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ASSOCIATION OF FOOD SCIENTISTS AND TECHNOLOGISTS

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Machinery for Cereal and Pulse Milling Industry[1]

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The foodgrain production during 1973–74 is expected to reach a figure of about 115 million tonnes. Rice and wheat together account for more than half of the total food grain production. The distribution and production of major cereals, millets and pulses is given in Table 1. Most of the foodgrains on harvesting are not consumed in their native form. These grains have to be processed to render them suitable for consumption. For example, the paddy has to be milled to have polished rice, which is an acceptable form for cooking and subsequent consumption. Wheat grain similarly has to be suitably ground into *atta*, *maida*, *soji*, flour, etc. before making products commonly used by the people. Likewise, millets are also ground before use, while pulses are invariably dehusked and split into *dhal* before cooking.

This brings out the need for appropriate machinery and equipment for processing different foodgrains on commercial scale into end products suitable for consumption by the households. In almost all operations of dehulling, dehusking or polishing, the principle of abrasion is generally employed. The type and the extent of abrasion force to be applied varies with the nature and variety of the grain. The machinery and equipment used in carrying these unit operations are simple as well as sophisticated depending upon the level of operation. To carry out the operations on large scale, one requires the handling, conveying, sieving, separation and bagging equipment, in addition to the equipment needed for main unit operations connected with dehulling or dehusking and polishing.

Nearly 75 per cent of our population reside in villages. They retain two-thirds of the total grains raised on the land for their own consumption and other uses. As and when required, the grains are processed in lots of 20–200 kg, either in small mechanical hullers or to a lesser extent by hand pounding. The remaining one-third enters the organised trade channels and is processed in large and medium capacity mills. There has been a long felt need for manufacturing suitable machinery and equipment for the processing of different categories of foodgrains and at different scales of operation to obtain maximum output of quality product. Some aspects of the existing machineries and equipment used for milling different foodgrains and the need for their improvement are discussed in this paper.

RICE MILLING

Rice occupies prominent position among the foodgrains produced in the country, and unlike other grains this is consumed as whole cooked grain.

The crop is harvested when the moisture content of the grain is between 16 and 18 per cent. It is often allowed to dry in the field for one or two days before threshing and storing.

Mechanised milling of paddy till recently was essentially done in two types of mills—(*i*) a mechanised sheller-cum-polisher mill of 1-4 tonnes per hour capacity, and (*ii*) the 'Huller' or 'Engelberg' type horizontal mill. The latter type ('Huller') is used generally for milling the parboiled paddy and also raw paddy in smaller lots for domestic consumption. The total number of these indigenously fabricated mills is estimated to be about 50,000 which are spread throughout the country. Of these, only about 7,000 are sheller type. In the last decade, rubber roller sheller mills have been introduced and their number at present stands at more than 200.

The main objective of any paddy processing system is to obtain maximum yield of head rice, an acceptable degree of polish and good quality bran for solvent extraction to yield high quality oil. The efficiency of the system should reflect on the low cost of operation. In achieving these objectives, the following play a major role.

1. Variety–husk content of paddy varies: 17-25 per cent
2. Presence of impurities
3. Shape of grain–long or round
4. Hardness of the grain
5. Defects such as white core of the kernel.
7. Method of drying after harvest
8. Degree of infestation or rodent damage
9. Moisture of the grain at the time of milling

1. Presented by the senior author at the Seminar on "Food Machniery" organized by AFST (Western Branch), Bombay on January 19–20, 1974.

TABLE 1. PRODUCTION OF MAJOR CEREALS, MILLETS AND PULSES*

Commodity	Production ('000 tons)	Major producing States
Rice	38,633	West Bengal, Tamil Nadu, U.P., Orissa, M.P., Bihar, A.P. and Assam
Jowar	6,443	M.P., Maharashtra, Karnataka and A.P.
Bajra	3,795	Rajasthan, Gujarat, U.P., Haryana, Maharashtra, Punjab, Tamil Nadu and A.P.
Maize	6,206	U.P., Punjab, Bihar, Rajasthan, M.P., Karnataka, H.P. and Jammu and Kashmir
Ragi	1,914	Karnataka, U.P., Tamil Nadu, A.P. and Orissa
Wheat	24,923	U.P., Punjab, Bihar, M.P., Haryana and Rajasthan
Barley	2,327	U.P., Rajasthan, M.P., Haryana and Bihar
Bengal gram	4,469	U.P., M.P., Haryana, Punjab and Bihar
Tur (Arhar)	1,748	U.P., M.P., Maharashtra and Rajasthan
Black gram (Urad)	1,829	M.P., West Bengal, Maharashtra and A.P.
Green gram (Mung)	538	Orissa, A.P., Maharashtra
Masoor (Lentil)	364	U.P., M.P., Bihar and West Bengal
Khesari	548	M.P., Bihar, West Bengal and Maharashtra
Peas	492	U.P., M.P. and Haryana

**Source:* Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi
Final Estimates for 1971-72 or 1972-73.

10. Parboiling which hardens the grain
11. Application of friction/abrasion force-intensity and manner.

Before discussing improvement in the milling of rice, the stage of harvest, drying conditions and cleaning of paddy are important considerations.

Harvesting of Paddy

Harvesting of paddy at right stage of maturity minimises the grain damage due to sun-checking. In case of paddy meant for parboiling, sun-checks are not of major consequence; but in the milling of raw paddy, this factor has a greater economic significance. Though the sun-checks are controlled by harvesting the paddy at higher moisture levels of 20-24 per cent, such paddy if not dried properly, may pose problems of discolouration and mycotoxin production. These problems are generally more serious, when paddy is harvested during monsoon or in the coastal area, where relative humidity is high.

Drying of Paddy

There is a need for an efficient drying system to bring down the moisture content from 24 per cent in case of raw freshly harvested paddy or from about 30-40 per cent in case of parboiled paddy to 12-14 per cent, an ideal level for efficient milling. Recent investigations have highlighted the need for two stage drying of paddy-initially to about 17 per cent moisture content and subsequently after storing the paddy for about 4 hours to a final moisture content of 12-14 per cent. Such drying avoids development of cracks observed in single step drying.

The ideal drying system requires drying of paddy at a low temperature, so as to eliminate the occurrence of cracks on the grains. A simple design of a drier to cut short the drying time from 3-4 days to a few hours at 70°C is desirable in most varieties of paddy. The important consideration in the design of a drier should be the efficiency of moisture removal and low cost of operation. This point is more relevant especially in the light of current energy crisis. A drier designed to utilise paddy straw or husk for fuel, which otherwise is difficult to dispose off on the farms and in rice mills is preferable in the rural areas.

Cleaning and Destoning of Paddy

Before milling, cleaning and grading of paddy based on size, shape, specific gravity and surface characteristics of rice is essential to improve the yield and the quality of rice. This is generally carried out on a vibrating screen. Efficient destoner consisting of an inclined plane working on the principle of specific gravity separation and difference in surface roughness has been designed. The destoner in combination with a chaff cleaner is not only necessary for improving the milling efficiency, but also prolongs the life of the sheller machines.

Dehulling of Paddy

This operation is being carried out by the use of hullers and shellers of various types.

Hullers: Engelberg designed huller is perhaps the simplest and most widely used machine. In this machine shelling-cum-polishing is achieved in a single operation. It is commonly used in the rural areas in this country, as it has the flexibility of milling smaller quantities of grain, which farmers or consumers may have to mill, as and when required. However, the disadvantages of such a huller are: (*i*) the high abrasive force required for shelling and polishing in a single operation resulting in excessive breakage of rice (upto 50 per cent) and high energy consumption; (*ii*) the bran, a valuable byproduct gets mixed with the husk, whereby the quality of the bran is adversely affected; and (*iii*) the rice grain is often

damaged due to overheating and bruising, thereby lowering the storage quality of the rice.

Disc sheller: This is essentially a mechanical adaptation of emery-lined stone *chakki* and gives shelling efficiency of 80-85 per cent depending upon the variety of paddy milled. In spite of feeding uniform size grains, the breakage is rather high, as the grain after shelling has to travel a long distance on the disc before coming out. This also results in partial degerming of the grain and pulverizing of the husk. Besides, some amount of bran is also taken off the grain. This gets mixed with the husk and is not recoverable on aspiration.

Rubber roller sheller: This sheller consists of an adjustable horizontal set of cylindrical rubber rollers rotating in opposite directions at a differential speed of 200 r.p.m. and offering adequate shearing action for the splitting of husk. This device is becoming increasingly popular, as it offers the following advantages:

i) Higher shelling efficiency (85-90 per cent);
ii) Low breakage during shelling
iii) The brown rice will have minimum bruises
iv) Recovery of purer bran possible
v) Better yield of germ

Studies carried out by various agencies in India and also in other countries have revealed that (*i*) rubber roller shellers yield about 1 per cent more rice; (*ii*) breakage during milling is 4-5 per cent less; and (*iii*) in case of parboiled paddy, the advantages of rubber roller shellers are slightly minimised, because the parboiled paddy gives less than 1 per cent breakage during milling, when the pre-milling processing conditions are optimum.

