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REVIEW PAPER

Convenience Foods for Defence Forces Based on Traditional Indian Foods

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ABSTRACT

This article reviews the traditionally used food items vis-a-vis convenience foods developed by the Defence Food Research Laboratory (DFRL), Mysore, during the past three decades keeping in view the quality requirements (QRs) of the Defence Forces. Simultaneously, information has been provided on the kind of processing technologies used that any entrepreneur becomes aware of the infrastructure required to produce these commercially to meet the demands of the Army Purchase Organisation (APO) with DFRL know-how. The information provided will also be of immense value to APO in planning the convenience foods requirement and their inclusion in packed rations for special tasks and missions.

1. INTRODUCTION

Food, a basic need to the humanity, sounds all the more audible for the Services serves as the priority concern for Defence Personnel, supposed to be of prime importance for Defence Supplies. Traditional food reflects on the age-old system of using the foods, while Defence use speaks of specific requirements based on logistic situations and convenience dictates a minimal handling by the consumer before consumption. A combination of three different facets for meeting partial need of the Services food requirements is of prime concern. Shasrabuddhe[1] has reported the modalities of procurement and distribution of food in the Armed Forces; however, he has not included the convenience foods. An attempt has been made to review the present situation so that the Army Purchase Organisation (APO) is fully informed to meet the needs of all the cadres faculty of the Services in general and the jawans, in particular.

2. TRADITIONAL FOODS

Traditional foods started with the inception of tradition and probably with the creation of the universe. The tradition dates back to *Aryan* civilization, followed by *Harappan*, *Vedic* and later Hindu culture combined with other cultures of the country and food habits also followed the same pattern. Barley was the major grain eaten by *Aryans*, followed by apupa, lajah, soma juice and rice. Wheat had entered in *Yajurveda* period. Similar pattern was observed in other classes of foods. A historical perspective of Indian food practice is well documented by Achaya[2]. As per cosmic moral cycle, the food is not simply meant for bodily sustenance, but should be taken for the harmony of the eater, food and the universe. *Prasad*, the left over food after offering to God is considered as the pure essence and maintains human's spirituality, imparts good health, sound work and success in life[3,4]. Thus, traditional food made the beginning from God's food as per the *Vedic* literature[5] and was further developed with modifications along with the scientific approach, cultural habits, leading to slight differences in the food habits of people residing in different parts of the country. Varied weather conditions, agronomical status and nature's blessing of selective agricultural produce, resulted in differences in the traditional

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Table 1. Indian traditional foods of common origin vs processing methods and calorific value

Processing method	Calorific value/100 g (Wet weight basis)
Cooking	
Kheer rice	141
Kheer rice with green gram *dhal*	267
Kheer rice with bengal gram *dhal*	267
Sweet *pongal*	285
Pulav vegetable	300
Ghee rice	223
Khichidi/savoury pongal	170
Lemon rice	230
Vadi pulav	230
Concentration	
Burfi	409
Coconut *Burfi*	400
Halwa	
Atta halwa	263
Khesari halwa	236
Toffee	
Chocolate	464
Coconut	429
Frying	
Ompudi	444
Paapari	444
Vada	440
Fried *dhals*	450
Gulab jamun	387
Jelebi	494
Bhaddurshah	485
Rava ladoo	464
Godam pakora	163

food patterns in different parts of the country. Though foods are classified into three major groups as energy yielding, body-building and protective, it reflects on the cereal, sugar, lipid-based products for energy; protein rich foods (meat, fish, eggs, pulses, nuts, etc.) for body-building and vitamins and minerals-rich foods (green leafy vegetables, fresh fruits, milk, etc.) for the body protection and proper functioning of the physiological mechanisms in the body. But all processed foods will have only one of the above groups as the major ingredient with small supplements of the other two. In India, cereals such as rice, wheat form the staple food followed by *jowar*, and *Ragi*. Presently, more than

Table 2. Processing methods for traditional foods

Processing method	No. of traditional foods (regionwise)			
	North	South	East	West
Cooking	43	14	5	11
Concentration	8	3	1	5
Frying	30	8	4	14
Drying	10	2	4	3
Roasting	2	2	4	4
Baking	2	4	2	4

250 traditional foods based on staple cereals are in use. The methodology of preparation and nutritional values of the foods based on rice, wheat and a few legumes is well documented by Swaran Pasricha and Rebello[6]. About 15 per cent of these are used commonly throughout the country (Table 1). The processing methods mainly confine to cooking, steam cooking, frying, shallow frying, roasting, baking, sun drying and salting. The processing methods adopted in the four regions of our country for the preparation of traditional foods are shown in Table 2. Relatively, southern region of the country rate the highest in number of recipes.

