Def Sci J, Vol 34, No 2, April 1984, pp 125-134

Processed Foods for Defence Needs—R & D Efforts at CFTRI

J. V. SHANKAR, V. H. POTTY & S. P. PILLAI
Central Food Technological Research Institute, Mysore-570 013

Received 28 February 1984

Abstract. The Central Food Technological Research Institute, Mysore, working under the council of Scientific & Industrial Research has developed a number of processes and techniques some of which are relevent to Defence needs. Items like spray dried egg powder and canned drinking water are already in use by the services while many others may find application in future.

1. Introduction

The Central Food Technological Research Institute (CFTRI), Mysore, a premier R & D institution functioning under the Council of Scientific and Industrial Research, New Delhi, has developed a variety of processes and products based on indigenous raw materials of plant and animal origin to provide the means of conserving them against wastages. Some of them have already been utilised to meet defence food needs while others merit attention for future applications.

The association of CFTRI with defence food efforts dates back to more than 20 years. The major emphasis at that time was on optimising conditions for the preparation of a variety of products offering advantages of light weight and compactness, transportation, extended storage under diverse climatic conditions, quick cooking and amenability for ready consumption. During the period 1962-63, production of some dehydrated foods was undertaken in collaboration with DFRL, Mysore, and supplies of 10 tonnes of dehydrated pre-cooked *dhal*, 7.5 tonnes of pre-cooked dehydrated rice, 1.2 tonnes of dehydrated potatoes and 150 kg of dehydrated carrots and also onions were made to defence forces[1].

The technologies/products of CFTRI relevant to defence needs can be broadly classified into two categories : (a) those suitable for use by personnel under field conditions; and (b) those helpful in defence kitchens and related establishments.

2. Products Relevant to Defence Uses Under Field Condition

These products offer convenience, being ready-to-eat as such, or after minimum preparation. They include : spray-dried egg powder from whole egg melange; canned drinking water; fruit bars; *chikki* type products based on jaggery, nuts and oilseeds; protein-rich chewy candy; canned food products; fruit juice concentrates; liquid fruits; emergency bread; comminuted beverages from orange; malted beverages using either vegetable protein or milk powder; coffee/tea whiteners based on casein and vegetable protein; instant tea; and butter-like bread-spreads from peanut and walnuts.

3. Products Useful in Defence Catering Establishments

Several items developed at CFTRI could also be useful in defence kitchens as they provide standard, clean, pre-processed products with extended shelf-life, which can be prepared with out difficulty at various intervals depending on the needs. These include: freeze-dried prawns for ready reconstitution and incorporation in dishes; pre-cooked cereals and pulses to reduce cooking time; ready-mixes for snacks, sweets; instant *Rasam*/*Sambar*, *Puliyogare* and *Bisi-Bele Bhath* capable of giving acceptable products with minimum kitchen work; ready gravy for meat/vegetables with extended shelf-life; spice oleoresins with concentrated flavours for incorporation into foods; tamarind juice concentrate and powder which are convenience products with long shelf-life; and improved indigenous foods such as fried and sweet-meat products (Table 1.)

Table 1. Some specialities of partially prepared foods

Product	Product speciality
Freeze-dried prawns	1 kg equivalent to 4 kg fresh prawns
Pre-cooked pulses	Reduction in cooking time by 0.75
Pre-cooked cereals	Reduction in cooking time by 0.75
Instant *Rasam*	Reduction by 0.75
Instant *Sambar*	Reduction by 0.75
Instant *Puliyogare*	Reduction by 0.75
Instant *Bisibele Bhath*	Reduction by 0.85
Ready meat-gravy	Saving preparation time
Spice oleoresins (pepper)	Standard flavour strength 1 kg equivalent to 25 kg black pepper
Tamarind juice concentrate	Hygienic product convenient for use and standard acidulation property
Tamarind Powder	Hygienic product, good dispersibility, standard acidulation property

The processes for some of these items have already been used in commercial production and products meeting the desired specifications are items of defence purchase.