The conventional shellers need emery replacement after milling 3,000 tonnes of paddy as against the change of rubber rollers (pair) after milling 80-100 tonnes of paddy.

For cutting down the cost of rubber rollers, the quality of the rubber need be improved. Alternative materials like hardened plastics have to be found for replacing the rubber, so that longer life of roller could be achieved for better economic advantage.

Centrifugal type sheller: In this device, the paddy is hurled by a centrifugal force on to a stationary rubber coated surface. The husk of the grain is split at the tips. The breakage of rice by this method falls in between the disc and rubber roller shellers. This device, if further improved, has the flexibility of adaptation on a small scale in rural areas in preference to hullers.

Husk aspirators, paddy separators and graders: There are several designs in use. However, there is scope for innovating better designs keeping in view the low energy requirements to improve economy of milling.

Polishing of rice: Consumer acceptability and nutritional considerations are the main controlling factors for the degree of polish to be given to the rice. Brown rice is polished by controlled abrasion technique; 3-4 per cent removal of bran is in any way inevitable. This operation can be carried out in a series of inverted cones of cast iron with emery coating. There is scope for changing the material of construction to make these units lighter and to operate with less energy consumption.

Parboiling

Nearly 60 per cent of the paddy in the country is parboiled before milling. Conventional method of cold soaking or soaking in warm water followed by steaming and sun-drying results in lowering of the quality of the parboiled rice. Hot soaking method developed about 15 years ago has cut down the soaking time significantly and eliminated the undesirable fermented smell. The hot soaking method of parboiling is gaining popularity with the millers. The parboiled rice on milling gives better yield of head rice and the bran has better keeping quality. There is need to develop efficient equipment for carrying out the parboiling operation and also the subsequent drying. For drying paddy, use of cheapest source of energy is desirable.

WHEAT MILLING

India produces nearly 25 million tonnes of wheat at present. Hardly 10 per cent of this is processed into products like *maida*, *atta*, *soji* and bran in the commercial roller flour mills. There are more than 220 roller flour mills with installed capacity of 4-5 million tonnes. The machinery and equipment in most of these mills are imported from countries like USA, Switzerland, UK, Poland, Hungary, West Germany, Czechoslovakia, etc. More than 80 per cent of the wheat is milled through the traditional grinding mills or *chakkis* and the product which emerges is essentially whole wheat *atta*. In some improvised *chakkis*, *soji* as well as *atta* are also manufactured.

Roller Flour Mills

Even today, facilities for fabrication of complete turn-key plants of required capacity are not available in the country. Whatever individual units are available on the market, they are essentially copies of the old modelled mills or adaptation of the old units to meet the individual requirements of the mills. Till recently, the centrifugal chilled cast iron required for the fabrication of the rolls was not available indigenously. This was a major lacuna in the fabrication of this pivotal item required for wheat milling.

The need of the day essentially is in the standardisation of the design for small, medium and large capacity roller flour mills and the economics of running these mills at full capacity. The technical expertise in the

country is adequate to fill this lacuna. Looking into the future need of the milling industry, the replacement of the outdated mills as well as establishment of the new mills, which may come up, offer considerable scope for roller flour mill fabrication in the future.

There is a good demand for the spares by the existing mills. A survey may be necessary to assess the type and the quantum of spares needed by the millers. Design details could then be worked out for the fabricators to meet the requirements.

Conventional chakkis: Very little research and development work has gone into the improvement and modernisation of the grinding machines or *chakkis* though these have been in use for milling major bulk of wheat produce. There is, considerable scope to improve these *chakkis* to deliver not only the whole wheat *atta* but also other product such as *soji*. The possibility of improvising the existing *chakkis* for pearling or polishing of wheat before grinding offers great deal of promise in obtaining wheat flour of desired grades. The "refined" *atta* from such *chakkis* can find an outlet in the manufacture of semi-brown bread of higher nutritive value. The present day *chakkis* can also be improved in reducing bulk weight of the movable parts and also economising the energy consumption required to run such units.

Bulgur production: This has had prominence in different feeding programmes for children. But little attention has been paid by the food machinery manufacturers to devise suitable processing units. There is considerable scope to modify some of the designs of modern rice mills to make them suitable for Bulgur production.

MAIZE PROCESSING

The hybrid maize is finding increasing acceptance with the farmers as a cash crop and is being produced now in larger quantities in several States. Being one of the cheapest grains, maize besides being used as a food item also finds its way into various industrial products.

Barring a few units which are engaged in the manufacture of corn starch by wet processing, the maize is essentially processed into whole grain *atta* and used either for human consumption or in poultry feeds. Maize having a bland taste finds easy acceptance as a raw material in the manufacture of various types of ready mixes, traditional snacks as well as composite flours which extend the availability of other cereals.

In view of the acceptable quality attributes, *soji*, *maida* and *atta* can be milled from good quality maize and marketed; one can forecast a bright future for maize milling industry in the country.

The increasing demand for starch in the textile industries indicate considerable scope both for dry as well as wet milling processes. No Indian firm fabricates presently machinery for integrated processing of maize, Therefore, machinery and equipment for milling, weighing, filling, sealing and packing has very good potential in the country.

MILLING OF MILLETS

The most important millets of economic significance in India are ragi, jowar, milo and bajra. These form the staple food in several States such as Maharashtra, Karnataka, Gujarat, Rajasthan, Madhya Pradesh, etc. In spite of their importance in the dietary of the people in these States, no millet is milled on commercial scale. Local *chakkis* which grind wheat and maize also grind these millets into flours which are used for the preparation of traditional dishes.

With the growing importance of composite flours and also relatively low price structure of these millets, larger population may desire to consume millets provided, undesirable qualities such as colour, excessive crude fibre, phytate, etc. in the milled flours are avoided. Some work has been carried out to remove partially or completely the husk from the grain, so as to make quality flour which may find better acceptance with the consumer. Moisture conditioning and pearling of jowar have shown commercial possibilities in the production of acceptable jowar flour which has been successfully used in the preparation of traditional dishes.

PULSE MILLING

The country produces about 12 million tonnes of various types of pulses. It is well known that pulses, which are mainly consumed as dhals, play a significant role as a rich source of protein in the dietary of the people. Most of the pulses are converted into dhal by the age-old methods of soaking, drying and dehusking by the application of abrasive force. It has been observed that there is a great deal of wastage in the traditional method resulting in a lower out turn of dhal. There is, therefore, a need to develop a new or improved technology for the milling of this highly important commodity in the country.

The traditional pulse milling methods are labour intensive, time consuming, seasonal and wasteful. This is mainly attributed to the following reasons:

1. The conventional process depends on climatic variations and varietal differences. Sun-drying is necessary to control the moisture content and hence seasonal in operation.

2. The loosening of the husk depending on the sunshine is inadequate during the first cycle of treatment and hence needs repeated processing.

3. Arbitrary use of oil and water affects the yield as well as keeping quality of the processed dhal.

CONCLUSION

From the foregoing account, it becomes clear that adequate thrusts are required in the fabrication of machinery and equipment such as complete milling machinery for wheat and maize, which have not been so far manufactured indigenously. Secondly, improvement in the existing machinery with a view to upgrade their working efficiency also needs utmost attention. Keeping in view the future requirements in handling, transportation, packaging and marketing of different milled products, there is a likelihood of increased demand for machinery and equipment for handling, weighing, bulk packing, retail packing, etc.

Research work needs to be intensified in the designing of equipment for wheat and maize milling and for pulse milling for large as well as small scale operations. Suitable machinery and equipment designs preferably with multipurpose utility for processing of millets like jowar, bajra, ragi and milo are also desirable.

Development of High Protein Bread. Part I. Groundnut Flour and Groundnut Protein Isolate Utilisation

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Manuscript Received: 17 *June* 1975

The optimum level of groundnut flour and groundnut protein isolate which can be added to Sharbati sonara variety of wheat and processing condition for obtaining high protein bread have been discussed. Groundnut flour (10%) fortified bread and 7% groundnut protein isolate fortified bread can be prepared by straight dough method using short fermentation time. Addition of sodium stearoyl-2-lactylate and potassium bromate increases the mixing tolerance, loaf volume, grain, texture and crumb colour.

Considerable work has been carried to make use of oil seed flours specially soya flour in the baked products to improve its nutritive value. It is also well known that use of oilseed flours in the baked products like bread creates technological problems i.e. changes in water absorption, mixing, fermentation properties and finally the acceptability of the baked products[1–6]. Utilization of groundnut flour has vast potential in the developing countries like India where about two million tonnes of flour and nearly a million tonne of protein for human consumption is available[7]. Therefore work undertaken at this institute to standardise a procedure for preparation of bread enriched with the groundnut flour and groundnut protein isolate and the results obtained are reported in this communication.

Materials and Method

The straight grade flour used in this study was obtained by milling *Sharbati sonara* wheat in a Brabender quadrumate junior experimental mill. Solvent extracted commercially available groundnut flour (100 mesh) and groundnut protein isolate were obtained from M/s. Tata Oil Mills Co. Ltd., Bombay. Sodium stearoyl-2-lactylate (Emplex) was obtained from M/s. C. J. Peterson & Co., USA. Potassium bromate manufactured by BDH, Bombay and Tower Brand compressed yeast manufactured by Indian Yeast Co., Calcutta were used in these studies.