Movement of people from place-to-place has given an opportunity to the people to modify their food habits. However, the major limitation is the short shelf-life of foods. Frying medium varies with the region and the shelf-life of the fried products vary depending on the unsaturated oil used. Today, the preservation of these foods is a necessity due to need-based logistic requirements of quality food by the Defence personnel. Also, the requirements of civilians for high quality, ready-to-eat foods of traditional nature with modern technological applications have become a necessity, both from the economy point of view and to reduce the losses of seasonal agricultural produce. Preservation of traditional foods either in ready-to-eat form or by canning of the products has achieved considerable success[7-16].

3. FOOD REQUIREMENTS OF THE DEFENCE PERSONNEL

Food, a basic need, plays an important role in keeping the Armed Forces personnel in fighting fit condition. The foods satisfying the Indian palate and the dietary habits are generally preferred. The processed food products are ideally suited to withstand

the various climatic conditions from the scorching heat of Rajasthan desert to sub-zero temperatures of Himalayas and to hot-humid conditions of Assam. The various factors like the nutritional status of the product, long shelf-life, reducing cooking time, suitable packaging for the required shelf-life, as well as withstanding the transportation hazards, lightweight packs vis-à-vis quality of the product pertaining to the sensory attributes fall under the umbrella of Defence quality requirements (QRs).

Besides these, depending on the operational tasks to be carried out, the ration scale in terms of the calorie requirements has to be stipulated to achieve the successful performance of the personnel during field operations. Diverse food patterns for land, sea and air operations demand a specific requirement based on logistics. Thus, the Defence requirements of food are specific. Logistics demand that these foods should provide convenience, light in weight, have longer shelf-life and acceptable quality as well as these should be easily available commercially.

The Armed Forces are the biggest consumer of processed foods and approximately 13 thousand tonnes of processed food is used annually. They have to subsist mainly on pack rations during operational situations. The convenience foods either in ready-to-eat form or precooked, dehydrated form (which require a few minutes of cooking in boiling water) are most suitable. In the early periods, prior to independence, two types of rations, i.e. field rations and peace rations were in use. Peace ration included rice, *atta*, *dhal*, potatoes, sugar and salt, while field rations had *ghee*, tinned milk, onions and fresh vegetables. In addition, provision for meat was made on alternate days.

Subsequently, attempts were made to design pack rations based on beaten rice, canned rice, canned curried vegetables and *dhals*. Also, considering the dietary standards of Indian Council of Medical Research, Defence Institute of Physiology & Allied Sciences, and recommendations of expert committees, etc. ration scale for the Army, Navy and Air Force, providing 3700, 3900, and 3900 cal per man per day, respectively were recommended. For troops at high altitudes (above 2743 m), ration scale providing 4300 cals was recommended. Separate ration scales for Jammu and Kashmir and north-eastern area were recommended. Further development lead to the designing of 5-man compo-pack ration, with the inclusion of biscuits, sugar, canned products, i.e. vegetable curried, precooked *dhal*, mutton curried and pickle. Besides these, whole milk powder, tea, salt and cashew nuts were also included. Though the ration pack was nutritionally adequate, it suffered due to the lack of popular traditional foods in preserved form, and thus became less popular. However, during long patrolling, exercises or combat operations, the need for the pack rations still remained a problem.

With the advancements in technological methods, Defence Food Research Laboratory (DFRL), Mysore, has contributed considerably to develop suitable technologies for preserving traditional Indian foods in lightweight flexible packages so that pack rations could be designed based on such items to meet the nutritional requirements of the Defence personnel for operational situations and this also paved the way for providing variety foods suiting to their taste. These efforts led to the development of convenience foods based on cereals, pulses, fruits and vegetables with a long shelf-life in flexible packs.

The main specifications for the supplies to the Armed Forces are:

- The foods should be ready-to-eat in nature which may require just warming before consumption.
- These should be precooked and dried which need simple reconstitution in boiling water.
- These should satisfy the Indian palate and should be akin to their taste and dietary habits.
- The product should be stable over a wide range of temperatures, i.e. from 45 to -40 °C.
- Products should be packed in suitable packaging material to withstand the environmental conditions and transportation hazards.
- The contents in one-man compo-pack (total weight 1 kg) should provide 4000 cals. But compact packing with less space and less

weight is desirable.

