further provides handholding support to all selected innovators for successful commercialization of their innovations.

2. DEFENCE RESEARCH & DEVELOPMENT ORGANISATION

Defence Research & Development Organisation (DRDO), the R&D wing of the Ministry of Defence, Government of India has completed 50 years of dedicated service to the Nation. The year 2008 marks its Golden Jubilee Year. With 50 research and development laboratories under its umbrella, DRDO has developed and produced several state-of-the-art military hardware and strategic systems. DRDO has synergised with the Armed Forces in capability building, both in terms of equipments and technologies. DRDO owes its success to the participation and contribution made by more than 100 academic institutions and over 500 industries from within and outside the country. Research centres, S&T establishments and various departments of the State and the Central Governments have also contributed to its success story.

DRDO was formed in 1958 from the amalgamation of the then already functioning Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development & Production (DTDP) with the Defence Science Organisation (DSO). DRDO was then a small organisation with 10 establishments or laboratories. Over the years, it has grown multi-directionally in terms of the variety of subject disciplines, number of laboratories, achievements and stature.

Today, DRDO is a network of more than 50 laboratories which are deeply engaged in developing defence technologies covering various disciplines, like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, special materials, naval systems, life sciences, training, information systems and agriculture. Presently, the Organisation is backed by over 5000 scientists and about 25,000 other scientific, technical and supporting personnel. Several major projects for the development of missiles, armaments, light combat aircrafts, radars, electronic warfare systems etc are on hand and significant achievements have already been made in several such technologies.

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1 Technology: Biopreservative for extending the shelf life of fresh mutton

At present, no technology is available for preservation of fresh mutton without the use of chemical preservatives. DFRL has addressed the problem by identifying and applying an edible preservative viz. pomegranate peel extract which enhances the shelf life of fresh mutton up to four days at ambient conditions. This biopreservative, thus increases the shelf life of mutton beyond twenty hours.

The technology is highly useful for meat industry for improving the shelf life of fresh mutton without chilling.

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2 Technology: Process for enhancing shelf life of fresh mutton at room temperature

Fresh meat is a highly perishable commodity and is spoiled within 18-20 hours at ambient conditions of 20-30 degree C. At present, no technology is available for the preservation of fresh mutton without the use of chemical presevatives and which can improve the shelf life beyond twenty hours.

DFRL has addressed the problem by identifying and applying an edible preservative viz. clove extract which enhances the shelf life of fresh mutton up to four days at ambient conditions.

3 Technology: Process for bacterial cellulose production

DFRL has developed a process of biomaterial and food ingredients using micro-organisms from renewable sources. The biopolymer is produced in the form of bacterial cellulose for use of dietary fibre and wane material.

The technology is useful for food processing, nano technology and biomedical applications and in purification process.

4 Technology: Aloe vera based fruit spread

Ulcerative colitis (UC) is a chronic inflammatory disease of the colon and rectum. The possible etiological factors that may play a key role in the development of UC are genetic, immunological and environmental. Commonly used medication for colon ulcer only offers temporary relief to UC.

DFRL has developed an aloe vera based fruit spread which has anti ulcerative properties. Aloe vera gel contains about 99 – 99.5 percent water with pH range of 4.4 - 4.7. The gel is rich in barbaloin, glucomannans, acemannan, tannic acid, c-chromosyl chromone, minerals and flavo-noids. The rich content of these phytoconstituents in the fruit spread contributes towards the reduction of colon ulcer. The fruit spread is shelf stable for more than seven months, organoleptically acceptable and microbiologically safe. The aloe vera based fruit spread developed has been experimentally proven in rats and it has been found to ameliorate the acetic acid induced colon ulcer.

5 Technology: Appetizer beverage mixes-spiced drink mix, spiced tomato mix and chakotha soup mix

The ready to reconstitute convenient appetizer mixes have been developed by DFLR 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.

6 Technology: Appetizing 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 by DFRL 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 base of the product makes it a multifunctional product as it helps in brain soothening. 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.

7 Technology: Barley bar and fibre enriched bar

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

8 Technology: Beet root juice powder mix

The vegetable juices are good source of minor nutrients and functional properties with higher assimilation into the body. The color 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 hemoglobin in human subjects has been proved through clinical trials.

9 Technology: Beetel leaf juice

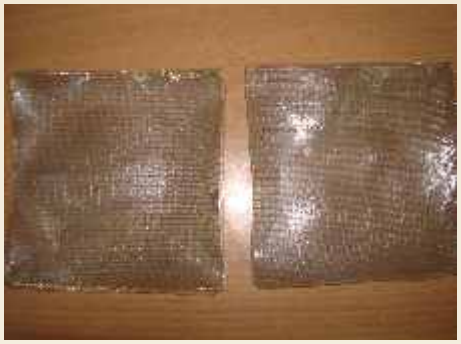
Beetel leaves have digestive property and are a good source of carotenoids, vitamins and minerals. However, constant chewing of leaves can have certain undesirable effects in the mouth and therefore juice form serves as a good alternative. The product is a ready to serve juice, which helps in regular digestion of food, particularly after a heavy meal. It has a shelf life of four months and can also be commercialized in sachets.

10 Technology: Biosynthesis reactor system

India's agricultural production base is quite strong but at the same time wastage of agricultural produce is massive. If the industry can adopt better/improved packaging techniques at farm level, the transportation losses could be reduced and at the same time freshness of the products can be maintained. Presently, synthetic imported films are being used to control the respiration in Modified Atmosphere Packing (MAP). Traditionally fruits and vegetables were coated with wax and shellac containing pesticides which are not eco-friendly.