2. Products Relevant to Defence Uses Under Field Condition

These products offer convenience, being ready-to-eat as such, or after minimum preparation. They include : spray-dried egg powder from whole egg melange; canned drinking water; fruit bars; *chikki* type products based on jaggery, nuts and oilseeds; protein-rich chewy candy; canned food products; fruit juice concentrates; liquid fruits; emergency bread; comminuted beverages from orange; malted beverages using either vegetable protein or milk powder; coffee/tea whiteners based on casein and vegetable protein; instant tea; and butter-like bread-spreads from peanut and walnuts.

3. Products Useful in Defence Catering Establishments

Several items developed at CFTRI could also be useful in defence kitchens as they provide standard, clean, pre-processed products with extended shelf-life, which can be prepared with out difficulty at various intervals depending on the needs. These include: freeze-dried prawns for ready reconstitution and incorporation in dishes; pre-cooked cereals and pulses to reduce cooking time; ready-mixes for snacks, sweets; instant *Rasam*/*Sambar*, *Puliyogare* and *Bisi-Bele Bhath* capable of giving acceptable products with minimum kitchen work; ready gravy for meat/vegetables with extended shelf-life; spice oleoresins with concentrated flavours for incorporation into foods; tamarind juice concentrate and powder which are convenience products with long shelf-life; and improved indigenous foods such as fried and sweet-meat products (Table 1.)

Table 1. Some specialities of partially prepared foods

Product	Product speciality
Freeze-dried prawns	1 kg equivalent to 4 kg fresh prawns
Pre-cooked pulses	Reduction in cooking time by 0.75
Pre-cooked cereals	Reduction in cooking time by 0.75
Instant *Rasam*	Reduction by 0.75
Instant *Sambar*	Reduction by 0.75
Instant *Puliyogare*	Reduction by 0.75
Instant *Bisibele Bhath*	Reduction by 0.85
Ready meat-gravy	Saving preparation time
Spice oleoresins (pepper)	Standard flavour strength 1 kg equivalent to 25 kg black pepper
Tamarind juice concentrate	Hygienic product convenient for use and standard acidulation property
Tamarind Powder	Hygienic product, good dispersibility, standard acidulation property

The processes for some of these items have already been used in commercial production and products meeting the desired specifications are items of defence purchase.

4. Highlights of Some Processes and Products

4.1. *Meat and Fish Based Foods*

Canned and dehydrated foods based on meat and fish were standardized considering the defence needs (Table 2).

Table 2. Convenience foods based on meat and fish

Canned foods	Pre-cooked, dehydrated and ready-to-eat foods
Mutton in brine	Mutton and rice with vegetable broth and spices
Mutton curry	
Mutton *Pulav*	Spiced mutton and rice (*Pulav* composition)
Mutton *Biriani*	Pre-cooked chicken (or mutton), rice and beans
Mutton curry	Pre-cooked freeze-dried shrimp
Egg in brine and curry	Dehydrated mutton mince
Mackerel, pomfret and sardine in oil	
Curried sardine and mackerel	
Shrimp in brine	
Shrimp *Pulav*	
Fish paste	

Dehydrated mutton mince had attracted the attention of defence organisation because of its light weight and quick reconstitution after warming in water. Studies undertaken in this context resulted in the development of know-how for pre-cooked mutton mince which could be satisfactorily dried in a through-flow drier in a short time; longer drying time was found to be necessary in a cross-flow drier. Dehydrated mutton mince[2] with a moisture content of 3-4% and fat level not exceeding 25% packed in nitrogen could be preserved for 6 months at 37 °C. Compressed blocks of dehydrated product[1] with a bulk density of 1.07 g/ml could also be prepared from mutton mince with a bulk density of 0.4 g/ml.