- The ration pack should be nutritionally adequate, should provide required calories, vitamins, (specially vitamin C), minerals and fibres for the proper roughage.
- Product should be calorie dense but light in weight.
- The flexible packets are preferable to rigid containers.
- Easy opening of the packets is desirable
- Varieties having both vegetarian and non-vegetarian dishes should be provided.

3.1 Convenience Foods

Convenience foods are a class of foods which impart convenience to the consumers by way of little or no requirements of major processing or cooking before their consumption. Convenience foods just require a minimum handling, such as mild heating/ warming for ready-to-eat products or rehydration in hot/cold water for dehydrated foods. However, the complexity of convenience foods lie in their composition, shape, size and method of processing. Viewing this heterogenecity, transformation of the product into a simpler form with minimum handling prior to consumption speaks of the skill of the technologist. However, the major thrust is to provide convenience by way of saving the cooking time and labour in the kitchen. In addition, for Defence supplies, the additional convenience for long shelf-life, reduction in weight, good quality, easy commercial availability are of prime concern. Convenience foods can be broadly classified into two groups, viz., ready-to-eat foods and ready- to-reconstitute foods (Table 3).

3.1.1 *Ready-to-Eat Foods*

Over the decades, with the treasure of traditional foods background, many of the foods have been converted into convenience form of processed food under ready-to-eat foods. The shelf stable are canned foods with stability of one year and fried foods with stability of a month, which can be extended to 3-4 months by the incorporation of antioxidants. The moist fried products have the limitation of 1-2 days shelf-life and undergo microbial spoilage because of high moisture (15-30 per cent) in the product. Baked, steam-cooked products also have a short shelf-life because of high moisture content (25-45 per cent) in the product. However, *chapaties*, *parottas* and *puris* have been preserved by using fungistatic agents[6,8]. The retort pouch foods which undergo thermal processing in inflexible packs have a shelf-life of 6 months[17]. The puffed/roasted products can be consumed as such or with shredded *salad* vegetables after adding spices. Extruded snacks of traditional nature need to be fried (sandige, *papads*, peni), while mechanically extruded snacks can be consumed as such with spicing. Besides the commercial products already available, a few more, such as *Chutneys*, intermediate moisture (IM) fruits are added under fruit and vegetable products. A limited non-vegetarian foods are also available either in canned form or retort pouch food form with a shelf-life of 12 and 6 months, respectively. The processing methods adopted for these foods are canning, frying, concentration, baking, puffing, extrusion, retorting, incorporation of chemical preservatives and fermentation. The shelf-life variation, as expected, will be based on the type of processing used and the packaging employed. Quality deterioration reactions during storage of preserved foods occur based on the composition of the food. However, some products developed by DFRL have been commercialised and a few are due for commercialisation, the technology transfer of which has been made to the private entrepreneurs by DFRL. A lot of scope exists for future development in the preservation of a few more foods with a long shelf-life. The trend in convenience foods in general[18] and cereal-based products, in particular,[19,22] has been discussed. The food preservation by hurdle technology is the developing field in the ready-to-eat foods and has been reviewed by Leistner and Gorris[23]. The shelf-life of *dhal* patties and *junnu* (a milk-based product) could be extended to 7-10 days by hurdle process[24].

3.1.2 *Ready-to-Reconstitute Foods*

Ready-to-reconstitute foods normally in dry form need to be mixed with water before consumption. Instant mixes are the most convenient stable foods which require reconstitution in boiling water with simmering for 2-10 min, depending again on the

Table 3. Profile of convenience foods

Ready-to-eat foods

Canned products	Fried products	Moist fried products	Retort foods products	Baked/ steamed products	Puffed products	Fruit & vegetable products	Hurdle technology foods
Upma	Pulses/*dhals*	*Samosa*	*Halwa*	*Chapaties*	Rice	*Murabbas*	IM fruits
Halwa	Groundnuts	Cutlets	Peas	*Puris*	Sorghum	*Jams*	*Kheer*
Parottas	Potato chips	*Vada*	Potato curry	*Parottas*	Ragi	Pickles	Coconut gratings
Idli	Banana chips	*Pakoda*	Fish *masala*	*Idli*	Extruded	*Chutneys*	*Upma* mix
Kheer	Sorghum flake	*Kachori*	Mutton *biryani*	*Dosa*	foods	IM Fruits	*Halwa* mix
Pulav	Beaten rice	*Bajji*	*Aaloo choley*				*Chapaties*
Peas *Paneer*	Chakkuli	*Bonda*					*Dhal* patties
Curry	*Khodabale*						*Junnu*
Fruits in syrup	*Murukku*						
Vegetables in brine	*Boondi Sev*						
Fish mutton curry	Tengol						
	Papads						
	Muchore						
	Shakarpara						
	Namakpara						
	Laddu						
	Sweet *boondi*						
	Jelebi, Jhangir						