DFRL has invented a biosynthesis reactor to develop different emulsion formulations of biopolymers and bio-preservatives for packing, and coating to enhance shelf life of fresh produce, has a capacity of upto 25 litres and has an automatic power pack. The parameters such as temperature, pressure, torque, agitation speed, feed rate and rotation with inert atmosphere can be optimized depending on the biopolymers to be synthesized. The operating system is portable, reduces labour requirement and the cost of processing. The system is suitable and provides opportunities for adding value to agricultural biopolymers which are abundantly available in nature as proteins of plant/animal or as by-products of the food processing industry thereby significantly reducing the environmental impact of synthetic film and health hazards. This biosynthesis reactor has been developed in order to develop and process different formulations of biopolymers and bio preservatives for applications in food technology.

11 Technology: Breathable films for packing fresh produces - enhancing mechanical properties



Traditionally, the quality and shelf life of fresh produces 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.

DFRL 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.

12 Technology: Chicken biscuits

Chicken is a good source of readily digestible protein and it contains all the essential amino acids and fatty acids as well as supplies vitamin B-group, minerals such as Cu, Zn, Na, K, Fe and P. Various type of biscuits are available in the market but with vegetarian ingredients only. Hence to develop a high protein biscuit which can deliver essential amino acids, fatty acids and iron, chicken biscuits were developed.

Chicken being a rich source of essential amino acids, fatty acids and iron if available in ready form can not only fulfill the protein requirement but also help to overcome biological problems arising due to high altitudes. It can cater to the needs of armed forces and civilian sectors. It can also be used to rectify the protein calorie malnutrition in children as it is a high protein snack.

13 Technology: Coco-cocoa delight bar

The highly liked chocolate bar has been prepared by DFRL 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.

14 Technology: Composite cereal bar

Composite cereal bar has been prepared using composition of different cereal ingredients of choice. The bar contains soy, wheat, maize, barley etc. as cereals to provide balanced protein in the diet. This energy bar provides all essential amino acids in a balanced amount derived from soy, barley, wheat and corn. The bar helps a lot in alleviating protein energy malnutrition, particularly in children as well as sports persons.

15 Technology: Composite tasty bar

Armed forces have to operate under various difficult circumstances. During emergency, survival situations and long patrol duties, 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.


Compressed Tasty Bar

DFRL has developed a bar which is a high protein bar, light in weight, easy to carry and provides sufficient energy in the form of calories during emergency and survival situations.

16 Technology: Continuous blanching system

Blanching is a pre-heat process for vegetable dehydration which inactivates enzymes, decreases microbial population and expels cellular gases. The two blanching methods commonly used are boiling in hot water and steam blanching. At industrial levels, steam blanching is the most widely used practical method. Steam blanching is more efficient because of the lower loss of nutrients and shorter period of exposure to heat. Blancher for commercial processing of vegetables is generally designed to suit the utility of the industries. Compared to the advancement of product technologies for quality improvement, the advancement in food processing machines is lagging behind. Thus the existing blanchers are suited for batch process or semi-continuous process and are not economical.


On-Line Conditioner (Isometric View)

DFRL has developed a continuous blanching system suitable for various vegetables, such as carrot, potato, curry leaves, beans etc., based on a controlled feeder, conveyor and steam injection. Also in our country the development of food processing is slow paced because of lack of suitable machineries for up-gradation. DFRL, thus keeping in view the food processing operations, economics of the process and routine requirement of machines for automation, has designed this continuous blancher for vegetables. The invented continuous blanching system for vegetables has a capacity of 500 kgs per hour and is fully power packed. It is suitable for continuous and speedy processing of vegetables. The conditions such as feed rate, conveyor movement and steam flow can be optimized depending on the vegetable to be blanched. The operating system reduces the labour requirement and cost of processing.

17 Technology: Dehydrated curry mix cauliflower-potato/peas/potato-peas

Development of the curry mix incorporates different dehydration techniques and pre-treatments inclusive of additive treated cauliflower for subsequent cabinet drying, colour fixed green peas for high temperature short time dehydration and diced potato processing by HTST/cabinet dehydration/ deep fat frying techniques. The methodology facilitates adoption of suitable technique depending on the infrastructure and process capacity required. The spice mix is in stabilized 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.

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18 Technology: Design for immobilized enzyme reactor system

The hydrolysis of lactose is desirable to overcome the problem of its moderate solubility in concentrated milk products and to ensure its easy digestion for cases of lactose intolerant infants and adults.

DFRL has designed and fabricated a bioreactor to make the hydrolysis of the lactose a cost effective, novel and simple to operate method either in batch or continuous mode. The biocatalyst, if reused for several times, can contribute in improving the cost-benefit ratio.

The lactose hydrolysis is carried out either at 5-15 degree C or 35 degree C to drastically reduce the microbial contamination in the bioreactor developed. The bioreactor can hold immobilized enzyme/whole cell catalysts at high density and varying operational temperatures. This bioreactor is able to retain immobilized biocatalysts prepared in form of granules, blocks, or fibrous materials. The instrument can provide long term mechanical and biochemical stability to immobilized enzyme preparations and effective hydrolysis of lactose in closed loop. The system achieved hydrolysis purity of 98% in milk. The economy and process efficiency of lactose hydrolysis in milk improved using this continuous flow bioreactor. The technology is economical and microbiologically safe.

