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FOOD TECHNOLOGY & NUTRITION—NEED FOR GREATER COLLABORATION WITH SPECIAL REFERENCE TO SOME MAJOR PROBLEMS OF DEVELOPING COUNTRIES

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Food technology, in relation to nutrition, has been discussed on several platforms, in different parts of the world. Some aspects of the subject were also discussed at the last International Congress of Nutrition held recently at Edinburgh While there is a growing realization that the two subjects are closely interrelated, and that the findings in one field can be applied with benefit, in the other, there are still schools of food technology which hold that, while the basic principles of nutrition have to be recognised, consumer appeal is far more important and that this should be given a high place even at the sacrifice of some of the nutritive value; if the consumer does not care for it, even a highly nutritious product cannot find any use. There are also nutritionists who are generally opposed to processing or who would agree only to some mild treatment; who argue that natural foods are generally superior to processed products and that the use of the latter should be discouraged as much as possible; that the use of materials like hardened oils, preservatives, antioxidants, spreaders, foam producers, colours, flavours and other additives which are incorporated by the food processor; pesticide and solvent residues, as also certain toxins and other injurious substances which may be present in the starting materials; as also infection, insect residues etc., as may be present in the finished product are only adding to the problems of the nutritionist There is a large amount of truth in both the points of view and it should be our attempt to effect a compromise. The object of scientific processing should be to provide food products with the necessary consumer appeal with maximum retention of nutritive value and no hazard to health. At the same time, the nutritionist has made allowance for certain classes of products like boiled sweets, chewing gums, certain types of beverages, liquors etc., which have consumer appeal, and which the users would like to have, though they may not have any growth promoting value. Several of the things which even the nutritionists themselves consume do not have any food value, but they also know if such products are harmless in moderate quantities and give satisfaction to the users, their usage need not be discouraged.

In some of the countries of the world, there is abundance of food of every kind and the people ordinarily consume a good and nutritious diet. There are, at the same time, much larger areas where there is not enough food or where the quality of the food consumed by a large section of the people is also poor. In combination with good food, which is also rich in protein, and various other food essentials, some added constituent which has no nutritive value and even contain a small percentage of deleterious constituents may not materially affect the health. On the other hand, the health of a population, which has to subsist at a low level of nutrition, may be adversely affected by such additives. This will naturally place an added responsibility on the food technologist in those areas. The food laws of the countries have been framed with the object of giving the different necessary guidance to the producer and, at the same time, to safeguard the interests of the consumer.

Objects of Food Technology

United States is today, perhaps the most advanced country in the study of nutrition. At the same time, it is also the most progressive in the application of modern food science and technology. The high status of food technology in that country can be appreciated when it is stated that the food industries to which it caters, constitute the largest single group of industries with an annual turn-over of over 60 billion dollars. The automobile industry which comes a distant second has a turn-over of less than 30 billion dollars. This enormous development has been possible with even what one may regard, as a specialised approach in relation to the needs of the consumers of that country. They have none of the problems which several other countries have to face and they have a large number and variety of materials, in abundant quantities, to draw upon. In a broader sense, food technology is even more comprehensive in its scope and may be listed under the following heads: i) to conserve the available food in the best possible condition with minimum loss of quality and maximum retention of nutritive value; ii) to make the food materials, as such, or in suitably processed forms, so that the consumer will be able to store them without deterioration and to use them, at convenience, with or without cooking; iii) to incorporate, nutrients, supplements and such other useful things that will enhance the nutritive value and the acceptability of the products; iv) to make use of low grade food materials and also to process and to enrich them so as to convert them into useful articles of food conforming to consumer requirement; v) to select potentially valuable food materials which, though containing some undesirable constituents, would still be valuable and vi) to standardise their preparation and processing so as to obtain clean and wholesome products. In all such programmes, the food technologist has to start with some knowledge of nutrition and apply modern science, through various disciplines, as also equipment and machinery, to assist him in his efforts. Physics, chemistry, biochemistry, microbiology, botany, zoology, plant physiology, entomology etc., all play their part in the basic studies and, together with these, use of various types of equipments and instruments, machine design and engineering have all got to play their part to give the necessary shape to a processing programme and to carry it to the stage of successful application. While the basic concepts may originate from a single person or a small group, whole teams of people have got to collaborate in executing any such programme. There are also problems relating to raw materials, storage of various accessories, packing, transport, marketing, distribution etc. all of which are important and each one of which will have a bearing on meeting the consumer requirement on the one hand and the price structure, turnover and profit on the other.