Ready-to-reconstitute foods

Instant mixes be heated with boiling water)	To be fried, baked or cooked	Fruit products (to
Bisibele bhath mix	*Janum* mix	Squashes
Pulav mix	Cake mix	Cordials
Khichidi mix	*Dosa* mix	Neetars
Choley mix	*Idli* mix	Fruit juice concentrates
Sambhar mix	*Rawa Idli* mix	
Rasam mix	Noodles	
Halwa mix	Breakfast cereals	
Upma mix		
Spiced *dhal* mix		
Spiced green leaves-rice mix		
Avial mix		
Tam-rice mix		
Urd-rice mix		
Chutney mix		
Lemon rice mix		

type of processing and the composition of the food. Fruit juice powders just need the addition of cold water and mixing for reconstitution before consumption. In general, these are precooked and dehydrated foods which need rehydration later to bring them into cooked form, ready to be eaten. However, keeping in view the sensory attributes of some foods, such as textural characteristics of *dhal*, rice, vegetables; flavour characteristics of spices; colour components retention during processing and reduction of cooking time before consumption, the chemical preservative(s) treatment and mode of dehydration is adopted. The application of processing method is itself an art clubed with scientific background. In this

Table 4. Profile of processed convenience foods for commercial manufacture

Food	Method of processing	Processing requirement before consumption
Bisibele bhath mix*	Dehydration & formulation	Heating in boiling water for 5 min
PD *pulav* mix*	Dehydration	Heating in boiling water for 8 min
PD *khichidi* mix*	Dehydration	
Halwa mix*		Heating in boiling water for 3-4 min
Upma mix*		
Kheer mix	Dehydration & formulation	Heating in boiling water for 3-4 min
Tam-rice mix	Dehydration	Heating in boiling water for 5-6 min
Urd-rice mix		
Chutney mix		Mixing in water and let stand for 3 min
Sambhar mix	Flaking & dehydration	Heating in boiling water for 3-4 min
Spiced *dhal**	Flaking & dehydration	Mixing in hot water at 80 °C & let stand for 2 min
Avial mix	Dehydration	Heating in boiling water for 10 min
Choley mix	Dehydration	Heating in boiling water for 8-10 min
Dhal-methi mix	Flaking, dehydration and formulation	Heating in boiling water for 2 min
Dhal-methi snack	Dehydration & spicing	
Kadhi mix	Spray drying	Heating in water for 2 min
Soup mix	Dehydration	Heating in water for 3-4 min
Rava idli mix	Dehydration	Mixing in curd and steaming
Omlette mix	Spray drying	Mixing in water and spread on *thawa*.
Scrambled egg mix	Dehydration	Heating in water for 3-4 min
Preserved *chapaties**	Chemical preservation and baking	Nil, warming if needed
Puff & serve *chapaties*	Chemical preservation and baking	Putting on the flame for few seconds for puffing
Retort processed *suji halwa**	Thermal processing	Nil, warming if needed
Retort processed peas potato curry*	Thermal processing	Nil, warming if needed
Retort processed *Aaloo choley**		
Retort processed fish *masala**		
IM fruits	Hurdle technology	
Fruit juice powder**	Dehydration	Mixing in cold water
Mushroom soup**		Mixing in hot water at 70 °C & keeping it aside for 10 min
Shrimp dried		
Chicken *pulav*		

* Commercialised
** High costing technology products

direction considerable contribution has been made by DFRL[25-30]. The second group of foods needs a little more cooking in terms of baking of cake mix, frying regarding *jamun* mix, steaming with reference to *idli*, *dosa* mix, noodles, and incorporation of milk and flavours regarding breakfast cereals.