For the mixing studies Brabender farinograph employing 50 g of flour at 14 per cent moisture basis was used. When the SSL (Emplex) was used the powdered material was blended into the flour in the farinograph bowl by running the machine for one minute before adding water. Wheat flour, defatted groundnut flour and groundnut protein isolate used in the study were analysed for moisture, protein and crude lipid values according to cereal laboratory methods[8] and the values are given in Table 1.

The following three methods were used to understand the influence of various formulae and procedural changes on the relative quality and loaf volume of finished bread.

1. A short straight dough method with 100 min fermentation time.
2. A 70 per cent sponge dough method with 4 hr fermentation time.
3. A 100 per cent sponge dough method with 1 hr fermentation time.

TABLE 1. CHARACTERISTICS OF INGREDIENTS

Ingredient	Moisture %	Protein %	Crude lipid
Wheat flour	14	9.8 (N×5.7)	0.80
Groundnut flour (Defatted)	6.8	46.8 (N×6.25)	1.5
Groundnut protein isolate	5.0	90.0 (N×6.25)	1.5

TABLE 2. EFFECT OF ADDITION OF DEFATTED GROUNDNUT FLOUR AND SSL (EMPLEX) ON THE FARINOGRAPH CHARACTERISTICS OF WHEAT FLOUR/WHEAT GROUNDNUT FORTIFIED FLOUR

	W.A. %	S.T.D. min.	T.M.D. B.U.
100% wheat flour	56.6	17.5	40
5% GNF*	59.2	11.0	60
5% GNF+0.5% SSL**	59.2	17.0	40
5% GNF+1.0% SSL	59.2	19.0	30
10% GNF	62.0	11.0	80
10% GNF+0.5% SSL	62.8	16.5	60
10% GNF+1.0% SSL	62.8	17.0	30
15% GNF	65.8	11.0	100
15% GNF+0.5% SSL	65.8	15.0	80
15% GNF+1.0% SSL	65.8	19.0	30

GNF* = Defatted groundnut flour
SSL** = (Emplex) sodium stearoyl-2-lactylate
W.A. = Water absorption percentage
STD = Stability time in minutes
TMD = Twenty minutes drop.

TABLE 3. EFFECT OF FERMENTATION TIME ON THE BAKING QUALITY OF 10% DEFATTED GROUNDNUT FORTIFIED FLOUR

Fermentation time min.	Volume (100 g loaf) ml	Grain score (out of 15)	Text. score (out of 15)
75	460	6.0	7.5
100	480	7.0	8.0
120	460	6.75	8.0
140	460	6.75	8.0
160	440	6.75	7.5
180	440	6.25	7.5

TABLE 4. EFFECT OF METHODS ON THE BAKING QUALITY OF 10% GROUNDNUT FORTIFIED FLOUR

	Volume (100 g flour loaf) ml	Grain score (out of 15)	Text. score (out of 15)	Colour of crumb (out of 10)
1. Short straight dough method	480	6.5	6.85	6.5
2. 70% sponge dough method	470	6.4	6.8	6.5
3. 100% sponge dough method	450	6.4	6.75	6.5

TABLE 5. EFFECT OF ADDITION OF GROUNDNUT FLOUR AT 5, 10 AND 15% LEVEL WITH AND WITHOUT SSL ON THE BAKING QUALITY OF WHEAT FLOUR

	Volume (100 g loaf) ml	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb score (out of 10)
100% wheat flour	530	8.0	10.0	8.0
5% GNF*	500	7.4	7.75	7.0
5% GNF+0.5% SSL**	550	7.5	8.00	7.4
5% GNF+1.0% SSL	580	8.0	9.10	7.8
10% GNF	480	6.75	6.50	5.0
10% GNF+0.5% SSL	520	7.00	6.75	5.25
10% GNF+1.0% SSL	560	7.25	6.75	6.50
15% GNF	390	5.5	5.00	4.75
15% GNF+0.5% SSL	420	5.8	5.0	4.75
15% GNF+1.0% SSL	440	6.5	5.5	5.00

*GNF = Defatted groundnut flour
** SSL = Sodium stearoyl-2-lactylate

TABLE 6. EFFECT OF ADDITION OF POTASSIUM BROMATE ON THE BAKING QUALITY OF 10% GROUNDNUT FORTIFIED BREAD

Potassium bromate ppm	Volume (100 g flour) ml	Grain score (out of 15)	Texture score (out of 15)	Crumb colour score (out of 10)
100% groundnut fortified flour	480	6.75	6.5	5.0
20	480	6.75	6.5	5.0
30	480	7.00	6.5	5.0
40	490	7.25	6.6	5.25
50	500	7.25	6.65	5.40
60	530	7.50	6.75	6.00

TABLE 7. EFFECT OF ADDITION OF GROUNDNUT PROTEIN ISOLATE ON THE BAKING QUALITY OF WHEAT FLOUR

Additive	Volume (100 g flour loaf) ml	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb score (out of 10)
100% wheat flour control	530	8.0	10.0	8.0
5% groundnut protein isolate	480	7.0	8.0	8.0
7½% groundnut protein isolate	450	6.0	7.5	7.0
10% groundnut protein isolate	300	4.5	5.5	6.0

TABLE 8. EFFECT OF FERMENTATION TIME ON THE BAKING QUALITY OF 5% GROUNDNUT PROTEIN ISOLATE FORTIFIED FLOUR

Fermentation time min	Volume (100 g flour loaf) ml	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb score (out of 10)
50	5003	8.0	8.25	6.75
75	500	8.0	8.00	6.75
100	480	7.0	7.00	6.75

TABLE 9. EFFECT OF POTASSIUM BROMATE ON THE BAKING QUALITY OF 7% GROUNDNUT PROTEIN ISOLATE FORTIFIED FLOUR

Potassium bromate ppm	Volume (100 g flour loaf) ml	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb score (out of 10)
20	490	6.0	7.75	7.0
30	480	5.5	7.50	7.0
40	480	5.5	7.50	7.0
50	480	5.5	7.50	7.0

TABLE 10. EFFECT OF SSL ON THE BAKING QUALITY OF 7½% GROUNDNUT PROTEIN ISOLATE FORTIFIED FLOUR

Additive	Volume (100 g flour loaf) ml	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb score (out of 10)
7.5% GPI fortified flour	500	6.00	7.75	7.0
7.5% GPI+0.5%SSL	530	6.50	8.00	7.0
7.5% GPI+1.0%SSL	570	7.25	8.50	7.0

GPI = Groundnut protein isolate.

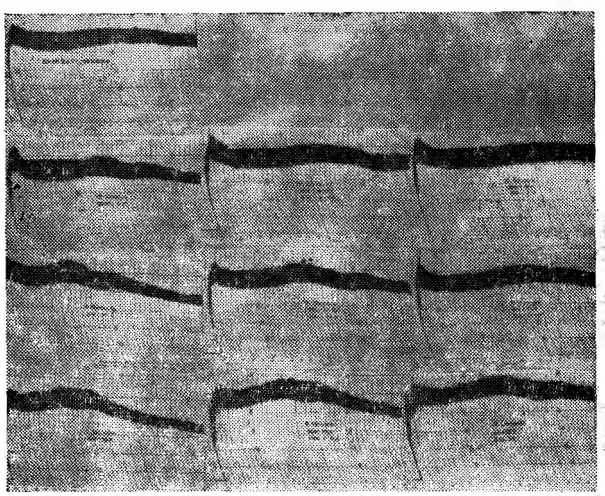

Fig. 1 Effect of addition of groundnut flour with and without SSL on the farinograph characteristics.

1st row–100% wheat flour; 2nd row–addition of 5% groundnut flour, groundnut flour +0.5% SSL, 5% groundnut flour +1.0 SSL; 3rd row–addition of 10% groundnut flour, 10% groundnut flour +0.5% SSL, 10% groundnut flour +1.0% SSL; 4th row–addition of 15% groundnut flour, 15% groundnut flour +0.5% SSL, 15% groundnut flour +0·5% SSL, 15% groundnut flour +1.0% SSL.

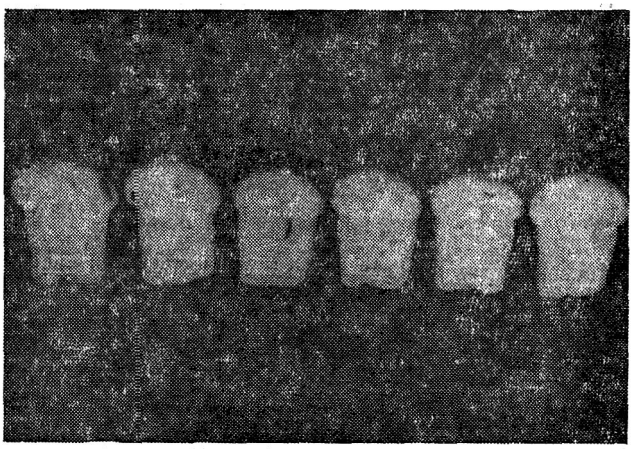

Fig. 2 Effect of fermentation time on the baking puality of 10% groundnut flour fortified dough. L to R: 75 min., 100 min., 120 min., 140 min., 160 min., 180 min.