19 Technology: Design for retort/steriliser processing of liquid, semi-solid and solid food products

Thermal processing of foods in rigid, semi-rigid and flexible packaging system is the most acceptable form of food preservation. It represents a unique combination of packaging, process and product technologies with potential functional, quality and economic benefits. The increasing consumer awareness and unwillingness to accept other methods of food preservation like chemical preservation, irradiation, etc., has offered a vast scope for thermal processing of foods.

In this retort, the pressure at 120^{0}C is about 15 psig pounds per square inch gauge and overpressure during processing is required to maintain the integrity of pouches and counterbalance the buildup of pressure inside the pouch due to limited resistance of internal pressure inside these packages.

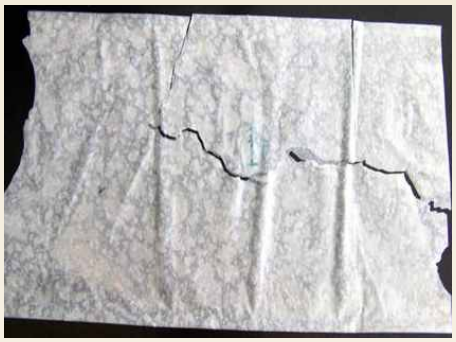
In order to evaluate the process efficiency of the newly developed retort, products such as potable water, sooji halwa, vegetable pulav and potato-peas curry were packed in multi layer flexible packaging material processed as per method prescribed by American Society for Testing and Materials (ASTM). The microbiological quality tests of the products packed both in flexible pouches and aluminium cans confirmed the commercial sterility of the products. The sensory analysis had substantiated the overall acceptability attributes of the products. Hence, it is evident that the newly designed retort is effective in processing of various food products and has various advantages.

20 Technology: 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 nearly 20 percent protein and deliver 475 KCal/100g. These nutritious, flavoursome and tasty biscuits score very high on consumer acceptability scale.


Protein Rich Egg Biscuits

21 Technology: Environmentally degradable films



Low-density polyethylene (LDPE) is one of the most commonly used commodity plastic for food packaging applications. Biodegradability of this material is quite limited and due to its ever-increasing use, very serious waste accumulation problems have araised. Considering the wide use of LDPE films and the magnitude of the environmental problem caused by such materials, need for environmentally degradable LDPE film is extremely important to avoid the serious threat of environmental pollution.

DFRL developed a LDPE based environmentally degradable packaging materials by incorporating a combination of biodegradable and photodegradable additives into LDPE. The addition of biodegradable additives into LDPE enables the microorganisms in the environment to degrade a portion of the additive, while the photodegradable additives results in chemical oxidation of the polymer chains triggered by UV irradiation or heat exposure. The combined effect of these additives lead to fragmentation and subsequent conversion of visible plastic contaminants into very small fragments, which reduces the environmental waste problems.

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22 Technology: Ergogenic bar

The ergogenic bar was prepared using jaggery, walnut, cinnamon, pepper, ginger, turmeric powder, etc. for the 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.

23 Technology: Ethylene absorbing formulation for shelf life extension of fruits and vegetables

Extending the shelf life of fresh fruits and vegetables requires a multi-facet approach in which generation of ethylene free atmosphere is of high importance. Sealed pouches and air-tight containers containing bulk stored fruits and vegetables tend to accumulate ethylene and ethylene being a ripening hormone promotes the ripening of fruits and senescence of vegetables. In order to make the storage atmosphere free from ethylene, suitable chemical formulation is required. Electronic gadgets which are imported can be used for scavenging of ethylene but they require continuous power supply and they can not be used in smaller containers and pouches.

Potassium permanganate is a highly reactive substance and it requires impregnation in suitable inorganic matrix for its ethylene scavenging ability. The pH of the matrix shall be ideal for ethylene trapping and subsequent oxidation. Another feature as a requirement of the matrix is to have sufficient porosity within the granules to allow optimal trapping and oxidation of ethylene. The matrix shall also be firm enough to avoid powdering and to keep the active principle permanganate in diffused state without crystallization for utilization in the oxidation process of ethylene. The solution necessarily incorporates all the above features and the formulation could be fabricated further in the form of filter blankets and sachets for use in reefer containers and prepackaged pouches respectively.

24 Technology: Fermented vegetable beverages - ashgourd fermented beverage, cucumber fermented beverage, cucumber mint fermented beverage

Fermentation is an age old method of preservation. However, there is a need for optimization of the process.

Fermentation improves digestibility, nutrient content, and functional properties in terms of increase in anti-oxidants and phenolics. Vegetable juices are susceptible to spoilage, thus to preserve them controlled fermentation and stabilization is required, to get a shelf stable product with less than 5 percent alcohol.

25 Technology: 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 of normal levels of sugar, cholesterol, lipid metabolism, bile acid secretion to elimination to fecal waste.

26 Technology: Flax based products - flax sweet mix, flax munch, flax cookies, flax chapati mix and flax tamrice 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 2 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 by DFRL. The clinical studies have provided the support for scientific evidence of benefits.