The commercial manufacture of these types of foods is on the increase for the past two decades but at a very slow pace. A few of the products, such as *jamun* mix, *rava idli* mix, noodles, breakfast cereals and fruit products are accepted well but the staple cereal-based products may require a different marketing strategy. The consumers may psychologically not realise the convenience in terms of savings of labour, materials, cooking gadgets and are financially not willing or not in a position to compromise the cost-convenience ratio. However, the technology for most of the instant mixes are available with DFRL. A few products, such as *halwa* mix, *upma* mix, *bisibele bhath* mix, *pulav* mix, *khichidi* mix, *kheer* mix and spiced *dhal* mix are manufactured commercially. Particularly, the commercialisation of cereal-based traditional foods like instant mixes needs the attention of the industrialists.

3.2 Diversity of Palate & Quality Requirements

The Defence personnel are hailing from different regions of the country and hence QRs justify the requirement of a variety of foods satisfying the psychological needs, sensory acceptance besides satisfying the basic needs of long shelf-life, easy-to-cook and lightweight products. Considering the weather terrain's too, ready-to-reconstitute foods serve as most ideal choice. As the altitude increases, cooking problems also increase, thereby the choice of instant mixes increases. Staple cereals and pulses-based instant mixes, specifically rice, *tur dhal* mixes are preferred for routine rations. However, lightweight of the pack is also an important criteria at high altitudes. The instant mixes, such as *bisibele bhath* mix, spiced *dhal* mix, *chutney* mix, spice rice mix, *sambhar* mix, vegetable *pulav* mix, etc. which just reconstitute in hot water around 80 °C, is desirable. For sweet meal, substitutes like *kheer* mix, *suji halwa* mix may be preferred for regular use. The other mixes which need to be reconstituted in boiling water are also acceptable.

In ready-to-eat foods, canned foods of commercially available samples, such as canned fruits in syrup, canned vegetables in brine, fish products, etc. are being procured at present. Preserved *chapaties*, retort foods, IM fruits along with instant mixes are being supplied for various expeditions, viz., mountaineering, sailing, antarctica, etc. Preserved foods suitable for mountaineering expeditions with the requirement of 2-3 months shelf-life is reviewed[31]. Recently, mini compo-pack rations providing tea, breakfast, meals of the day with 1500 cals, with a lightweight of less than 1 kg have been supplied to the Army to the tune of 1.5 lakh by DFRL. Defence Purchase Organisation (DPO) has the wide choice of a variety of foods for inclusion in pack rations.

Considering the treasure of knowledge of traditional foods, development of convenience foods and technological advancement, the progressive development in the direction of marching towards achievement is at a very low pace. Lot of scope still exists for further developments in this area. Also, these convenience foods are being marketed mainly in small-scale sector and a few products in industrial sector. A systematic approach is needed for better distribution to the consumer based on their needs. The processed foods with the methods of processing that are ready for implementation with technology transfer by DFRL, and the present commercially manufactured foods are given in Table 4 for the best utilisation of the industry, for defence and civil sectors. Such developmental activity in convenience foods helps in providing a variety of foods for introduction to the Army supplies, specially personnel deployed at high altitudes and at difficult terrain/conditions.

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REFERENCES

Shasrabuddhe, Y.D. Procurement, storage and distribution of food stuff in the Armed Forces. *Def. Sci. J.*, 1984, **34**, 149-54.

2. Achaya, K.T. Indian food–A historical companion. Oxford University Press, Delhi, 1994.

3. Khare, R.S. The Hindu health and home. Vikas Publishing House Ltd., India, 1976.

4. Khare, R.S. Culture and realisty. Indian Institute of Advanced Study, Simla, 1976.

5 Achaya, K.T. Foods of the Gods. *In* Indian food historical companion. pp.28-40.

6. Pasricha, Swaran & Rebello. Common Indian recipes and their nutritive value. Indian Council of Medical Research, Hyderabad, 1991.

7 Nagarathnamma, Krishnamurthy & Siddappa, G.S. Canning of rice. *J. Food Sci. Technol.*, 1965, **2**, 128-31.

8 Kameshwar Rao, G.; Malathi, M.A. & Vijayaraghavan, P.K. Preservation and packaging of Indian foods – *chapaties*. *Food Technology*, 1966, **20**, 94-98.

9. Mathur, V.K.; Siddhaiah, C.H.; Bhatia, B.S. & Vijayaraghavan, P.K. Canning of conventional Indian meals for Defence requirements. *Indian Food Packer*, 1973, **27**(2), 46-51.

10. Kodkol, S.B. Ramanathan, L.A.; Pitchamuthu, P. & Bhatia, B.S. Canning of *idlis*. *Indian Food Packer*, 1973, **27**(3), 17-19.