Storage of perishables

Over every part of the world and, particularly in the tropics, various types of perishable commodities become available, some times in very large quantities, during short seasons. A large part of the produce tends to perish quickly, and even what is sold, fetches a very low price to the producer. In certain seasons, the glut is so considerable that it does not pay even to transport the product to the market. This is particularly true of certain categories of fruits and vegetables and also of fish. The average loss through perishing in a country like India is about 35% of the total production, while the losses through nonsaleability especially of low grade products may be 90% or more. Two years ago, a considerable part of the mango crop of Uttar Pradesh in India was lost in this manner. Almost every year, a large part of the catches of fish are lost or at any rate, so spoilt that they can be used only as manure. Quite recently, a single catch near Mangalore in South India brought about 1.7 million mackerels and such a large quantity will naturally present a serious problem in the matter of storage and efficient utilisation. Such things happen in almost every country where there are not adequate facilities for storage or other type of quick preservation.

The nutritionists have been advocating the increased production and consumption of such classes of protective foods; the object of the technologist is to preserve them and to make them available at reasonable prices throughout the year. For many commodities frozen storage will be ideal, but for a number of others even ordinary cold storage or air-conditioned storage will extend the life and facilitate transport. At the present time, the major part of the available facility for freezing and frozen storage in India is used for prawns intended for export; while the limited cold storage facility, which is largely confined to North India, is used mostly for potatoes. India will require about 100 times the present cold storage facility for even some of the essential commodities which have a good storage life under such conditions.

As compared with the above, U. S. A. and also some of the European Countries have introduced frozen storage and transport on a gigantic scale. Starting from small beginning during the late forties, frozen storage and distribution of fresh and processed food including even bread has now become one of the major industries of U. S. A. accounting for a turnover of several billion dollars.

Side by side with the above, the food scientist has successfully utilised treatment with growth regulators to retard or to accelerate maturity depending on the requirement, to prevent sprouting during storage, and to regulate the size and colour in the case of fruits and vegetables. Hormone treatment has also been successfully applied to fish and other forms of life to improve the yield. The techniques of momentary heat treatment (blanching) to arrest biological changes and to control infection, the use of regulated gas storage with or without low temperature, precooling, application of fungicidal wax emulsions for skin coats, use of antiseptic wrappers have all been utilised successfully for fruits and vegetables. Indian workers have made several contributions in this field and they have also been applied on a large scale, particularly in the export of certain types of fruits, and especially, bananas. Blanching-cum-steeping preservation technique has been applied successfully in the case of arecanut, peas and other fruits and vegetables, without any deterioration of quality. The successful use of sugar cane wax for protective coats also originated from Indian effort. In the case of fish, silaging in the absence of air and in acid fermenting media has been successfully used in Scandinavia. Indian workers have recently demonstrated the use of ammonia as a preservative at ordinary temperatures without any adverse effect on the protein-value or the over-all nutritive value. Treatment with certain preservatives, antibiotics etc. have also helped to extend, the storage life, and the latter have been shown to be relatively harmless in the small doses that were used. More recently, different radiations have also been successfully used for sterilising and disinfesting certain classes of food materials without any adverse effect to the consumers.

Dehydration

Dehydration has been successfully used in the case of a variety of perishable foods. While the nutritive value has been largely preserved, there is still need for improvement in the quality of several dehydrated products, especially in respect of flavour Improvements are being steadily made and some dehydrated products have already been successfully marketed. In India, dehydrated peas have already become popular. Cauliflower, onions and a few other vegetables and fruits offer scope for the immediate future. If preservatives are to be fully excluded, there is need to improve the technique especially in the final stages and to suitably pack so as to avoid deterioration of colour and other desirable properties during storage. Accelerated freeze-drying can yield products of higher quality, but it is still rather expensive and can be applied, with prospects or useful return, only in certain classes of products and especially in times of emergency. While it would be easy to satisfy the nutritional requirements, the technologist has yet to evolve some new and improved methods for obtaining dehydrated products with maximum consumer appeal at minimum cost. Traditional sun-drying, with or without addition of salt, does have its uses

and, during recent years, the technologist has introduced several improvements, thus enchancing their acceptability and storage life.

In some parts of India, there is a common belief that some of the vegetables are more wholesome in the dried condition than in the fresh state. The significance of this in relation to nutrition would deserve some study.