Fig. 3 Effect of different methods on the 10 per cent groundnut flour fortified bread. L to R: 100% wheat flour bread, 10% groundnut flour fortified bread with straight dough method, 70% sponge dough method, 100% sponge dough method.

Fig. 4 A. Effect of SSL on the 5 per cent groundnut fortified bread. 100% wheat flour bread, 5% groundnut fortified bread, with 0.5% SSL, with 1.0% SSL.

Fig. 4 B. Effect of SSL on the 10 per cent groundnut fortified bread. 100% wheat flour bread, 10% groundnut fortified bread, with 0.5% SSL, with 1.0% SSL.

Fig. 4C. Effect of SSL on the 15% groundnut fortified bread. 100% wheat flour bread, 15% groundnut fortified bread, with 0.5% SSL with 1.0 SSL.

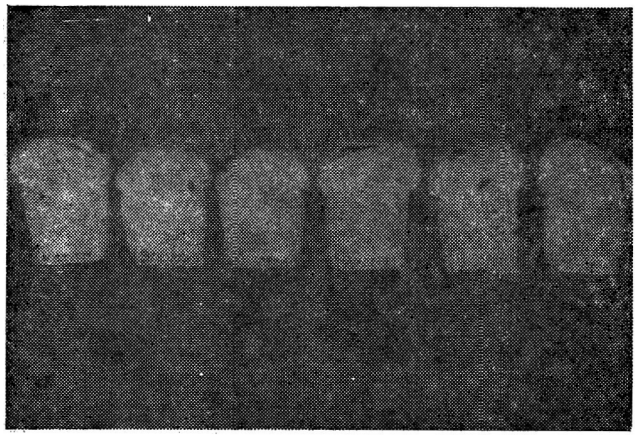

Fig. 5 Effect of potassium bromate on the 10% groundnut fortified bread. 10% groundnut fortified flour bread, 20 ppm, 30 ppm, 40 ppm, 50 ppm, 60 ppm potasium bromate.

Fig. 6 Effect of groundnut protein isolate on the baking quality. 100% wheat flour, 5% groundnut protein isolate fortified bread, 7.5% groundnut protein isolate fortified bread, 10% groundnut protein isolate fortified bread.

Fig. 7 The effect of fermentation time on the 5% groundnut protein isolate fortified bread. 100% wheat flour, 5% groundnut protein isolate with 50 min., 75 min., 100 min. fermentation time.

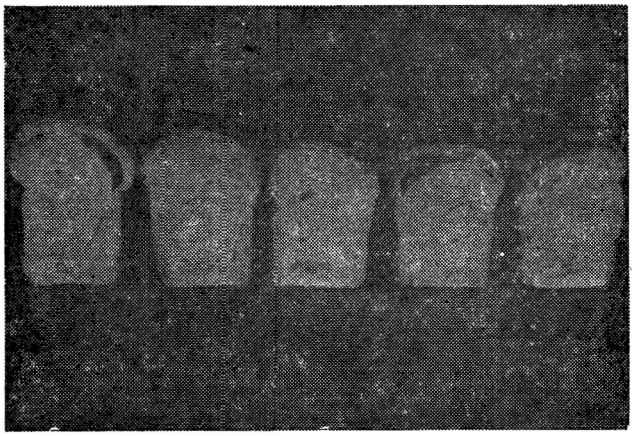

Fig. 8 Effect of potasium bromate on the 7.5 per cent groundnut protein isolate fortified bread. 100% wheat flour, 20 ppm, 30 ppm, 40 ppm, 50 ppm potasium bromate.

Fig. 9. The effect of SSL on the 7.5% groundnut protein isolate fortified bread. 100% wheat flour bread, 7.5% groundnut protein isolate fortified bread, with 0.5% SSL, with 1.0% SSL.

Baking formula and procedure: For producing 10 per cent groundnut fortified bread by straight dough method:

Flour 100% groundnut fortified (g)	200.0
Water (g)	140.0
Yeast (g)	6.0
Shortening (g)	4.0
Sugar (g)	10.0
SSL or potassium bromate	As required

All the ingredients were mixed at room temperature in the National Mixor with appropriate water absorption and optimum mixing time. Dough temperature was kept at 27°C. The dough was rounded by hand and fermented at 27°C and 85 per cent relative humidity upto selected time period. Fermented dough was moulded by National Moulder and placed in the greezed pan and proofed at 45°C and 85 per cent relative humidity upto appropriate proofing. Baking was done for 20 min at 220°C. The loaf volume was measured by rape seed displacement method within 10 min after removing loaf from the oven and scored after 18 hr.

Baking formula and procedure: For producing 10 per cent groundnut fortified bread by a 70 per cent sponge dough method the following ingredients were used.

Sponge (g)	140.0
Water (g)	84.0
Yeast (g)	6.0
Shortening (g)	4.0

All the ingredients of sponge were mixed for 2 min in National Mixor and sponge was kept at 27°C and 25 per cent R. H. Sponge was taken out and remixed upto appropriate mixing time with the following in a National Mixor and dough was kept at 27°C.

Dough (g)	60.0
Water (g)	52.0
Salt (g)	4.0
Sugar (g)	10.0

Floor time given was 45 min; soaking and intermediate proofing was for 10 min. Dough was moulded and kept in greezed pan and proofed upto appropriate proofing at 50°C and 85 per cent R.H. Baked at 220° for 20 min.

Baking formula and procedure: For producing 10 per cent groundnut fortified bread by a 100 per cent sponge dough method baking formula used is same as mentioned for producing 10 per cent groundnut fortified bread by straight dough.

All the ingredients of sponge method (except sugar) were mixed for 1 min in National Mixor. Sponge was kept for fermentation for one hour at 27°C and 85 per cent R.H. Sponge was taken out and remixed with salt (4 g) and sugar (10 g) in National Mixor.

Dough temperature was 27°C; floor time was 45 min, scaling and intermediate proofing was 10 min. Dough was moulded and kept in the greezed pan for proofing at 50°C and 85 per cent R.H. for appropriate proofing and baked at 220°C for 20 min.

Results and Discussion

Mixing studies: The effect of addition of defatted groundnut flour and SSL (Emplex) is shown in the resulting farinograms presented in Fig. 1 and the interpretation of the mixing curves are given in Table 2. Farinograph studies indicated that water absorption of control flour was 56.6 per cent and by the addition of 5, 10 and 15 per cent groundnut flour the water absorption increased. 58.2, 61.8 and 65.8 per cent respectively. The stability, MTI and TMD was usually less than wheat flour alone. The narrow farinogram width at the addition of SSL (Emplex) at level of 0.5 and 1.0 per cent did not make any effect on the water absorption but could delay dough development, increase dough stability and tolerance which are well comparable with wheat flour farinograms.

The increase in water absorption of groundnut fortified flour mainly depend upon the type of processed groundnut flour used. Generally over heated flour absorbs high percentage of water as compared to under heated flour.

Studies on the effects of fermentation time: To shorten the straight dough procedure, the effect of fermentation time was first evaluated. Ten per cent groundnut fortified flour was fermented at 27°C for 75-180 min with the 25 min difference from 75-100 and 20 min difference from 100-180 min. Figure 7 shows bread produced with different fermentation time and the results are summarised in Table 3. When the dough was fermented for 160-180 min the resulting bread had slightly lower volume and also resulted in open thick wall grain with slightly harsh texture of dull colour crumb. Fer-

menting the dough for 75 min resulted in slight decrease in volume and inferior grain and texture than 100 min fermented dough. The dough fermented for 100 min gave good volume, grain than the dough fermented for 120-140 min. Fermentation time appropriate for the development of 10 per cent groundnut fortified bread was 100 min and hence this was selected for further study.

Quality and loaf volume of finished bread: The effect of the three different methods viz. (1) short straight dough method with 100 min fermentation time; (2) 70 per cent sponge dough method with 4 hr fermentation time; and (3) 100 per cent sponge dough method with one hour fermentation time, on the bread quality of 10 per cent groundnut fortified flour is shown in Fig. 3 and the results are summarised in the Table 4. These show that very acceptable bread was produced by the short straight dough method and 70 and 100 per cent sponge dough method. The volume grain score were slightly decreased in the 70 per cent sponge dough method. Bread prepared by the 100 per cent sponge dough method decreased in volume for about 30 ml than the straight dough method otherwise the grain, texture and crumb colour score were equal to the dough prepared by other methods employed. Therefore short straight dough method was selected for further studies.

Baking quality of wheat flour by the addition of groundnut flour: Addition of groundnut flour adversely affects the loaf volume, grain, texture and crumb colour score of finished bread and the adverse effect intensifies as the quantity of groundnut flour is increased, particularly to 10-15 percent (Table 5; Fig. 4 A, B, C). Results of the baking studies showed that the addition of 5 per cent groundnut flour to wheat flour did not affect significantly the loaf volume, and grain score but the texture and colour of crumb score decreased. By the addition of 0.5 and 1.0 per cent SSL the volume, grain and texture score were increased.