27 Technology: Flax based spice powders - flax spice powder for sambhar, flax spice powder for rasam, flax spice powder for tamrice, flax spice powder for bisibele bhath, flax spice powder for vegetable pulav

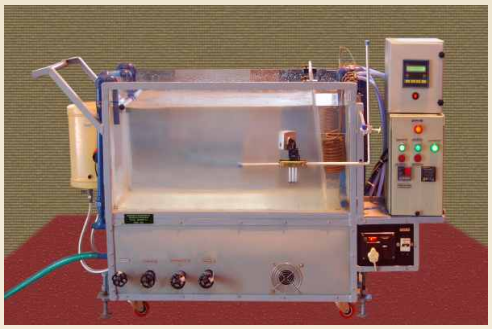
Flax seeds are rich source of omega fatty acids and also the only with plant origin. It is good for brain functioning and cardiac health.

Flax powder development and their stability are yet to reach the consumers base. Thus, DFRL has developed flax spice powders for routine use, and supply of omega fatty acids, providing various health benefits. Also, it improves dietary fibre and protein profile of the products where these spice powders are used. The constant use of these will help in maintaining good health.

28 Technology: 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.

29 Technology: Forced swim endurance test system



Forced-swimming test is a method used for evaluating the endurance capacity of mice treated with various nutraceuticals/functional foods/plant extracts/drugs. Several natural compounds present in various fruits, vegetables, medicinal plants and herbs have been proved to be capable of increasing the physical work capacity/athletic performance of humans. Supplementation of these compounds has also been shown to increase the capacity exhaustive exercise in experimental mice models. Therefore, a most reliable method with high reproducibility is required to screen the myriad of plants or drugs for its physical performance enhancing properties in mice.

DFRL has designed and indigenously developed a unique system for mice forced swim endurance test having an on-line control and monitoring of water flow, temperature, swim tracking and time, also adjustable, testing and backwater area. This invention was made for evaluating swim endurance capacity of mice after administering dietary compounds and drugs. In this system, mouse is allowed to swim against surface water current adjustable and the swimming capacity was measured until becomes fatigue, defined as the failure to raise to the surface of water to breath within a 7second period.

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30 Technology: Freeze dried mango milk shake

Freeze dried fruit drinks serve as a natural source for delivering functional components. 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, DFRL 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.

31 Technology: 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.

DFRL has developed these products that are refreshing and have a shelf life of six months. Also as 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.

32 Technology: Green leafy vegetable chapaties/parothas

Chapaties are regularly consumed and are the staple diet of Indians. Green leafy vegetables are rich source of vitamins, minerals and dietary fibre. DFRL has developed green leafy vegetable chapati parothas/premix that require just mere addition of water for kneading and baking thus reducing the time of preparation of chapaties. The chapaties are stable for one year under ambient conditions and useful for packed meals rations.

33 Technology: Groundnut burfi

Burfi based on khoa is a sweet product relished by all segements of population having a limited shelf-life. Burfi prepared by using groundnut, which is a rich and economic source of protein and other micronutrients and has a longer shelf-life is not available.

Groundnut burfi developed by DFRL is not only nutritious, but is calorie dense and has a shelf–life of more than five to six months.

34 Technology: Holibite

DFRL has developed this instant energy health oriented ready to eat product for emergency use after exercises or for relaxation after exertion. This is an innovative product based on honey.

This is helpful in providing immediate energy to the body and provides 108 k cals for 30 g capsule. Four to six capsules are good enough for managing emergency situations. Such a product containing 70% honey is yet unheard of, and the honey percentage it has also been proven in this product.

35 Technology: 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 minimize/avoid microbial proliferation result in shelf stable ready-to-eat fruit products with high moisture content. These high moisture fruits retain their fresh appeal and are processed using a combination preservation (hurdle technology) technique from tropical and semi-tropical fruit slices. 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.

36 Technology: Insta nutro cereal mix - bisibele bath mix

DFRL 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. The product remains stable for one year and can be reconstituted in three to four minutes in boiling water.

37 Technology: Instant carrot halwa

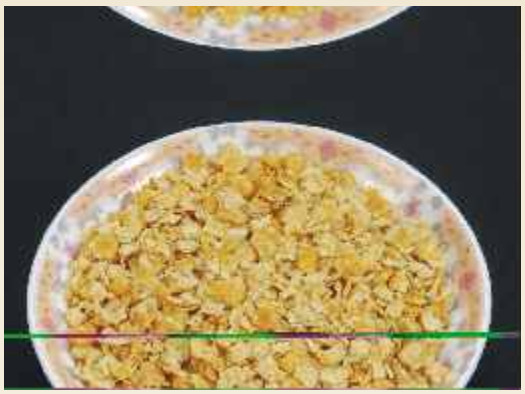
'Gajar ka halwa' and 'Gajar pak' are extremely popular amongst a host of Indian and subcontinental consumers. Traditional carrot halwa and gajar pak preparations are very elaborate and far too cumbersome. Moreover the freshly prepared carrot halwa has limited shelf life of two to three days at room temperature and about one to two weeks in refrigerated condition. The development of Instant carrot halwa is intended to solve these problems.

The instant mix developed by DFRL 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 condtions 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.

38 Technology: Instant coconut chutney mix

Coconut chutney provides a definite tang to many of the traditional south Indian delicacies such as idli, dosa, uddina 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 hydro besides curry leaves and mustard seeds as essential ingredients. The product reconstitutes almost instantly on addition of water.

39 Technology: 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 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 100^{0}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. The cooking time of dal can be reduced by increasing the surface area of grain by flaking and breaking the PCMP complexes, and by cooking and drying in suitable dryer to less than 6 percent moisture content.