Elimination of pests and pesticide residues

Over many parts of the world, the foodgrains including pulses, form the most important articles of bulk food. In India, the per capita consumption of cereals or millets is of the order of 14 oz and in order to meet this requirement and to maintain some buffer stocks, the country has to import about 3.5 million tons per annum. The current production of all classes of grains and pulses in the country is, estimated to be of the order of 80 million tons. The total annual losses on the field, prior to harvest, and during storage after harvest is stated to be of the order of 35-40% in the case of some crops and about 25% in others. The losses in the field are due to birds, squirrels, rats etc., while during storage, it is chiefly due to rats, insects and fungi. In a recent experiment conducted in Tanjore District, it was reported that loss of rice due to rats alone may be as high as 25%. Complete eradication of such pests has been achieved in some countries and if such methods can also be applied in India, the present deficiency can easily be covered. At the present time, only central government stocks amounting to 1-1.5 million tons, as also stocks in the warehouses, are protected against different pests during storage and the losses are reported to have been reduced to less than 1%. Through the efforts of the Central Food Technological Research Institute, some improved methods have been applied for the storage of stocks held by state governments, defence forces and to some extent, also to the stocks held by merchants. The technique of using a mixture of methyl bromide and ethylene dibromide (Durofume Process) as developed at Mysore, has cut down the cost to about one-eighth of what is with a mixture of ethylene dichloride and carbon tetrachloride (Edct) as generally adopted The requirement of the former for 1000 cu ft of grain in bags is of the order of 2 lbs and that of the latter, 35 lbs. The spraying of another formulation (Durobase) either on the bags or on polythene sheets covering the bags eliminates reinfestation and also discourages attack by rats. The saving, thus effected may be of the order of 10% or more depending on the grain and the environmental factors The pesticide residue is negligible and generally less than one-tenth of the permissible limit. Among the direct additives to foodgrains, malathion and also phosphine generating compounds have been found to be useful, and these leave residues which are quite harmless. Activated clays and calcium phosphate have been found useful either as direct additives to the grains or as surface coats to bags.

While there is a large amount of literature on the hazards from certain types of pesticides, there is also ample evidence to show that there are other forms which are relatively innocuous. There is also persistent endeavour to discover new chemicals and new systems of treatment which would be highly efficient and at the same time absolutely safe to the user and the consumer. On the other hand, it will be a negative attitude to discourage or to stop such treatments. Insect infestation, if left unchecked, can not only reduce the available quantity of food, but also adversely affect its nutritive value, besides making it unacceptable to the consumer. Considering the difficult food position in many of the countries, there is a strong case for gradually eliminating all forms of life that eat away or destroy food, that is produced for human consumption. Several countries are engaged on systematic research in this direction so as to ensure the maximum conservation of food for mankind.

Preservation of some of the tubers and root crops even for short periods (2-3 days) has long been a problem. In the case of topioca, hypochlorite has been very effective in protecting it for fairly long periods (10-15 days) against fungal and bacterial spoilage. In such cases, the

residue is negligible and even that is harmless.

Nutritional and economic advantages of bulk production and distribution of processed foods

The contributions of food technology to preservation of food by processing are too well known to require much elaboration. Although the discovery of cooking food goes back to the very early days, the application of the technique in such a way as to ensure permanent preservation of a cooked product, is only about 150 years old and started with the contributions of Nicholas Appert during the Napoleanic wars. During the years that followed, and especially during the past few decades, there have been tremendous improvements in the technique with the result that some of the processed products have better flavour, taste and digestibility than even the fresh foods. In fact, some of the fruits and vegetables used for processing are quite sour, bitter or otherwise unpalatable in the raw state. A recent introduction has been the continuous spin-cooker which finishes the operation in about one-eighth of the normal time with maximum preservation of the original quality. The raw materials are specially chosen or produced and the pretreatment so arranged that the leading manufacturers have generally no need to add any preservative. The techniques have been extended to a variety of pre-cooked and ready-to-serve foods of every kind and the production is organised on such a gigantic scale and the products are sold with a small margin of profit such that in quite a number of cases, it is cheaper to buy them than to prepare such products in the home.

In countries like India, the cost of additives like sugar, containers, packing and transport are considerably more than in other countries. This, combined with the limited turn-over, necessitates a high retail price, thus discouraging the use of such products, even by the middle class people. At the same time, there is one direction where bulk processing may prove to be economical and help to reduce waste. In many of the western countries, different food preparations are processed in bulk and distributed through restaurants which are able to offer a large variety of low priced dishes to the consumers. This procedure was further extended during the second world war when in U. K. for instance, the national restaurants provided all the meals which people could buy and either consume in the spot or take them home. It is worth considering whether such a procedure can be introduced with benefit to the consumers at any rate in some of the bigger cities. Bulk cooking and processing, with suitable pressure cookers is much more economical in fuel and involves less wastage of food material than doing the same thing on a small scale in individual homes. If this can be successfully applied, it can be easily extended to the improvement of the nutritive value of such foods so as to ensure the maximum benefit to the consumers.

Pre-cooked, dehydrated foods have a variety of uses. A large amount of work in this line has been done at Mysore with particular reference to the use of such foods in emergency and at high altitudes. Such products can be made in various forms, but they may find the maximum acceptance in forms in which they can be easily reconstituted and will appeal best to consumer taste. If the bulk processing can be done at reduced initial levels of moisture, the cost of subsequent dehydration may be reduced to a minimum.