1. Kodkol, S.B.; Ramanathan, L.A.; Das, S.A.; Pitchamuttu, P.; Gopinathan, V.K. & Bhatia, B.S. Convenience mixes based on dehydrated mutton and vegetables. *Indian Food Packer*, 1973, **27**(3), 15-16.

12. Kannur, S.B.; Premavalli, K.S.; Arya, S.S.; Parihar, D.B. & Nath, H. Studies on flavouring compounds of *chapaties* – carbonyls. *J. Food.Sci. Technol.*, 1974, **11**, 5-9.

13. Arya, S.S.; Premavalli, K.S. & Parihar, D.B. Precursors of carbonyls in *chapaties*. *J.Food Technol.*, 1976, **11**, 543-47.

14. Arya, S.S.; Vidyasagar, K. & Parihar, D.B. Preservation of *chapaties*. *Lebensm. Wiss. Technol.*, 1977, **10**, 208-13.

15. Ghosh, K.G.; Krishnappa, K.G.; Srivatsava, A.N.; Eapen, K.C. & Vijayaraghavan, P.K. Inpack processing of ready-to-eat foods in indigenous flexible packaging materials, Part III :Studies on newer packaging materials capable of withstanding the processing temperatures. *J.Food Sci. Technol.*, 1979, **16**, 198-201.

16. Premavalli, K.S. & Arya, S.S. Physical and chemical changes during roasting of semolina. *J. Food Technol.*, 1983, **18**, 469-79.

7. Jayaraman, K.S. Development of instant foods and emergency survival rations for Service use. *Def. Sci. J.*, 1984. **34**, 161-72.

18. Arya, S.S. Traditional foods–Some recent developments. *Def. Sci. J.*, 1984, **34**, 173-82.

19. Premavalli, K.S. Present scenario on the preservation of traditional foods. Paper presented in the symposium on Traditional Foods, 5-6 November 1997. Food Science and Nutritional Department, Univ. of Mysore.

20. Arya, S.S. Convenience foods – emerging scenario, *Indian Food Ind.*, 1992, **11**(4), 31-41.

21. Premavalli, K.S. Cereal products–emerging scenario, 1995. Paper presented at the symposium of AFST(I), 10 June 1995. Hotel Ashoka, Bangalore.

22. Premavalli, K.S. Quality assurance of processed cereal and cereal products. Paper presented at the symposium on Food Quality Assessment, 14 February 1997. UAS, Bangalore.

23. Lothar, Leistner & Leon, G.M. Gorris. Food preservation by hurdle technology. *Trends Food Sci. Technol.*, 1995, **6**, 41-45.

24. Premavalli, K.S.; Madhura, C.V.; Mohan, M.S.; Srihari, P. & Arya, S.S. Application of hurdle technology for traditional–based cereal products. Paper presented at the symposium on Hurdle Technology Applications, 29-30 December 1997. DFRL, Mysore.

25. Jayaraman, K.S.; Ramanuja, M.N.; Venugopal, M.K.; Leela, R.K. & Bhatia, B.S. Studies on preparation of intermediate moisture pineapple. *J. Food Sci.Technol.*, 1975, **12**, 309-12.

26. Ammu, K.; Radhakrishna, K.; Subramanian, V.; Sharma, T.R. & Nath, H. Storage behaviour of freeze–dried juice powders. *J. Food Technol.*, 1977, **12**, 541-53.

27. Arya, S.S.; Premavalli, K.S.; Siddhaiah, C.H. & Sharma, T.R. Storage behaviour of freeze–dried watermelon juice powder. *J. Food Technol.*, 1985, **20**, 351-57.

28. Premavalli, K.S.; Vidyasagar, K & Arya, S.S. Studies on traditional Indian Foods–part II: Development and storage stability of *upmam* mix. *Indian Food Packer*, 1987, **39**, 23-30.

29. Arya, S.S.; Vidyasagar, K. & Premavalli, K.S. Studies on development, storage stability and acceptability of Insta nutro cereal mix. DFRL, Mysore, 1989. Report No. SI-P1-84/DFR-179.

30. Thakur, B.R. & Arya, S.S. Packaging requirement and storage stability of fried wheat snacks. *J. Food Sci. Technol.*, 1990, **27**, 76-80.

31. Premavalli, K.S. Preserved foods for mountaineering expeditions. Paper presented at the symposium on Mountaineering Food, 17 November 1996.

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