40 Technology: Instant cooking rice

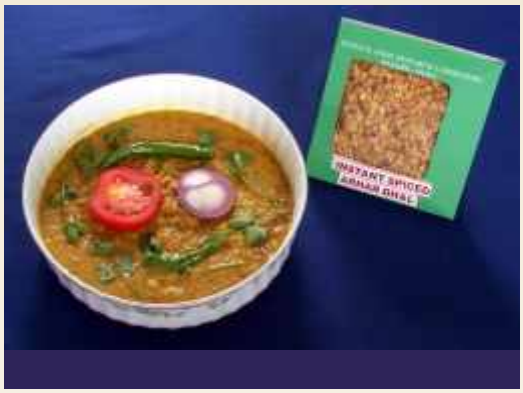
Cooking of rice is a time consuming process and requires elaborate cooking facilities like pressure cooker, cooking vessels, gas etc. The preparation becomes much more difficult and requires a long time at high altitude areas where boiling point of water is less than 100^{0}C. The cooked rice has a limited shelf life of twelve to twenty four hrs. at ambient condition.

DFRL has developed the instant cooking rice by pressure cooking and conditioning to particular moisture content, flaking to a specified 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^{0} - 90^{0} C within five to ten minutes.

41 Technology: 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 hrs 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% moisture content. In this process developed by DFRL, dal grains are cooked under pressure, conditioned to low temperature and dried under high air velocity trough flow 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 pre-cooked dehydrated dal grains are blended with spices and seasoning to instant dal curry. The instant dals and instant dal curries does not require cooking. The dal curries like redgram dal curry can be prepared for consumption by mixing with hot water within three to five minutes. The product has more than one year shelf life and forms complete meal along with rice, chapatti or parotha. It is useful during traveling, expeditions, institutional feeding and during odd times at homes.



42 Technology: 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 developed by DFRL 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. Its process of manufacture is fairly straight, simple and easily adaptable at commercial level.

43 Technology: 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 she/he looks forward to.

44 Technology: Instant upma mix and rava idli mix

Upma and Rava idli are traditional products which are routinely consumed. These products have been developed by DFRL in convenient form of dry mixes which can be reconstituted or cooked in three to five minutes. Rava idlis are popular item of snack 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, in order to provide convenience to consumers, DFRL has developed a ready-to-cook formulation which has all the essential ingredients akin to rava idlis. The product has excellent domestic as well as export potential.

45 Technology: Instant vegetable wadi mix

Different types of wadi are available in the market that are made from urad dal, moong dal, etc. However, they take long time for cooking and instant vegetable based wadi are not available. DFRL has developed vegetables, potato, bottle gourd and carrot based wadi to provide better nutrition and ease of cooking.

46 Technology: Instant wheat porridge mix

Supply of fresh food to troops engaged in combat operations or during inaccessible terrains is almost not possible. Hence troops have to survive on ready to eat foods or convenience foods which should be less in weight, with longer shelf-life and should provide adequate calories.

DFRL has developed instant wheat porridge dalia mix capable of reconstitution in four to five min in hot water and provides 435 Kcal

47 Technology: Instant whole pulses and their curries

The cooking of whole legumes like kabuli chana chole, chickpea green gram, rajmah is a time consuming process and requires elaborate cooking facilities.

The cooking time of whole legumes/pulses can be reduced by pressure cooking and drying grains in a suitable dryer to less than 6% moisture content. In this innovative process, the whole pulses are cooked under pressure, conditioned to low temperature and dried under high air velocity trough flow dryer such that grains retain their shape and size with porous structure and minimum density. These dehydrated products when added to hot water gets reconstituted within two to three minutes. The precooked dehydrated whole pulses are blended with specific spices and seasoning for instant whole pulses curry like chole curry. The instant whole pulses and its instant curries do not require cooking. The whole pulses curries like chole curry or rajmah curry can be prepared for the consumption by boiling in water within five to ten minutes. The product has more than one year shelf life and forms complete meal along with rice or chapatti or parotha and useful during traveling, expeditions, institutional feeding and during odd times at home.

48 Technology: 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 and volatility which results in batch to batch variation in the concentration of antioxidant.

DFRL has developed this salt, coated with antioxidant which could be used at 2% level which is sufficient to take care of the onset of rancidity.

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49 Technology: 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 antimicrobial in nature.

The juice has harmony 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.

50 Technology: Millet dhokla mix and millet bhatura mix

There are no convenient mixes available for fermented and millet products. Hence DFRL has developed millet based fermented products such as dhokla and bhatura that 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. Also these products give nutrient benefit from millet and are of the additional new products in the market.


Millet Dhokla

51 Technology: Millet ragi based products

This product has been developed by DFRL for providing high calcium and dietary fibre in the diet. The specific millet called finger millet ragi is antidiabetic too. The product provides high convenience such as ready to eat or cold water reconstitution.

These products are good for skeletal health becase of high 200-300 mg calcium content. Good for easing constipation problem, controling lipid profile because of 20% dietary fibre content. Constant use helps diabetic patients in controlling their disease.


Millet Cookies


Millet Chapathi Mix

52 Technology: 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.

53 Technology: 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. 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.

54 Technology: 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 at DFRL requires just two to three hours for fermentation and it is fortified with necessary vitamins and minerals as per RDI requirements.

55 Technology: 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, 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. The process for production of Nata-de-coco has been standardized and conditions optimised. 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.