There is increasing amount of consciousness, especially in the case of ready-to-use foods, that in addition to ensuring the maximum retention of the original nutritive value some of the deficiencies which exist should also be made up, without sacrificing the consumer appeal.

Improvement of quality and nutritive value of low grade food materials

A food material may be regarded as being of a low grade, if, for example, it is predominently starchy as in the case of tapioca (cassava); if it is associated with a large amount of fibre or undesirable colouring or odoriferous substances, bitter principles, etc. Examples of the latter will be some of the millets, a variety of leafy materials, brans of different kinds, some of the oilseed meals such as those from mus-

tard, rape, safflower, niger, linseed etc. and certain varieties of pulses, beans etc. Once the undesirable constituents are removed or in the case of gross deficiency, certain supplements are incorporated, these would become excellent articles of food and thus add to the food resources of the world. A good example of the contributions of technologist in this field would be the processing of tapioca, which the nutritionists all over the world, have condemned as being very poor article of food because it contains practically no protein (0.5—1.5% depending on variety). It also contains a cyanogenetic glucoside which is fairly high in some varieties. At the same time, it is the only type of crop that can be easily raised under certain types of conditions and which is also a much heavier yielder than grain crops. The technological work which was largely done at the Mysore Institute, has shown that the root can be preserved in a good condition and can be i) made to yield an attractive white flour which is free from the glucoside and can be used for a variety of food preparations in the same way as corn flour popularly known in some parts of India as the American flour; ii) enriched with other protein-rich materials to obtain a good quality edible flour with a protein content of about 14% (Mysore flour); iii) used for several food preparations, besides production of starch, glucose, dextri-maltose, dextrins etc.; iv) incorporated with wheat, groundnut flour etc. to extend the supply of wheat to the extent of 25% without sacrificing the nutritive value or consumer appeal (Paushtik Atta); v) processed with a protein-rich material like groundnut flour to obtain a variety of paste goods (macaroni products) with any desired shape and size and thus to partly replace cereals in the dietary of the people. While the basic concepts in respect of such uses have been established, the technologist has still an uphill task in carrying his findings to the stage of large-scale application. To take an instance, the colour of the macaroni product has yet to be improved; the product should be made hard and washable prior to cooking; the cooking quality should fully correspond to that of a cereal and involve minimum gruel loss; the product should withstand changes in humidity and permit handling, packing and transport in the same way as grains. Many of the problems have already been solved, while some others are still awaiting solution. It will thus be seen that while the nutritional aspect of making up of deficiencies can be easily attended to, the technological part of producing acceptable products out of such formulations is much more difficult and will require the concerted efforts of large teams for several years. At each step in processing, one has to be certain the nutritive value is not seriously affected.

Instances of the above type can be multiplied. The nutritionist has demonstrated that the proteins present in some of the leaves and grasses are comparable, either singly or in combination, with good quality animal proteins like those in milk. The attendant problems of presenting these proteins in a manner acceptable to the consumer have not yet been solved. As a result of this, a whole class of protein-rich materials remains unutilised.

Improvement of the digestibility and better *utilisation of certain classes of food materials*

The contributions of food technology towards the improvement of the acceptability and facilitating larger utilisation of certain food materials have been extensive and very valuable. The modern food technologist cannot claim credit for all these, and many of the basic findings go back to the early days when they were found empirically and on the basis of long experience. The process of making leavened bread, cheese, smoked products like bacon, cured fish products, different products of the sausage type, predigested products out of soya bean, wheat and rice, application of alcoholic, lactic, acetic and such other fermentations, for preservation and other uses, use of beneficial yeasts and moulds etc.—all of these date back to the early days and some of them deserve to rank as outstanding discoveries of mankind. The South Indian discoveries of parboiling rice to improve its milling quality and better retention of vitamins, the *Iddli* fermentation which is brought about by a mixture of rice and a particular gram (*Phaseolus*

mungo), one providing the body and the other the fermentation and the medium to hold the gases and even the finding that such a product is best prepared only by steaming deserve to rank in the same class. Many countries have indigenous methods of preparing paste goods, but the main credit for discovering macaroni products based on wheat semolina should go to the Italians. This, again is a very important finding During recent years, the discovery of the uses of bitter and sour oranges, passion fruit, certain varieties of peaches, apricots and beans, the whole class of baked products out of a variety of materials, use of fruit pulp and peels, various gums, mucilages, alginates and products like carboxy methyl cellulose (CMC)—all of these have brought out new possibilities with consumer appeal and have helped to add a number and variety of new products to our larders. A further achievement of modern times is the complete mechanisation of a variety of processes such as fruit and vegetable processing, right from the stage of harvest, production of chicken broilers, bread, biscuits, beer, sausage etc., thus maximising production at minimum cost. The breakfast cereal paste goods and other pre-cooked foods and meat industries have also mechanised their operations on a gigantic scale.