By the addition 10 per cent groundnut flour the volume of the bread was decreased by about 50 ml than the 100 per cent wheat flour bread and the bread was of acceptable quality. With the addition of 0.5 per cent SSL the volume of 10 per cent groundnut fortified bread was the same and the addition of 1.0 per cent SSL increased the volume by about 40 ml more than the 100 per cent wheat flour control bread. With the addition of 15 per cent groundnut flour the volume was reduced about 140 ml and the grain and texture score were very poor. Addition of SSL resulted in slight increase in volume but the grain and texture score were not affected and bread produced was of unacceptable quality. The studies indicated that the addition of 0.5–1.0 per cent SSL in the 10 per cent groundnut fortified flour resulted in the bread of acceptable quality.

Oxidation requirement: Many deleterious effects of groundnut flour, as a bread supplement, can be overcome by raising the bromate level. The levels of bromate tried in these studies vary from 20-60 ppm. Results of addition of bromate showed (Table 6; Fig. 5) that bromate upto 30 ppm did not have any effect on the volume and texture except slight improvement in grain score. Addition of 40-60 ppm bromate improved the bread volume, grain, texture and crumb colour score and the bread was comparable to the wheat flour control bread. The groundnut fortified dough could tolerate the over treatment of the bromate. This may be due to the presence of sufficient amount of protein to buffer the oxidative effect of bromate.

Baking quality of wheat flour influenced by groundnut protein isolate: Baking studies were conducted to determine the effect of addition of groundnut protein isolate at various levels on the baking quality of wheat flour. Breads were prepared by straight dough method with 3 hr fermentation time. The effect of addition of groundnut protein isolate at the level of 5, 7.5 and 10 per cent are shown in the Fig. 6 and the results are summarised in Table 7. The adverse effects of groundnut protein isolate intensify when the quantity is increased from 5-10 per cent. The results of the baking studies showed that addition of 50 per cent groundnut protein isolate did not have significant effect on the loaf volume but the texture of the bread was slightly harsh. Addition of 7.5 and 10 per cent groundnut protein isolate produced bread of lower volume with poor grain and texture score and the bread was unacceptable.

Effect of fermentation time: In order to obtain best possible quality of bread the effect of fermentation time was studied. Five per cent groundnut protein isolate fortified flour was fermented for 50-100 min at 27°C. Figure 7 shows the bread produced with different fermentation time and the results are summarised in Table 8. The dough fermented for 50 and 75 min produced bread of good volume, grain and texture score. The 50 min fermentation time produced the bread of slightly better in grain and texture score than 75 min fermented dough. The volume of both the fermented dough was same. The 100 min fermentation time was found to be long for preparation of groundnut protein isolate fortified flour. For the preparation of 7.5 per cent groundnut protein isolate fortified bread 50 min fermentation was selected.

Effect of potassium bromate: Results of addition of potassium bromate show (Figure 8, Table 9) that acceptable bread can be produced without oxidant. The increase in quantity of potassium bromate had a little deleterious effect on the grain and texture score of 7.5 per cent groundnut protein isolate fortified bread.

Effect of SSL and groundnut protein isolate: Baking studies were conducted to determine the effect of addition

of 7.5 per cent groundnut protein isolate with and without SSL by using the short straight dough method with 50 min fermentation time. The results show (Table 10, Figure 9) that addition of 7.5 per cent groundnut protein isolate produced bread of acceptable quality. Addition of SSL at 0.5–1.0 per cent level improves the volume, grain and texture score. Groundnut protein isolate (7.5 per cent) fortified bread with 1.0 per cent SSL has higher volume than the wheat flour control but the grain and texture score were slightly less.

Conclusion: In comparison to the wheat flour, groundnut flour contains more sucrose, soluble nitrogen, several minerals which stimulate the yeast activity and favours the short fermentation time. Ten per cent groundnut fortified dough could tolerate the bromate (40-60 ppm) treatment. Addition of 7.5 per cent groundnut protein isolate produced bread of acceptable quality when short straight dough method was used. The bromate (40-60 ppm) treatment could not be tolerated the groundnut protein isolate fortified dough. Addition of SSL improves the baking performance of wheat flour fortified groundnut flour and groundnut protein isolate.

Acknowledgement

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Preparation and Nutritive Value of Serum and Whole Blood Protein Meals from Slaughter House Blood

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Serum and whole blood protein meals from buffalo blood have been prepared after coagulation by pressure cooking and air drying at 65°C. Serum yielded a light brown powder while whole blood yielded a dark black product. The PER of wheat *atta* protein (1.93) could be enhanced to the same extent (2.50) when the protein in the wheat *atta* diet (10%) was replaced by the two blood meals or casein to the extent of 2.5% protein. Use of serum protein meal as human food has been suggested.

In India, there are more than 30,000 slaughter houses where approximately 50 million animals are slaughtered annually[1] draining an estimated 60,000 tonnes of blood, most of which is not collected resulting in an estimated loss of one crore rupees. In a few cases, a crude product for use as a fertiliser is prepared by sun drying.

In U.S.A., blood serum has been dried to a limited extent for food purposes[2]. As early as 1925, Max Winckel[3] reported drying of blood and other slaughter house by-products for use as fertiliser and feed. The utilisation of blood from abattoirs has been described by Benoit[4]. Vickery[5] has discussed the recovery and utilisation of edible proteins of blood and trash fish. Spray dried plasma developed as a substitute for dried egg

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albumin[6] showed the potential of blood as a human food source. Cooked blood of pig, chicken and duck has been used as human food for a long time in Formosa[7]. Panda[8] has discussed the possibilities of processing and utilisation of poultry industrial by-products for feed purposes. Recently, Young and Lawrie[9] have outlined methods for the preparation of meat analogues by spinning blood plasma proteins.

In North India and Kerala, large number of buffaloes are slaughtered every day. There have been no concerted attempts to recover this blood to augment this animal protein supply and conserve this resource. The preparation of protein meals from buffalo blood and their nutritive value is reported here.

Materials and Methods

The blood was collected directly into clean aluminium vessels from buffaloes slaughtered by the *halal* method in the Bareilly slaughter house. Sodium citrate at a level of 5 mg/ml was used as anticoagulant for making whole blood meal. For serum protein meal, the blood was allowed to clot and the separated serum was centrifuged to remove any suspended cells. pH of the clear serum was adjusted to 5.0 using dilute HCl (4 NHCl). The serum and whole blood were cooked at 15 psi for 20 min, the protein coagulums were pressed through cloth, and dried at 65°C for 10 hr in a cross flow drier. The protein meals were ground to 80 mesh in a Wiley mill. Fat, moisture, protein and ash were determined in the dry samples by AOAC methods[10].

The supplementary value of the protein meals was studied by the rat growth method. The protein efficiency ratio (PER) at 10 per cent protein level of plain wheat *atta* supplemented with fat free casein (Nutritional Biochemicals) or the blood meal proteins, was determined according to standard procedures[11] using freshly weaned male albino rats of 34 g wt. divided into groups of 10 according to randomised block design, housed in individual cages provided with wire screen bottoms. The diets contained 3 per cent salt mixture[10], 1 per cent vitamin mixture[10], 6 per cent refined groundnut oil and 1 per cent sugar. Supplemented diets contained blood meals or casein providing 2.5 per cent protein, while wheat proteins constituted 7.5 per cent of the diets. The protein level of all the diets was adjusted to 10 per cent using starch. The animals were fed *ad lib* and weekly records of food intake and weight gain were maintained. After feeding for four weeks, the animals were sacrificed and the weights of fresh livers and brains were recorded. Sections of livers were examined histologically according to the procedure of Venkata Rao *et al*[12].

Results and Discussion

The yield, drying and grinding characteristics of serum protein coagulum were dependant on the pH of the serum. Adjusting the pH to 5.0 was essential to obtain a spongy coagulum which could be easily squeezed out from water, dried and powdered efficiently to give a light brown coloured meal. At higher pH levels, it was too hard to squeeze out the water completely and the colour of the meal was also greyish. Adjustment of pH of whole blood did not improve these characteristics. Whole blood yielded a very dark product fit only for animal feeding.