56 Technology: Noni-based RTS health beverages

Noni Morinida citrifolia is a non conventional, under utilized, non-table fruit which is very rich in various polyphenolic, antioxidant and neutraceutical principals. However, ripe Noni fruit has a typical butyric-offensive odour which restricts its usage as table fruit despite its numerous health benefiting and restorative properties. The utilization of Noni fruit, thus, demanded innovating a process that could effectively mask the unacceptable odour of ripe Noni fruit in order to develop consumer acceptable value added products from it.

57 Technology: Novel mould design for retort processing of liquid, semi-solid and solid food products

Retort processing is the most acceptable form of food preservation for ready to eat food products. It represents a unique combination of package, process and product technologies with potential, functional, quality and economic benefits. It requires just warming in a microwave oven or water bath before eating. It can be classified as light weight, flexible laminated food package that maintains shelf-life, texture and nutritive value of food.

A significant advantage of this invention is that it provides an easy-open aluminum mould for flexi-pouches to maintain excellent structural integrity of individual pouches, better heat transfer, stackability to counterbalance the builtup internal pressure of pouch during retort processing.

58 Technology: Omega-3- rich bar

Omega-3-rich bar has been prepared 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 source of omega-3-fatty acids, but this bar is a vegetarian product. Omega-3-rich bar contains vegetable source of omega-3-fatty acids. The bar can be used as a substitute for food containing non vegetarian source of fatty acids.

59 Technology: On-line conditioning system

In the development of processed foods, the on-line conditioner has its place in conditioning of dal and rice prior to flaking, and vegetables prior to frying. Also with the adjustable air flow and temperature management, it can also be used for drying of vegetables or cereals to overcome thermal abuse during conventional dehydration. It is also a very convenient method for drying heat sensitive food materials as it prevents their overheating due to mixing. From energy and environmental viewpoints as well as the global requirement to feed the growing population, it is very important to improve the conditioning techniques to reduce spoilage and enhance the keeping quality of the product.

At present conditioning of the products is a manual operation and automation will quicken the process and make it more economical. Hence, an effort has been made to design 750 Kg/hr capacity on-line conditioning equipment for agro-products. This operator friendly equipment has been engineered with controlled temperature, air velocity, product movement and an auto loading and delivery system.

60 Technology: 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 utilized for developing Aloe Vera-based pomegranate 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.

61 Technology: Preservative mixture

Chapaties are perishable and get spoiled within 24-48 hours due to mirobiological spoilage.

Thus, DFRL has developed preservative mixture, formulated with permitted preservatives. By using these preservatives chapaties shelf-life can be extended for ten to fifteen days.

62 Technology: Preservative and flavoured chapaties

The technological measures employed to preserve and stabilise this popular Indian wheat-based staple includes certain preservatives and thermal treatment alongwith 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.

63 Technology: Production of lactic acid bacterium as B-galacto-sidase sources

Lactic acid bacterias are predominantly used as probiotic bacteria to improve the intestinal health of human beings and some farm animals woldwide. The bacteria are also widely used for the producion of beta-galactosidase (lactase) for the hydrolysis of lactose, a disaccharide, in milk. Betas-galactosidase is an enzyme which can convert lactose into glucose and galactose moieties. Hydrolysis of lactose is essential from medical, environmental and food technological angles. Many adults and children can not digest milk sugar and therefore develope complications generally known as lactose intolerance. Extraction and use of this enzyme from lactic acid bacteria can give a solution to the problem. Use of lactic acid bacteria as probiotic bacteria and extraction of beta-galactose from lactic acid bacteria is the subject of technological importance of the patent mentioned. Therefore the reproducible growth of lactic acid bacteria in a culture medium is essential from biotechnology point of view. Practically, the growth of lactic acid bacteria is affected by viral infections and the quantity of bacterial biomass obtained varies from batch to batch. Moreover the media ingredients used for the growh of lactic acid bacteria mainly comprise of beef extract and peptone which are not acceptable to the Indian population.

In view of these problems a growth medium for lactic acid bacteria production has been developed comprising of soypeptone and soybean meal for food applications as well as for probiotic use in human consumption. Moreover the growth media has been modified to reduce phase (virus) infection to obtain reproducible amounts of lactic acid bacteria biomass, since the bacteria was grown using plant based ingredients the enzyme extracted is suitable for Indian population. The technology mentioned is useful for the production of probiotic bacteria as well as the enzyme beta-galactosidase in a cost effective acceptable manner. Using this technology it is possible to obtain a substantial amount of bacterial biomass for probiotic use and for enzyme extraction.

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64 Technology: Puff and serve chapaties

These partially-baked chapaties are stablised by incorporating certain antimycotic antistaling and softening agents. Baking over a flame or hot plate puffs them readily 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 phulka when making use of this kind of chapati. An ideal preparation for any housewife short on time and energy.

65 Technology: Ready to eat appetizers

Prolonged exposure to high altitude and certain pathological situtation leads to loss of appetite. To address this problem of appetite, spice based appetizers have been developed by DFRL. To provide convenience to consumers, these were developed in a ready-to-eat form with shelf life of ten months. Active components present in the appetizer promotes secretion of juices from several glands and improves the appetite. The convenience of ready-to-eat product and longer shelf life are added advantages.