In countries like India food technology is a comparatively new subject and has largely been an off-shoot of bio-chemistry on the one hand and nutrition research on the other. In Institutions like the C.F.T.R.I., the nutritionist is a close collaborator in several technological programmes so much so, that the nutritional significance of each step in processing is taken careful note of There is, of course, an understandable divergence in relation to the degree of processing and the importance of consumer appeal; the nutritionist always feeling that the technologist is over-doing it and the latter feeling, that his methods are still not perfect and that he has not gone far enough. One may take, for instance, the case of extensive contribution by Indian workers to vegetable milks which may be described as milk substitutes of vegetable origin. The nutritionist has accepted them as desirable food supplements, but the technologist could not go far enough to satisfy the consumer whose standard is the cow or buffalo milk to which he or she is accustomed. The nearest approach to an acceptable product is the fermented curd, but even that could find only a limited demand. A fortunate off-shoot of the effort was the development of an integrated process for the production of oil and protein of high purity directly from oilseed and particularly from groundnut. The use of the isolate, as a concentrated protein food did not meet with ready favour from nutritionists and even today, there are some schools of workers, especially in the U.S.A., who are opposed to the use of isolates in preference to the meals; but fortunately its usefulness in the treatment of protein malnutrition has now been convincingly demonstrated by the valuable work done independently at Mysore, Hyderabad and Vellore. In combination with a small percentage of milk powder, that product has proved to be quite as effective as milk powder in the treatment of kwashiorkor and as a supplement to the dietary of the pre-school age children. This can be cited as an excellent case of collaboration between the technologist and the nutritionist in India in the development and utilisation of a new class of processed food product for the relief of malnutrition

A large amount of work has been done, especially at Mysore, to show that the isolate has practically the same protein efficiency ratio as the protein in the original groundnut or the meal and that processing methods employed had not adversely affected that value. Besides, being highly concentrated with a purity of 95% or more, the isolate is bland in taste, lends itself to solubilisation, thus becoming useful in a variety of ways for incorporation in food formulations for all age groups. It also offers scope for use in the amelioration of metabolic diseases like diabetes, use in weight reducing formulations, reduction of body fat which normally tends to increase with advancing age, and so forth. Further collaborative studies along these lines will be highly rewarding.

An important line in which the nutri-

tionist and the technologist worked in close association with highly fruitful results is the production of protein-rich edible quality meals and their use for enriching foods and for relieving protein malnutrition The first findings in respect of the protein-deficiency in various dietary patterns, as also the existence. and the consequences of protein malnutrition, come from the nutritionists. In India, the efforts went farther and during the late forties the nutritionist and the technologist got together to discuss the ways and means of producing acceptable forms of edible quality meals from different oilseeds. The subsequent developments came from the technologists who had to go into all the related details including the shelf-life and costing. A serious difficulty in the way of using such materials in countries like India is the popular prejudice which is traceable not only to the familiarity of the products but also to the general knowledge of the condition of the commercial expeller pressed meals which contain all types of impurities and which are suitable only for use as animal feeds or as manure. Strangely enough, an oilseed like groundnut commands more respect in Europe and even U. S. A. than it does in India, where even a clean product has to be modified in flavour and taste so as to ensure consumer appeal.

The Indian workers had realised the importance of using only clean, uninfected groundnut kernels and also the need for elimination of stones and other foreign matter right from the early stages, chiefly for better hygienic conditions and for longer storage life of the prepared products. Only carefully hand-picked kernels have been used by the Mysore Institute since the early fifties and some thousands of tons of the edible quality meal prepared out of them have been utilised for various types of feeding programmes. The discovery of the aflatoxin, as being present in certain types of mouldy groundnut, did not in any way interfere with the Indian work as the toxin had been automatically eliminated by the method which had been adopted even before the existence of the aflatoxin came to be known.

Although there has been a general world awakening in respect of protein malnutrition, the use of protein-rich foods has yet to make sufficient headway to make the effects felt among a large section of the vulnerable groups that need them most. Among those which have found application, the first place will naturally go to skim milk powder, which, because of its earlier start as a general food supplement, its ready consumer appeal and availability in surplus quantities in some parts of the world is, today, the most widely used for such treatment all over the world. The use of skim milk powder itself as a food supplement is of comparatively recent origin and the credit for the demonstration of its value should go to Aykroyd and his collaborators in India, during the thirties, even before its value in the treatment of protein malnutrition came to be realised. A good way behind, among the conventionally recognised oilseeds, but, nevertheless second in order will come groundnut, which though a late comer, assumed prominence and found substantial application chiefly because of the Indian effort. Several countries in Africa and particularly Uganda, and Nigeria are making good use of groundnut and but for the scare in respect of the aflatoxin the use in various parts of Africa would have been much more extensive than is now the case. The Indian effort was largely made possible by an extremely generous and helpful gesture on the part of the American Meals for Millions Organization which readily accepted the Indian Multipurpose Food in place of the one based on soyabean. The credit for first introducing protein-rich foods based on oilseed meals should really go to the American organization and the earlier collaborative effort between Henry Borsook and Clifford Clinton who first conceived of the idea of a balanced cheap meal for the starved and malnourished millions all over the world. The soya based multipurpose food has so far reached 129 countries, chiefly through various charitable organizations, and 13 million pounds of the product have been distributed. The introduction of protein-enriched foods based on cottonseed meal is largely traceable to the valuable efforts