Table 1 shows the proximate composition of whole blood and serum protein meals. These are very rich in proteins containing more than 82 per cent protein. The results of animal experiments are given in Table 2. The food intake and weight gain of the supplemented groups were significantly higher. The PER of the wheat *atta*

TABLE 1. PROXIMATE COMPOSITION OF BLOOD MEALS, CASEIN AND WHEAT ATTA

	Whole blood meal	Serum protein meal	Casein	Wheat *atta*
Moisture (%)	10.70	9.70	8.30	13.60
Fat (%)	1.04	0.24	0.05	1.70
Protein (%)	84.80	82.19	91.12	11.97
Ash (%)	4.37	5.21	0.43	2.70

TABLE 2. GROWTH RATE OF RATS FED WHEAT ATTA DIET SUPPLEMENTED WITH WHOLE BLOOD MEAL, SERUM PROTEIN MEAL AND CASEIN AT 10% PROTEIN LEVEL

Diet	Weight gain (g)	Food intake (g)	Protein intake (g)	PER	Fresh liver wt. (g)	Fresh brain wt (g)
Wheat *atta*	54.7	284	28.4	1.93	2.69	1.26
Wheat *atta*+WBM	89.5	345	34.5	2.59**	4.83	1.53
Wheat *atta*+SPM	87.3	351	35.1	2.49**	5.01	1.72
Wheat *atta*+casein	92.2	364	36.4	2.53**	4.40	1.59

**Significant at 0.01 level; PER = Protein efficiency ratio; WBM: Whole blood meal; SPM: Serum protein meal.

proteins could be significantly increased from 1.93 to 2.50 by supplementing blood meals ($P < 0.01$). The supplementary value of both the blood meals was not significantly different from that of casein.

The fresh weights of livers and brains of rats receiving the supplemented diets were significantly higher ($P<0.01$ than those of rats receiving wheat proteins alone. Histological sections of the liver tissues of animals fed on wheat *atta* diet only, showed a moderate degree of protein deficiency type parenchymal damage. Fatty infiltration could be observed in all the sections though necrosis of the liver cells was absent. The liver sections of rats receiving the blood meal supplements were normal indicating that incorporation of blood meals to give 2.5 per cent protein level could rectify the deficiency of protein quality in the wheat *atta* diet. Nutritive value of blood meals from different sources like pig[7], poultry[8] and cattle[13–17] have been reported. Whole blood meal has been reported to be a rich source of lysine[7]. Beef blood proteins are known to be deficient in isoleucine, methionine and to some extent in arginine. When used as a sole source of protein, blood meal could not support growth, development and other biological functions in rat[18]. However, in small amounts, it has been recommended as a supplementary source of proteins in various poultry rations and animal feeds[7,13,14]. The present results corroborate the reported supplementary value of blood meal proteins[13–17].

Drying of whole blood resulted in a very dark product having poor eye appeal. But the meals obtained from serum were light brown and could be easily blended with wheat *atta* upto 10 per cent level without affecting the colour. In view of the regular use of blood to prepare products like sausages in European countries, it may be worthwhile to use light coloured powders of blood serum to improve the status of protein nutrition of those who cannot afford other sources of animal proteins like milk, meat and eggs. Such developments would not only augment the protein supply but also add to the economy of abattoir operation.

Most of the present abattoirs in our country are not equipped to produce hygeinic meat and by-products. Modern abattoirs are coming up in a few large cities with proper facilities for ante-and post-mortem inspection, bleeding and dressing operations where the carcas is suspended on the overhead rail to effect complete recovery and utilisation of by-products is made possible. Edible as well as technical blood meals could be produced hygeinically in such a set up by installing additional equipment needed.

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Changes in Reserve Proteins of Cow Pea, Chick Pea and Green Gram during Germination: Physico-chemical Studies

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Changes in the reserve proteins of cow pea (*Vigna sinensis*), chick pea (*Cicer arietinum*) and green gram (*Phaseolus aureus*) during germination were studied by the techniques of ultracentrifugation and polyacrylamide gel electrophoresis. Seeds germinated for 24 and 72 hr were studied. Three fractions with $S_{20,w}$ values or 2.5, 8.5 and 11.6S were observed in ungerminated cow pea, two of 6.3 and 10.2S in chick pea and only one of 5.8S in green gram; the values decreased during germination, suggesting degradation of the proteins. The breakdown of globulins was also seen at 72 hr of germination in all the legumes. In gel electrophoresis, ungerminated chickpea proteins gave about 20 bands, cow pea about 18 bands and green gram 14 bands. With germination the number of fast moving components increased. Both sedimentation analysis and gel electrophoresis indicated breakdown of the proteins during germination upto 72 hr though the changes were not drastic.

Legumes, both unsprouted and sprouted, constitute a major source of food proteins[1]. During germination of the legumes the proteins undergo considerable change[2] because of proteolytic activity[3–5]. The reserve proteins, which are stored in the cotyledons, slowly disappear to sustain the growth of the developing axis. The profile of the proteins changes significantly in the early stages of germination of legumes with the breakdown of low molecular weight fractions, followed by high molecular weight components[6,7]. This results in an increase in the levels of free amino acids and peptides which are translocated to the embryonic axis[8].

Danielson[9] has reported that globulins are the most predominant class of proteins in most legumes. With germination the globulin content decreased while little change was observed in the albumin content[9–11].

While considerable literature is available on changes in proteins of germinating soybean and groundnut[2,12] the changes in reserve proteins of cow pea, chick pea and green gram during the course of germination have not been studied. The work reported here deals with ultracentrifugal, electrophoretic and gross chemical study of the above three legumes during the early stages of germination.

Materials and Methods

Legume seeds and germination: 'PS-17' variety of green gram (*Phaseolus aureus* Roxb.), 'KC' variety of chick pea (*Cicer arietinum* Linn.) and 'C-152' variety of cow pea (*Vigna sinensis* Savi) supplied by the University of Agricultural Sciences, Hebbal, Bangalore were used. The seeds were soaked in distilled water for 4 hr and germination was continued in muslin cloth bag supplied with enough moisture at room temperature (27°C). At 24 and 72 hr germination healthy seedlings containing cotyledons and axis were collected for analysis.

Estimation of nitrogenous constituents: Total nitrogen, protein nitrogen (TCA precipitable) and non-protein nitrogen of ungerminated and germinated legumes were estimated by Kjeldahl method.

Preparation and concentration of proteins: The proteins were extracted in 0.03 M phosphate buffer of pH 7.3 containing 1M NaCl (buffer I). Globulins were prepared by the method of Klimenko[13] dissolved in buffer I and dialysed against the same for 24 hr for sedimentation analysis. For gel electrophoretic runs, proteins and globulins were dialysed against phosphate buffer alone until it gave no precipitate with aqueous silver nitrate.

Protein concentration was determined by absorption measurement at 280 nm, using a value of 13, 14 and 12.6 for green gram, cow pea and chick pea respectively for $E^{1\%}_{1\,cm.}$. This value was determined by a calibration curve of absorption against protein concentration. Protein concentration was obtained by Kjeldahl procedure (protein was estimated by $N \times 6.25$).

Sedimentation velocity experiments: Sedimentation velocity was estimated with Spinco model E-analytical ultracentrifuge equipped with RTIC unit and phase-plate schlieren optics. A standard 12 mm duraluminium cell centre-piece was used. The experiments were carried out at room temperature (27°C) with 1 per cent protein solution using speeds of 50,740 rpm, or 59,780 rpm. $S_{20,w}$ values were calculated by the standard procedure[14].

Polyacrylamide gel electrophoresis: A Shandon disc electrophoresis apparatus was used.

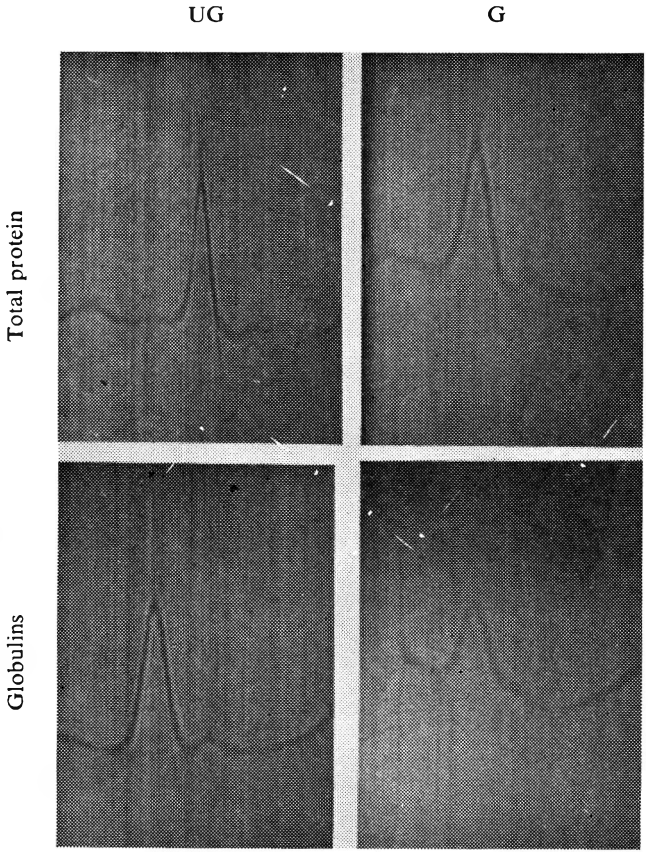

Fig. 1 Sedimentation velocity pattern of cow pea protein. UG—Ungerminated; G—72 hr germinated

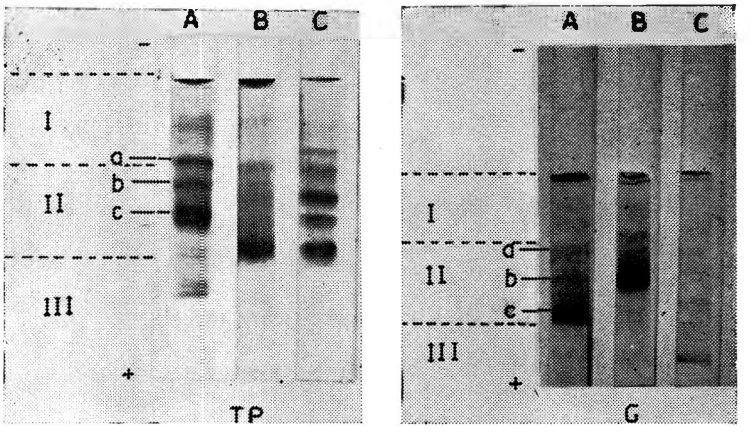

Fig. 2 Polyacrylamide gel electrophoresis patterns of cow pea proetin. A—Ungerminated; B-24 hr germinated; C-72 hr germinated; TP-Total proteins; G-Globulins.