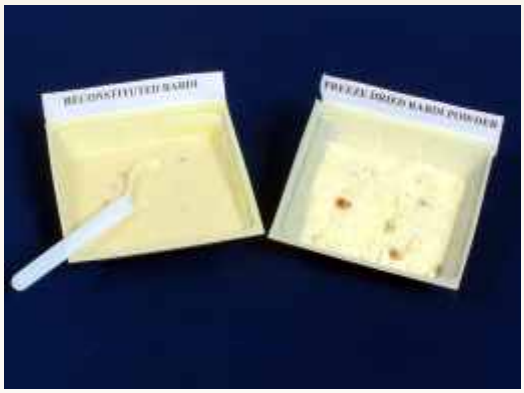
66 Technology: Ready to Eat (RTE) and shelf stable fried chicken leg pieces

Ready to eat non-vegetarian product were 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 by DFRL to deliver a protein rich convenient and 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.

Fried Chicken Leg Pieces

67 Technology: Ready to reconstitute freeze dried, shelf stable rabri powder

Many service locations are in far flung and high altitude areas where sweets are not available. Therefore, to address these situation this innovation was done by DFRL. This invention is a process of preparation of a freeze dried ready to reconstitute, shelf stable rabri powder having good quality characteristics in terms of microbiological, chemical and sensory attributes and stable under ambient temperature conditions.



68 Technology: Ready-to-eat 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.

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 the damages caused due to crystal ice formation. Thus cryostabilization 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.

69 Technology: Ready-to-eat nutri food bar

Due to the change in lifestyle and long working hours, there is a feeling of tiredness and need to have calorie dense foods. This product by DFRL, Nutri Food Bar, is ideally suited for these purposes and also there is a physiological feeling of fullness when 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.

70 Technology: Ready-to-eat 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 ready-to-eat 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.

71 Technology: Ready pouch processed foods

Foods such as aloo choley, sooji halwa, fish curry, rice, dhal 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 ready-to-eat 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 oven 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.

72 Technology: Ready processed chapaties

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


Retort Processed Chapaties

73 Technology: Rice based products-Instant tamrice mix and instant urd rice mix

Rice being a staple cereal is a component of the ration scale of armed forces. But to meet the requirement of light weight, convenient and easy transporation, processed rice product development was inevitable.

Rice based tamrice mix, urd rice mix are traditional touch products which satisfy the Indian palate. The stabilisation of the products have been achieved which makes the product ready to eat in three to four minutes reconstitution in boiling water.

74 Technology: Salmonella species, Shigella spices, Escherichia coli group and proteus species identification kit

The Enterobacteriaceae are a large family of bacteria, including highly potent pathogens, such as Salmonella, Shigella, Escherichia coli and Proteus having the capacity to cause serious diseases. Millions of Salmonellosis cases are reported worldwide every year resulting in thousands of deaths. Conventional methodologies for identifying these pathogens are tedious and would need five days to achieve the results. Commercial kits available for detection are highly expensive, needs to be imported and these kits can detect only one organism at a time.

The test kit developed at DFRL, detects Salmonella genus, Shigella genus, entire E. coli group along with Proteus spp. simultaneously, employing monoclonal antibody based simple dot ELISA and a set of four biochemical tests namely, Indole, Urease production, KOH string and Oxidase test. It is reliable, simple, takes three hours to produce results and is relatively inexpensive. This test system has been tested with number of reference strains, isolates and clinical samples. Third party evaluation of this kit was done at three medical colleges of Karnataka with satisfactory reports.

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75 Technology: Seabuckthorn based spiced squash

Oxidative stress is the initialisation of the onset of many degenerative diseases. The seabuckthorn based spiced squash has been developed which is capable of reducing incidents of oxidative stress. The squash is shelf stable for more than eight months and rich in vitamin C and minor amounts of spice principle and other antioxidants.

The seabuckthorn based spiced squash is spiced with locally available spices. The squash is unique in nature as it is enriched with ascorbic acid and phenols. Hence, it is good in tackling the problem associated with stressful situtations.

76 Technology: Seabuckthorn based baked foods

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 extract 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.

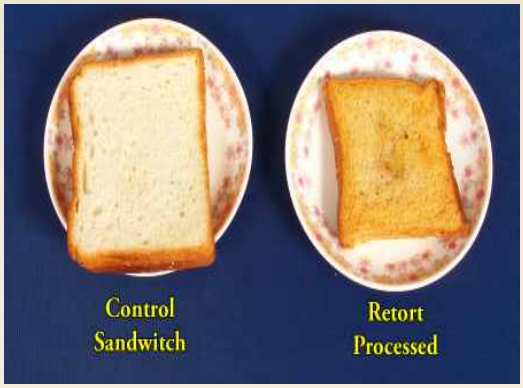
The baked foods developed by DFRL are unique as no other technology/product is available for baked food rich in antioxidants. The baked foods are antioxidative in nature and hence the consumption of these foods can reduce the incidence of chronic diseases.

77 Technology: Seabuckthorn based herbal tea

Daily intake of fried foods, high fat foods, environmental and physical stress leads to the development of oxidative stress. Oxidative stress is an initial step towards the development of many degenerative diseases. The herbal tea developed using seabuckthorn leaves and locally available herbs and spices reduces the onset of oxidative stress as evidenced by experiments conducted in rats.

The tea is rich in polyphenols, flavonids, spice principles and hence pre natural antioxidants. The tea is refreshing, stimulating and stress relieving apart from being a thirst quencher.

78 Technology: Shelf stable, ready to eat mutton sandwich



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

The above problem has been addressed by developing a mutton based product, viz. mutton sandwich which is nutritious, ready to eat and shelf stable up to twelve months at room temperature of twenty to thirty degree C with no preservatives. The mutton sandwich packed in multilayer flexible pouches is light in weight and easy to carry.