of the Central American Institute at Guatemala under the leadership of Nevin Scrimshaw and his associates. This effort backed by a large volume of scientific research and elaborate programmes of educational and publicity work and extension services, deserves recognition as the best effort of its type and should serve as a model to others. Products based on coconut also offer very considerable scope and the excellent start recently made in Philippines under the leadership of Salcedo and Pascual bids fair to make rapid headway. The Indian workers have also contributed substantially to the processing of coconut, both by itself, and also in combination with groundnut and other oilseed meals. The main handicap in the way of the more extended use of coconut meal is the associated fibre which constitutes over 10-15% of the meal and makes it difficult to digest, besides rendering it unacceptable to the consumer. The Indian workers, in collaboration with Messers Krauss-Maffei have also standardised an integrated method of processing the wet coconut kernel, which in addition to giving a high grade oil, also yields a fraction which is rich in sugar, protein and minerals as a by-product. Various figures for the protein efficiency ratio of coconut protein have been cited, but therecent work at Mysore would show that it is not so high as that of milk protein, but superior to that of groundnut or cottonseed protein. The associated minerals also make valuable supplements to poor cereal diets More than anything else, coconut products have a pleasing flavour with consumer appeal. Sesame meal has possibilities, at any rate as a supplement to other meals because of its high methionine content. More extended application of sesame meal will depend to a large extent, on the successful removal of the associated bitter principle and the fibrous skin Oilseed meals from mustard, sunflower, safflower and several others have been worked upon both in India and in other countries. There is immense scope for development on these lines, but as in the case of sesame, the future will depend on the technological advance leading to the production of the fibre-free products with acceptable flavour and taste.

The mystery of soya bean - an instance of lack of co-ordination between the nutritionist and the technologist

Soya bean should be placed, in a separate class by itself, as it comes half way between a pulse and an oilseed. It is rather unique in the plant kingdom as it contains 35% of its weight as a good class protein together with about 20% in the form of a high grade edible oil. Its present production and utilisation will far exceed that of any other protein-rich material, if we take all the uses into account. While its origin and varied uses are traceable to centuries of experience in the Far East, most of the recent developments are largely due to the contributions of the nutritionists and technologists of the West and particularly of U. S. A. In the latter country, it was first raised largely for use as animal food, but, during recent years, it is finding increasing amount of application as human food. Reference has already been made to the first Multipurpose Food which was based on soya grits. During recent years increasing amount of interest has centred round the use of whole and defatted soya flour supplemented with minerals and vitamins. Soya protein isolate is also being produced on a large scale and is finding varied applications in food industries. It is also being processed to simulate meat and milk products and in such forms, it is being used either as such, or in combination with others. With the backing of the soya bean council and various big industrial groups, its utilisation is already quite extensive and accounts for a substantial turnover. There are still some problems in respect of the use of soya bean in various forms and these are certain to be solved in course of time.

The Indian work on soya bean which started during the early forties and continued for nearly ten years showed for the first time the 'Jekyl and Hyde' nature of that bean. A major collaborative study between a number of institutions showed that, as a pulse, cooked in the conventional way as practiced, the bean was, in

some unaccountable way nutritionally inferior to the other pulses already used in India in spite of its higher protein content and better quality proteins. The milk prepared out of it was found, to be a nutritionally good product with a high digestibility and a protein value equivalent to 80-90% of that of cow's milk. The apparent divergence in behaviour between the natural and the processed product should have given the clue in respect of the antitrypsin and antigrowth factors which are present in whole soya bean which were latter discovered by the American workers. Here is an instance to show how lack of co-ordination between the nutritionist and the technologist in India resulted in the failure to make a significant contribution to the subject.