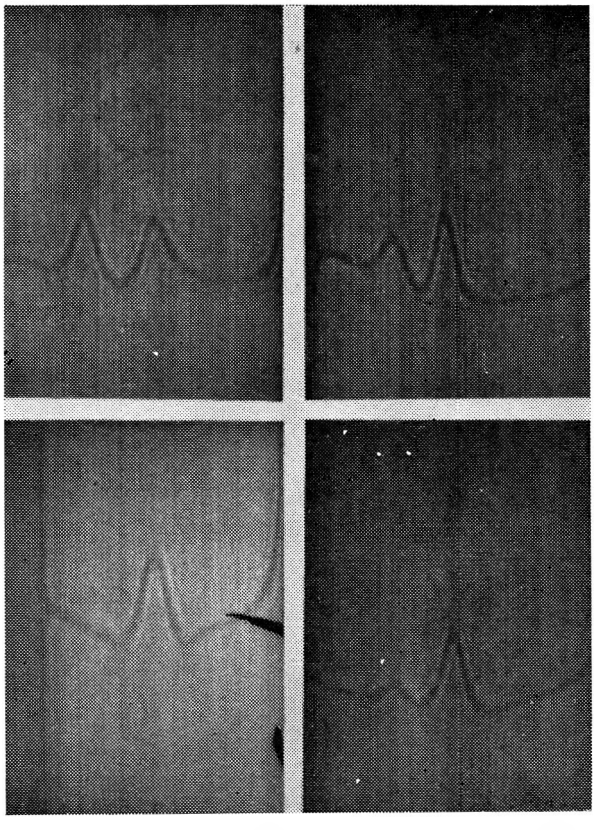

Fig. 3. Sedimentation velocity pattern of chick pea protein. UG—Ungerminated; G-72 hr germinated.

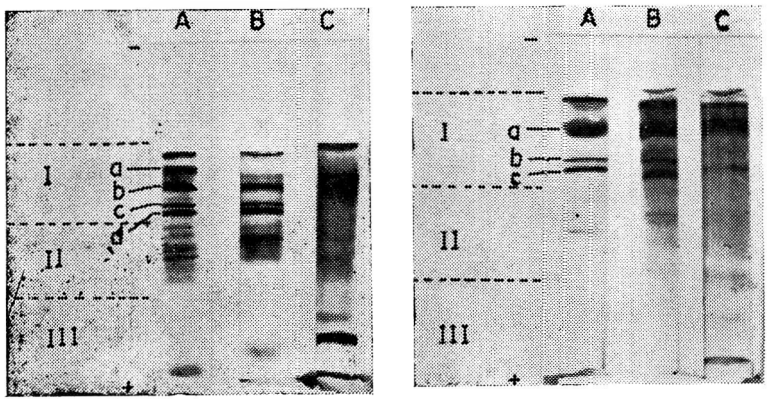

Fig. 4 Polyacrylamide gel electrophoresis patterns of chickpea protein. A—Ungerminated; B–24 hr germinated; C–72 hr germinated; TP–Total proteins; G-Globulins.

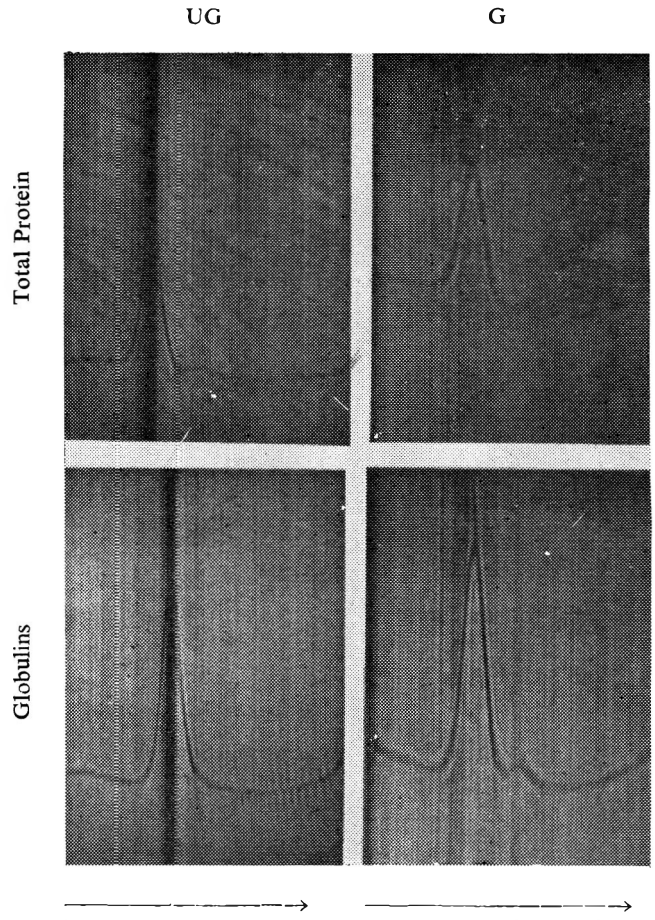

Fig. 5 Sedimentation velocity patterns of green gram protein. UG–Ungerminated; G–72 hr germinated.

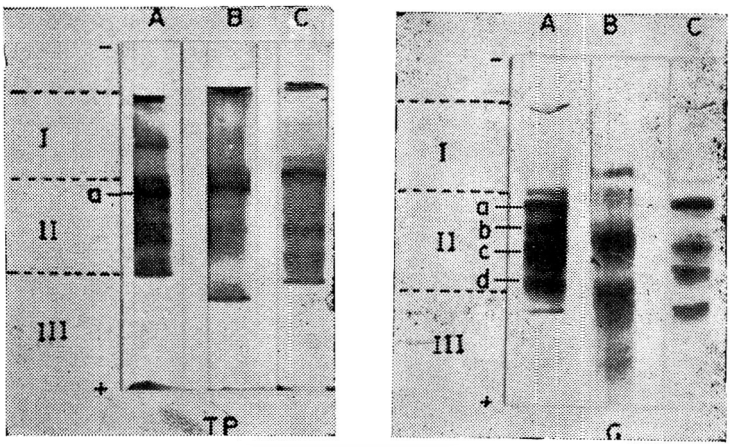

Fig. 6 Polyacrylamide gel electrophoresis patterns of green gram protein. A–Ungerminated; B–24 hr germinated; C–72 hr germinated; TP–Total proteins; G-Globulins.

Gels (10 per cent) were prepared in the phosphate buffer (0.03 μ, pH 7.3). Electrophoresis of 200 to 400 μg sample of protein in buffer containing 40 per cent sucrose and bromophenol blue as marker was carried out for 3 hr with a constant current of 4 mA per tube in the same phosphate buffer. The gels were stained for 2 hr with amido black. Destaining was done in 7.5 per cent acetic acid solution. The gels were screened on a chromoscan densitometer.

Results and Discussion

Changes in cow pea proteins: A progressive reduction in protein nitrogen could be seen during the increasing stages of germination (Table 1). Protein nitrogen decreased from 3.2 per cent in ungerminated to 2.4 per cent at 72 hr of germination.

The sedimentation velocity patterns of ungerminated and germinated cow pea protein are shown in Fig. 1. The ungerminated cow pea protein gave 3 peaks with $S_{20,w}$ value 2.5, 8.5 and 11.6S. The major peak was the 8.5S which constituted more than 90 per cent of the total. At 72 hr of germination, only 2 fractions of 6.0 and 8.8S were seen; the 2.5S fraction was not detected. The major peak here was the 6.0S component. The 11.6S fraction of the ungerminated had perhaps degraded to 6.0S at 72 hr of germination. The globulin fraction of cow pea also showed marked changes as germination proceeded upto 72 hr. While the ungerminated cow pea globulin showed two components 5.2S (major) and 8.1S (minor), at 72 hr only one fraction of 4.75 was observed. Danielson[9] while studying the pea globulins had reported a marked degradation of globulin fractions with the progress of germination. Though the S values for cow pea globulins and proteins are not available in literature, the trend observed here seems to be comparable to that in peas[15].