Subsequently, the preparation conditions were worked out at the instance of defence for dehydrated mutton mince, incorporating 50% vegetable protein. The product with 3-3.5% moisture and 18-20% fat packed under nitrogen in hermetically scaled containers remained acceptable for six months at room temperatures ranging from 25-30 °C; nitrogen packing was indispensible[1].

4.2. *Egg Powder*

It is a defence food item highly rated for its reduced bulk and weight, easy handling and transportation, stability and extended shelf-life, even at ambient temperature. Since there was no capability for indigenous manufacture in the country before 1965, the

defence needs for egg powder were mostly met by imports. The research and developmental work for the production of egg powder was undertaken in the country almost 18 years ago. After optimising the procedure at laboratory level, egg powder was produced in the pilot plant of CFTRI and supplied to the Armed Forces.

The process for egg powder essentially consists in obtaining the melange (the liquid portion) from washed and cleaned eggs, homogenisation, filtration, pasteurisation and fermentation to remove glucose followed by pasteurisation, cooling and spray-drying. The product obtained in powder form is immediately cooled and gas-packed in unit containers. It can be preserved at ordinary temperature for several months[5].

Egg powder is a versatile product, which can be used in the preparation of ready-mixes, omlettes, ice creams, cookies, noodles, doughnuts, and many such products. A manufacturing unit with a capacity of 150 tonnes of egg powder per year has been established in the private sector availing of this know-how. Composition of egg powder manufactured by this process is presented in (Table 3).

Table 3. Composition of egg powder

Characteristics	Requirements under IS : 4723-1968
Moisture % wt. (max.)	2
Protein N×6.68% wt. (min.)	45
Lecithin and Fat % wt., (min.)	38
Solubility % wt., (min.)	80
pH (max.)	7-9
Oxygen content % wt. (max.)	2.0
Bacterial count, per gm, (max.)	75000
Yeast and Mould count, per gm, (max.)	100
Coliform count, per gm, (max.)	100

4.3. *Pre-cooked/Ready-to-eat Vegetarian Foods*

Development of ready-to-eat, high-calorie, light-weight precooked foods had been receiving careful attention between 1960-65 to meet the defence needs, particularly in forward areas and stress conditions. It had been noticed that oven drying or vacuum shelf-life drying of cooked starchy foods did not impart the desired consistency and also posed difficulties in injestion. On the contrary, drum-dried preparations of precooked rice, wheat, semolina, pulses and *dhals* showed advantages of compactness, storage, organoleptic qualities and uniformity of calories for a given weight. Hence, the principle of drum drying was extended to the preparation of food items such as *Sambar Bhath* (rice and *Tur dhal* curry), *Rava Upma*, vegetable *Biriani* (cooked wheat, semolina, salt and spice), *Pongal* (rice and *Mung dhal* salted) and sweet preparations (wheat, Bengalgram and sugar) (Table 4).

Table 4. Composition, nutritional characteristics of some light weight pre-cooked foods

Product	Unit g	Protein g	Fat g	Calories g
Sambar Bhath	25	1.8	5.0	135
Biriani	25	3.2	4.2	130
Pongal	25	2.3	4.2	130
Sweet	25	1.5	1.3	130

In these items, the proportion of major components was suitably adjusted to provide for protein content of about 10%. The products obtained by pre-cooking and drum drying had a flaky appearance. They were then sieved (30 mesh) to obtain a uniform powder which was then mixed with salt or sugar, flavouring agents and essential vitamins. Four different foods, namely, *Sambar bhath, Biriani, Pongal* and sweet were prepared. After adjusting the moisture to about 8%, the product was compressed into briquettes of 25 g each to provide for convenience in transportation and consumption. Depending upon the composition of the foods, each briquette provided 130-135 calories, 1.8-3.2 g of proteins and 1.3-5.0 g of fat (Table 4). These products could withstand accelerated conditions of storage (37°C and 50°C) for 10 months without loss in edible quality, seepage of fat and bacterial spoilage. They were sent to QMG and to Air headquarters (on request) for field trials[4].