Other classes of soya products have long been in vogue and they constitute one of the major sources of protein to a large section of people in the Far East. They are based on either processing to form the milk or pre-digestion with microorganisms. A large number of traditional methods have yielded a variety of food products which go into the dietary of all sections of the people. Modern scientific methods have been applied, especially in Japan, for the prepararion of such products. They constitute between them the largest group of protein-rich foods of vegetable origin which now find application and they have also been successfully introduced, over centuries, into the dietary pattern of the people. The quick adaptation of such methods into the dietary patterns is rendered difficult because of the difference in the taste habits of the people and the general resistance to the flavour and taste of new classes of products. Sooner or later, these barriers should be broken and it will be the responsibility of food technologist to adopt his methods to fit in with the taste habits of the people in each country. Among the other classes of products which have been recently introduced in the East, special mention should be made of the dried, water dispersible product (*Saridele*) based cheifly on soya milk but supplemented with other vegetable milks such as those from sesame and groundnut. This development owes its origin to the earlier work done in India. The product is steadily finding favour in Indonesia, and it deserves more extended use. Any practical difficulty standing in the way should be overcome with special consideration for the cost and the consumer appeal. Reference may also be made to the valuable work done on *Tempeh* which is a pre-digested product with a good protein-value and excellent keeping quality through the anti-oxidant chiefly (Genistin) produced by the organism used for the digestion.

Need for greater collaboration between the *nutritionist and the food technologist*

There are certain directions where the nutritionist and the technologist will have to get together in finding practical solutions to certain problems. A good example of this will be the choice of the type of food which the weaned and pre-school children should have. At the present time, there are two possible approaches One is the provision of a complete food which will contain all the nutrients and which can be so conditioned as to permit of administration with or without cooking The other is to provide a concentrated preparation containing a high percentage of proteins, together with minerals and vitamins and which can be added in small quantities to supplement any food that may be normally given in the homes. The first approach is represented by *Incaparina* which is now being successfully used in Guatemala and in the neighbouring Central American countries. There are also some commercial products of that type on the market, but they are, generally, costly preparations. The second would be represented by the high protein foods of the type developed by the Mysore workers.

A composite formulation containing 20-25% (or more) of protein has the merit that the children will get an *ad libitum* feed of a type which they should have at that age. On the other hand, such foods will have the disadvantage of being monotonous. Morever, the components in such a formulation will have to be changed, depending on the cereals or millets available in each region In Central America, the dietary patterns are more or less the same whereas, in a country like India, the pat-

terns vary with the regions. Furthermore, it may well be argued that there is no need to introduce into a packed food formulation, certain components which the people may normally use in their homes. This will increase the cost of packing and transport. In India, as also in other countries, the normal practice is to give to the weaned children a diluted version of what is normally consumed in the homes. The mothers do not often have the time, nor, in a large percentage of cases, the means to prepare separate food of the right quality for such children. In the majority of homes of low income groups, the weaned children get only the usual poor cereal or tapioca diet. Such foods are generally deficient and as the children at that age need a great deal more of proteins and other food essentials, there is poor growth and the children are often in a condition bordering on acute malnutrition and a fair number also show the characteristic symptoms. Under these conditions and considering that the tastes will vary, the more convenient arrangement would be to provide concentrated supplements which can be added in measured quantities at the time of feeding the children. The supplement thus added should be versatile in use and should be capable of blending with the food preparations that are now being given to such children. Such concentrates, in terms of daily requirement, would be much cheaper than composite foods. If they are also so processed that they require no further cooking, they can be easily added to the children's feeds without any extra trouble or expense.

In the course of some recent discussions with the UNICEF authorities at Bombay, Bangalore and other centres, the above issues were raised by, not only the technologists, but also the industrialists and others interested in such programmes The latter were generally in favour of a concentrated supplement that can be added to any food. Though the immediate object of the UNICEF programme in India is to provide a composite food, taking advantage of free supplies of grains and certain other materials, the necessity for a fresh approach in favour of concentrated products was generally agreed upon.

The development of the desired formulations and the demonstration of their value will be the responsibility of the technologist and the nutritionist. Some carefully planned experiments should be designed so as to evaluate, under comparable conditions, similar types of foods, as provided in composite forms and as cooked foods to which concentrated supplements, in equivalent measure are added. The practical aspects of adding the latter to different types of foods as actually used in the homes should also be studied. The ultimate object should be to get the desired measure of benefit even on supplementation of a tapioca or a maize-tapioca diet which may be regarded as being of the poorest type. Such experiments should be done on a sufficiently big scale and at more than one centre, to evaluate the benefits. Every aspect should be carefully studied so as to arrive at a satisfactory practical solution. The rationale is certainly in favour of concentrated supplement, but this must be experimentally verified before application. Such a programme would be worthy of support from national and international agencies and they should also be tried in different countries.

Production of fish flour (fish protein concentrate), in which the nutritionist and the technologist are both interested, has proved to be a more difficult problem than was first expected. Apart from the problem of storage of fish for the entire working season, there are also those relating to the removal of the associated oil and odour which requires repeated extractions with solvent; reversion of odour as observed under certain conditions; insolubility and reduced nutritive value of the fish protein as the result of the treatments that have to be adopted on the basis of our present knowledge and experience. We have yet no simple method of obtaining low fat, odourless fish flour. There is evidence to show that some of the methods of drying and use of certain solvents have adverse effects on the value of the resulting product. It will be necessary to develop a basically new type of approach that will greatly simplify the procedure and yield a bland, odourless product with desirable physical

properties and maximum nutritive value.