79 Technology: Shellac coating

India produces and exports a large quantity of shellac. However, there is no commercial shellac based surface coating available for the purpose of coating of fruits and vegetables for extending their shelf life. The waxol based coatings have number of disadvantages such as non-uniform nature, incidence of anaerobiosis within the fruits, long drying times etc.

Shellac is soluble in specific solvents at specific pH and temperature conditions. Stock solution in aqueous form is prepared at higher concentrations and diluted to the required level depending on the commodity for application as a surface coating. The formulation also consists of hydrocolloid suspension, emulsifying and thickening agents for use as a surface coating.

80 Technology: Short -term preserved chapaties

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

81 Technology: Soy fortified instant sooji halwa and upma mix

Various instant food mixes are developed by DFRL which get reconstituted within four to five minutes with long shelf-life but they are not whole some in terms of essential amino acid or protein as cereals are good source of methionine and legume in lysine.

Instant mixes were developed by using soy bean or soy sooji which are very good sources of all essential amino acid and are known to improve the protein efficiency ratio.

82 Technology: Soy fortified 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 soy and beta glucan fibre content of oat provides maximum health benefits to the consumers.

83 Technology: 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.

84 Technology: Stabilized green chutney

Chutneys such as green chutney made up of green tomato, coriander leaves and spices are delicacies which have huge market potential in the defence and civil sectors. The chutney is highly perishable and not suitable for long distance transportation in catering at room temperature. Stabilization of the product requires technical inputs in building up the solids and subsequent stabilization by hurdle processing.

Hurdle processing is ideal for stabilization of green chutney and the hurdles include water activity control, pH regulation and minimal thermal process in the form of in-pack pasteurization.

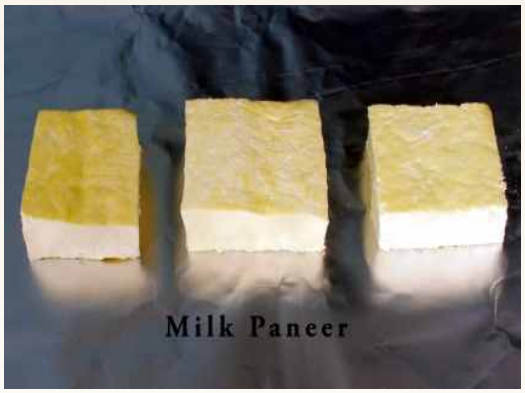
85 Technology: Stack encapsulation technique

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.

A simple innovative stack encapsulation technique has been developed by using polyethylene film 400-700 guage with permitted fumigants which completely prevents moisture ingress and infestation. This technique can be used with and without fumigation of products.

86 Technology: Standardization 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 standardization of paneer preparation and to study the physico-chemical, microbiological and sensory attributes and raw material treatment with different hurdle treatments.


Milk Paneer

Different treatments were given to paneer, like addition of preservatives, salt and sorbic acid, surface drying, vaccum packing and in-pack pasteurization. In most of the treatments a combination of all the above were given to establish the shelf life enhancement.

87 Technology: Sweet and sour tasty bar

Generally energy bars are sweet in taste and part of various survival/energy rations. In order to provide change in taste, sweet and sour tasty bars have been developed which contain salt, chilli powder, sugar, different nuts and other ingredients of choice.

88 Technology: Sweetcorn products stabilized kernels and paste

Sweetcorn products have gained increased popularity over the years. The laboratory has developed a minimal process for extending the shelf life of sweetcorn kernels for a period of sixty and forty five days at low (6 + 1°C) and ambient 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 sweetcorn spread and also can be used for other preparation i.e., dosa and other culinary preparations.

89 Technology: Tetra pack products-spiced drink appetizer, curd cereal drink, ashgourd juice, cucumber juice, ashgourd pudina juice, tender coconut water, apple electrolyte, orange electrolyte, mango electrolyte

The tetra pack products are processed in a way that causes least possible nutrient damage to food. To reduce thermal damage and to promote concept of vegetable juice, or ready to drink appetizer these products were developed. The curd cereal drink is a first of its kind particulate food product in tetrapack and has an excellent shelf life.

The products processed in tetrapack retain its nutrients and flavor properties almost like a fresh product. The shelf life of six to ten months and ready to eat form makes it an exceptional product. The innovative ingredient compositions are responsible for their functional properties.

90 Technology: Thermally stable whole/split legumes based ready to eat 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 under go 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.

DFRL has developed ready to constitute thermally processed whole/split legumes concentrates 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.

91 Technology: Vegetable juices-ashgourd juice, ashgourd pudina juice, cucumber juice, bottlegourd 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.

Appendix

1. ASTM: American Society for Testing and Materials
2. CAP: Controlled Atmosphere Packaging
3. DFRL: Defence Food Research Laboratory
4. ELIZA: Enzyme-linked immunosorbent assay
5. HTST: High Temperature Short Time
6. KOH String: Potassium Hydroxide String
7. LDPE: Low-density Polyethylene
8. MAP: Modified Atmosphere Packing
9. Minerals such as Cu, Zn, Na, K, Fe and P: Copper, Zinc, Sodium, Potassium, Iron, Phosphorus
10. PCMP: Pectin, Calcium, Magnesium and Phytin content
11. RDA: Recommended Dietary Allowance
12. RDI: Recommended Daily Intake
13. RTE: Ready to Eat
14. RTS: Ready to Serve
15. UC: Ulcerative Colitis
16. UV: Ultraviolet

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