The use of flexible packages was successfully tested for cooking rice either alone or in combination with other food components in low pressure polythene bags at 15 lb per sq. in. for 10 minutes and by further reinforcement with aluminium foil laminates. The products so cooked and packed were found to remain intact during a storage period of one month[1].

4.4. *Soup Powders*

The principle of pre-cooking followed by dehydration was extended to the evolution of Indian type soup products based on tomatoes, potatoes, carrots, green/dried peas, chicken and mutton. Other ingredients were starch, skim milk powder, hydrogenated vegetable oil, common salt, and mixed spices. The cooked vegetables could be dried without difficulty in cross-flow driers but tomatoes required drying in vacuum shelf-driers. The soup powder had a shelf-life of several months.

Subsequently, *Sambar* type soup powders were also evaluated and the experience gained in this effort provided the basis for ready-mixes developed in subsequent years, which have become popular in urban areas. The soup powder as well as the *Sambar* mixes are reconstituted in water and warmed before consumption[5]. These products have the potential for becoming popular among defence personnel, in the light of their strong preference indicated in a study carried out in 1966 for simple foods consisting of *Parota*, rice, dhal, vegetables and meat[6,7].

4.5. *Canned Drinking Water*

The product was being imported into India over a number of years since it is a strategic item in survival ration for defence services personnel. Although canning of drinking water appears to be simple but internal rusting of cans, sediment deposition, off-flavour pick up and opalescence were problems requiring solution to meet the rigid specifications of the Army Supply Corps. In order to develop the indigenous capability for this item, a method was worked out for canned drinking water, which, however, developed opalescence after 6 months, showed an iron content of more than 2.5 p p m (revised) which is the upper limit prescribed by ASC, and also became unacceptable[8]. Since most of the emergency rations are required to possess a shelf-life of more than 2 years, efforts were necessary to ensure the same shelf-life in canned drinking water also. Use of citric acid and sodium citrate as buffer salts to adjust the pH of water to 5.4 extended the shelf-life of canned water beyond 2 years. Electrolytic tin plates manufactured in the country also proved suitable for canned drinking water[9]. Canned drinking water was supplied to defence organisations till 1975; thereafter know-how was given to an industry in Bombay which is producing 50,000 cans every year. The specification of canned drinking water is presented in (Table 5).

Table 5. Suggested specifications for canned drinking water

Characteristics	Value
pH	5.2-5.4
Turbidity	5 Silica scale
T. S. S. (max)	500 ppm
Nitrogen, as free ammonia (max)	0.05 ppm
Nitrogen, as albuminoid ammonia (max)	0.10 ppm
Nitrogen as nitrates, nitrites (max)	250 ppm
Sulphates (carbonates), (max)	250 ppm
Chlorides, (max)	20 ppm
Lead (max)	0.1 ppm
Copper (max)	0.2 ppm
Iron (max)	2.5 ppm
Zinc (max)	5.0 ppm

5. Some Novel Products with Potential for Future Use

5.1. *Ready-mixes*

Breakfast items such as *Idli*, *Dosa* and *Vada* have become popular throughout the country including the western and the north-eastern borders. In order to overcome the problems faced in the fermentation of the batter of *Idli* and *Dosa* and also the drudgery associated with their preparation, ready-mixes have been developed and made ready for commercial use[1]. The ready-mixes can be made into the batter of

appropriate consistency by the addition of water and then steamed for *Idli* or fried on a pan for *Dosa*. These products hold immense potential for providing variety to the defence personnel particularly those serving at high altitudes.

5.2. *Emergency Bread*

Nutritionally adequate products with non-thirst provoking properties were being imported for use in life-rafts and life-boats; this provided the incentive for CFTRI to develop a similar product namely emergency bread using locally available raw-materials. This product also has potential for use by defence forces.The proximate composition of emergency bread is given in (Table 6).