Another direction where the two groups can and should get together is in respect of field programmes and generally that of reaching the public in the most effective manner. Under the existing conditions of acute deficiency as prevailing over vast areas, every possible means of improving the conditions should be attempted. There is an important place for helping people to produce their own requirements of protective foods wherever it is possible. The people should also be advised to select and to utilise natural foods of better quality. Even with all this, there may still be some deficiency of one kind or another. There is also a large section, especially in urban areas, who will not have the facility to produce their requirements. Many may not also quickly change their dietary pattern owing to some reason or other. In addition to whatever else may be done, there would still be an important place for supplements and in the pursuit of this programme the nutritionist and the food technologist should get together, with mutual regard for each other's efforts. This would be specially required in the matter of reaching the pre-school age children through the homes. The children themselves have fewer prejudices than the parents and guardians as may be instanced by experience in the case of fish liver oil, concentrated products with residual odour of fish, meat, oilseeds or leafy materials or even of some natural colour such as chlorophyll and also the vegetable milks. In such cases, the objections come largely from the elders who have their own set views and tastes and who would naturally insist that the children should have only those things that they approve of. In such cases, there should be a concerted effort to reach the homes and particulary the women, who have the main care of the children. Social workers, home economists community development organizations and others who have opportunities to reach the homes can play a big part in popularising new and useful classes of products. More than that, the concerned industries can also do a lot to reach the people through the homes. This technique which has already been successfully applied in the case of toiletries, cosmetics and other consumer foods can also be extended to this important line. This kind of approach will be highly effective especially in urban areas where there is a large concentration of population even in small areas and where the people are generally receptive and have also the means to buy such products. The rural areas should also be reached, but if the efforts first succeeded in the towns, it will greatly strengthen the case for extension to the villages.

The future programmes will have to take the following into account: 1) Irrespective of cultural background or economic status, the average citizen in any part of the world is shrewd and wishes to have the best value for the money; 2) Apparently external features like the appearance, flavour, taste and the type of pack used have profound influence on the initial choice of a product and these have to be taken care of if even a good product is to eventually succeed; 3) The parents and guardians anywhere in the world would be prepared to make sacrifices and get the requirements of their children if they are fully satisfied about the value of what they are getting; 4) The children above a certain age are impressionable and if they are told about the benefits of what they are getting or need, they will themselves have an influence on the elders to get what they need for better health 5) Free gifts and distribution through charitable organisations are very important, but they cannot, by themselves, create any market, though it may not be difficult to have a sustained and even increasing demand. In countries like India, where there is a numerical predominance of low income groups, there will be no incentive to buy as long as free supplies become available. There have been several instances, even in India, of products being appreciated and even sought after as long as they are freely available but for which there was practically no demand when they were offered for sale. By and large, the success of a product will depend on the extent to which the consumer will willingly pay for it. It would be far better to start with a limited off-take, for which there is a return with a small margin of profit, than to start with one with only a

large amount of free distribution. The industry should, of course be enterprising and enter into new lines after introducing all modifications that are necessary to ensure consumer appeal. There should of course, be adequate incentive for such ventures and it is for the state authorities concerned, to determine how they can be provided. An exclusive state venture will be justified only if the industry is shy or if there is any difficulty in making the product available to consumers on reasonable terms. In industrially developed countries, the price structure is largely determined by the volume of turnover and by the extent of competition in any particular field.

There should be basically no major difference in outlook between the nutritionist, the technologist, and the industrialist. The object of each is ultimately to serve the people, who are als ie consumers and who will also be the ultimate judges of the value of any effort. The latter are not difficult to win over provided the products have some reasonable appeal. There should also be some give and take between the nutritionist and the technologist with a general recognition that perfection is not easily or quickly attained; that a beginning with somewhat inferior products with consumer appeal would be better than either no beginning at all or the introduction of even nutritionally high class products which the consumer may regard as being crude or otherwise unacceptable. Even at the present time, many leading nutritionists are against baby foods based on milk as they consider them to be overpriced or diluted forms of milk powder. The consumers have, however chosen to have them and have found them to be more dependable and more beneficial to the babies than fresh milk that they the are able to obtain in many areas. As the result of this, several classes of baby foods are now onthe market and the demand for such products is steadily increasing. The people who appreciate the value of baby foods will also readily take to the weaning foods, if they fulfil the essential requirements. Cheapness should not be an essential criterion and once the markets are established and there is competition among the producers, the price level will get automatically adjusted, with maximum benefit to the consumer.

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