Table 6. Proximate composition of emergency bread

Characteristics	Value (%)
Protein	10.6
Fat	21.3
Sugar	7.9
Ash	1.3
Fibre	0.8
Starch	54.6

Calorie/g = 484

5.3. *Meat Products*

A sausage formulation containing cooked lean mutton, fat, salt, spices, green curry stuff, fillers and binders has been evolved. It can be filled into casings and formed into links of desired length to obtain sausages or processed into loaves, by filling into mould. These products are marketed as cooked ready-to-fry /roast products, and also can be stored in refrigeration for 10-12 days[10].

A salted cracker type of product was prepared by using whole wheat meal and cooked mutton mince. It is easy to munch and contains 25-30% protein. The dough prepared by mixing the flour and cooked mutton with a small amount of sugar and shortening is sheeted, cut into small size and baked[1].

Meat soup cubes are a ready-to-serve product based on meat extract and hydrolysate, hydrogenated fat, pepper extract, gelatin and salt. The formulation is concentrated to about 70% solids and further processed into 1 cm cubes (4.5 g each). The product has a moisture content of 5.5%. It becomes soft at 8% moisture and shows fungal growth at 10% moisture level[11].

Concentrated meat gravy is a new product that contains vegetables, green curry, spice/spice oils and some quantity of meat to impart the desired flavour. In this

product the stages of collection, measuring and preparation of individual items are eliminated, thereby offering the convenience for use in army messes and industrial canteens. Processing conditions for six types of meat gravies (namely, Mutton *Kashmiri*, Mutton *Mughlai*, Mutton *Neelagiri Koorma*, Mutton *Palak*, Mutton coconut curry and Mutton *Dhanasak*) including canning have been established. These products can be stored at room temperature for one year[12].

Ready-to-eat products such as chicken sandwich spread barbecque and *Tandoori* chicken developed at CFTRI, should also be of interest to the defence forces in providing variety to suit the palate of personnel from various regions of the country

Substantial quantity of sausages in spiced brine, ham-in-spiced brine, meat chunks in gravy/brine, *Kheema*-in-curry, concentrated gravy (vegetarian/non-vegetarian, *Kashmiri*/ *Mughlai* type), fish pickle, and freeze-dried shrimp supplied to second Antarctica expedition elicited the good response from the crew in view of their taste profiles as well as convenience. These products have been designed to suit the Indian taste and flavour preferences (Table 7).

Table 7. Composition of some ready-to-use and meat-based products

Product	Proximate composition			
	Moisture (%)	Fat (%)	Protein (%)	Carbohydrate (%)
Conc. gravy Mutton Kashmiri	68.02	19.46	5.34	1.06
Conc. gravy Mutton Mughlai	68.76	19.43	4.17	1.70
Conc. Gravy Mutton Neelgiri Kurma	51.97	33.71	5.18	2.66
Conc. Gravy Mutton Palak	59.95	26.75	4.10	4.46
Mutton Coconut	55.38	27.98	4.86	2.05
Mutton Dhansak	74.58	4.48	5.09	11.36

5.4. *Fish and Shrimp Based Products*

A laboratory level process was worked out for this product in 1965; the product was acceptable to the armed forces[1]. A variety of other products like canned prawns, fish sausages and thermal processed fish products (frozen cutlets/breaded fish, frozen packed fish curry, ready mixes for fish *vadai*), fish pickles and frozen ready-to-serve fish products should also have the potential for use as defence food items[13].

5.5. *Fruit Based Confectionery*

Apart from conventional canned fruits, juices, concentrates and dehydrated vegetables, fruit toffee is an item likely to be of value in situations where the need is for compact, light-weight, ready-to-eat foods. It resembles defence food items such as cardamom flavoured sweet bars (oil-puffed rice, sugar, skim milk powder, cashewnuts, raisins,

and cardamom powder) and fruit flavoured sweet bars (foam mat dried or spray-dried fruit pulp, skim milk powder and sugar)[14]. It is prepared by using pulps of bananas, mangoes, papaya, guavas and even jack fruits, sugar (including some quantity of glucose) and preservative, skim milk, vanaspati, essense and colour. The fruit pulp is concentrated, other ingredients are mixed and then cooked to about 1/5th of the original weight of the fruit pulp. The cooked mass is spread into thin sheets, cooled, cut into toffees and dried at 50-55°C to a final moisture content of 5-6%. The toffees are then wrapped in cellophane paper and packed in air tight jars or tins.

Fruit bar is a product belonging to the class of intermediate moisture foods. It is prepared by mixing pulpy fruits such as mango, banana, papaya and guava with sugar and preservatives followed by drying at 70°C to a moisture level of about 15%. The product wrapped in cellophane and sealed aluminium foil (0.02 mm)—polyethylene (150 gauge) laminate were tested under hot-dry conditions at Jodhpur and hot humid climate of Tejpur. The mango bars remained acceptable for a minimum period of one year and banana bars for about 6 months under field conditions at both Jodhpur and Tejpur. The fruit bars have also stood the test of the preferences of the crew of first and second Indian expeditions to Antarctica.

6. Conclusion

The country has developed excellent R & D capabilities in the Defence Food Research Laboratory and the CFTRI, Mysore for meeting the defence food needs. These organisations have been functioning in close collaboration complementing and sharing each other's expertise and facility. With these two institutions working at Mysore, Indian armed Forces can be sure of obtaining the R & D services to meet their food and nutritional needs.

References

1. Annual Report, CFTRI, Mysore, 1960, p. 43; 1962-63, p. 35-36, 66, 69, 88; 1971, p. 45; 1969-65, p. 15.
2. Iyengar J.R., Bhatia B. S. & Lahiry N. L., *Indian J. Technol.*, **1** (1963), 43.
3. Iyengar J, R., Ramanathan P. K., Soumithri T. C. & Sripathy N. V., *J. Fd Sci. Technol.*, **6** (1969), 184.
4. Srinivasan M., Kapur O. P., Krishnamurthy K. S. & Anandaswamy B. and Raju P. V., *Res. & Ind.*, **8** (1963), 321.
5. Bhatia, B. S., Nair K. G. & Girdhari Lal, *Defence Sci. J.*, **11** (1965), 5, 14, 43.
6. Rao N. A. N. & Vijayaraghavan P. K., *J. Nutr. Dietet.*, **3** (1966), 75.
7. Rao N. A. N. & Vijayaraghavan P. K., *J. Nutr. Dietet.*, **3** (1966), 851.
8. Nanjundaswamy A. M. & Siddappa G. S., *Fd Sci.*, Mysore, India, **9** (1960), 211.
9. Nanjundaswamy A. M., Saroja S. & Radhakrishnaiah Setty G, *Canning of Drinking water*, paper presented at CDSO-FSG Meeting, India, 1975.
10. CFTRI Information Brief, Process Code No. AP-027 and 034.

11. Baliga B. R., Sripathy N. V. & Lahiry N. L., Proceedings of Symposium on Proteins, CFTRI, India, 1961, p. 335.
12. Kadkol S. B., Dhanraj S., Govindarajan V. S. & Baliga B. R., *J. Fd Sci. Technol.*, **17** (1980), 146.
13. CFTRI Information Brief, Process Code No. AP-039.
14. Jayaraman K. S., Arya S. S. & Vijayaraghavan P. K., in Proceedings of Symposium on Status and prospects for Confectionery Industry in India, Organised by AFST, India, CFTRI, Mysore, and ICMA, at Mysore, 1979, p. 15.

Hunger does not breed reform, it breeds madness and all the ugly distempers that make an ordered life impossible.