In the polyacrylamide gel electrophoresis pattern a total of 12 bands could be recognised in the ungerminated cow pea protein. Of these 3 major bands A, B and C (Fig. 1) constitute 17, 26 and 40 per cent of the total cowpea protein respectively. On 24 hr germination the intensity of the 3 major bands decreased. An intense band (28 per cent) appeared in region II. At 72 hr of germination the bands B and C decreased further. Appearance of new bands with increased intensity could be recognised in region II. The ungerminated cow pea globulins on the other hand showed three major bands A, B and C with 8, 11 and 37 per cent respectively. On 24 hr of germination the mobility of the bands decreased. At 72 hr there was a marked change in the pattern. The high molecular weight components appeared to have been degraded.

Changes in chick pea proteins: With the progress of germination the protein nitrogen decreased from 3.4 per cent in ungerminated to 2.8 per cent at 72 hr of germination (Table 1).

The ungerminated chick pea proteins gave two components of 6.3 and 10.2S in almost equal proportion (Fig. 3). At 72 hr of germination two components of 5.0S and 8.7S were observed in the approximate proportion of 40 and 60 respectively. The globulins of ungerminated chick pea (Fig. 2) gave only one peak of 7.1S. Germination at 72 hr showed degradation of globulins into two fractions with the emergence of a new minor peak with 4.7S.

The polyacrylamide gel electrophoresis pattern of the ungerminated chick pea (Fig. 4) revealed a total of 20 bands, with 4 major bands A, B, C and D with 26, 18, 12 and 16 per cent respectively. At 24 hr of germination bands A and B decreased while bands C and D increased in proportion considerably. At 72 hr of germination the number of fast-moving components increased. The ungerminated chick pea globulin gave 3 major bands A, B and C with 43, 8 and 14 per cent respectively. At 24 hr of germination the band A showed increase in intensity to 49 per cent. There appeared to be breakdown of both major and minor bands at 72 hr germination of the chick pea globulins.

Changes in green gram proteins: A reduction in protein nitrogen from 4.1 per cent in ungerminated to 3.3 per cent with the progress of germination could be seen in green gram (Table 1).

The proteins from ungerminated green gram gave only one sharp peak of 5.8S (Fig. 5). The globulin fraction also gave a single peak with S value of 5.1. It is possible that the globulins comprise most of the proteins in green gram. At 72 hr of germination the S value changed from 5.8 to 5.4. A similar result was obtained with the globulin fraction also (from 5.1S to 4.5S).

The ungerminated green gram protein gave about 14 bands in the electrophoretic pattern with one major

TABLE 1. CHANGES IN NITROGENOUS CONSTITUENTS OF LEGUMES DURING GERMINATION

Legumes	Germination (hr)	Total N (%)	Non-protein N (%)	Protein N (%)
Cow pea	0	3.5	0.3	3.2
	24	3.3	0.5	2.8
	48	3.2	0.6	2.6
	72	3.1	0.7	2.4
Chick pea	0	3.8	0.4	3.4
	24	3.8	0.4	3.4
	48	3.6	0.5	3.0
	72	3.4	0.6	2.8
Green gram	0	4.4	0.3	4.1
	24	4.2	0.4	3.8
	48	4.1	0.5	3.6
	72	4.1	0.8	3.3

Dry weight basis.

band A of 18 per cent (Fig. 6). Band A decreased to 15 per cent at 24 hr and to 6 per cent at 72 hr of germination. There was progressive increase in the intensity of the lower molecular weight fractions with the period of germination. In the ungerminated green gram globulin 4 major bands A, B, C and D with 5, 14, 52 and 13 per cent respectively could be seen. With germination the band C decreased to 35 and 23 per cent respectively at 24 and 72 hr of germination.

The degradation of major bands were more clearly marked in green gram globulins compared to cow pea and chick pea. The mobility of the globulins of green gram during germination was greater than those of the total proteins.

Catsimpoolas *et al*[2] have suggested that during germination of the soybean seed, the protein fractions dissociate into their constituent subunits. No information is available if the protein fractions of cow pea, chick pea and green gram contain subunits. Several workers[2,7,9,12] have reported major breakdown of globulins during germination of many legumes. However, these workers have considered much later stages of germination where the pattern could be expected to be more complex with synthesis of new proteins in the embryonic axis. This study is confined only to early (0-72 hr) stages of germination. The results of both the sedimentation velocity and gel electrophoresis experiments indicated breakdown of reserve proteins. A similar trend was also seen in protein nitrogen. However, the data presented here do not suggest drastic changes in proteins of the legumes during the early stages of germination.

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Studies on the Quality of Dried Processed Cheese from Buffalo Milk

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A method for the preparation of dried processed cheese from buffalo milk was standardised by spray dried process. The product was gas packed and stored for 3 months at 30±1°C to study the shelf life. Results of dried cheese indicate that moisture content and bulk density increased wtih increase in the level of total solids. In the initial dried cheese, a loss of about 5-7 per cent in the volatile fatty acids was observed. The packed bulk density of all the samples averaged around 0.275 g/ml. Using regression equation it is concluded that the product can be stored for 10 months at 30±1°C after gas packing.

Economic drying methods resulting in minimum moisture content will go a long way to increase the use of cheese in our country. In western countries drying of cheese is practiced to minimise waste offcuts in rindless cheese (Bradley and Stine[1]). The main limiting factor in the drying of cheese is the melting and exudation of fat caused by the high fat content. Out of the various methods of drying spray drying, roller drying or the more recent foam-spray drying (after the emulsification of cheese-slurry) have been reported to be suitable. Various attempts have been made in the past by different workers to dry cheese and to prepare cheese powder[2–11].

According to Giraud[12] the spray dried natural cheese contained 3-5 per cent moisture. Solaipa[13] obtained powdered cheese having 2.5-3.0 per cent moisture and dried cheese was claimed to have 99.8 per cent dispersability.

The object of the present study was to ascertain the quality of spray dried cheese. The study was planned to get information on (*a*) selection of cheddar cheese of different ages for making a good blend (*b*) standardization of the conditions for (*i*) emulsification using trisodium citrate, (*ii*) homogenization, and (*iii*) heat treatment; (*c*) possibilities of using spray drier (*d*) storage quality of the dried cheese and (*e*) the reconstitution property of the dried cheese at various intervals of storage.

Materials and Methods

The processed cheese was prepared by blending 12 months old cheddar cheese[14] with 30 days old young cheese in the ratio 1:1 along with water to bring the final moisture content in the finished product upto 55 per cent. Trisodium citrate was added at the rate of 3 per cent of the blend.

The processed cheese was homogenised at 71°C in a two stage homogeniser at 175 kg/cm^2 and 75 kg/cm^2 pressures. The homogenised cheese slurry was diluted with water to test 35 per cent total solids before spray drying at an inlet air temperature 160°C and outlet temperature of 100°C. The cheese powder after cooling was bagged in tin containers in 75-g capacity with double gas packing. The packed product was stored in an incubator at 30±1°C and removed for chemical and sensory evaluations at 0, 30, 45, 60, 75 and 90 days.

Chemical analysis of cheese blend and cheese powder: Samples of cheese blend and the dried cheese were examined for fat, total solids, pH, salt, total nitrogen, non-protein nitrogen, free fat and volatile fatty acids. The bulk density was determined only for dried processed cheese (fresh). The dried cheese tins, opened at regular intervals, were used for physical examination. The dried product was reconstituted by adding 40-42 per cent hot water. The temperature of the contents was increased to about 75-80°C with constant stirring. When satisfactory consistancy as indicated by the viscous flow was attained, it was transferred to the refrigerator for immediate cooling. After about 4-6 hr the reconstituted cheese samples were examined for body, texture and flavour by a trained panel.

The non-protein nitrogen was determined by the method proposed by El Sokkry and Hassan[15]; free fat was determined by the method of Hall and Hedrick[16].

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TABLE 1. AVERAGE COMPOSITION OF CHEESE BLEND USED IN DRIED CHEESE PRODUCTION

Particulars	Batch No. I	II	III	IV	V	Average
Fat%	32.2	33.9	27.4	28.1	32.7	30.9
Total solids %	67.17	67.97	63.4	62.1	65.7	65.25
Moisture %	32.83	32.03	36.6	37.91	34.34	34.75
pH	5.5	5.7	5.6	5.55	5.65	5.60
Salt %	0.996	0.952	1.04	1.01	1.12	1.02
Total nitrogen %	4.78	4.84	5.03	4.81	4.75	4.84
N.P.N.	0.981	1.10	1.3	1.35	1.17	1.18
Free fat (as % of total fat)	13.3	13.6	13.2	13.2	13.5	13.36
V.F.A.	5.9	5.8	6.2	6.1	5.7	5.94

Volatile fatty acids, ml of $\frac{N}{10}$ NaOH per 100g.

TABLE 2. PRODUCTION DATA AND PROCESSING TREATMENTS OF THE CHEESE BLEND

Particulars	Proportion of blend Old cheese (kg)	Young cheese (kg)	T.S.%
Batch I	6.0	4.0	27.0
Batch II	5.5	4.5	34.7
Batch III	6.0	6.0	28.0
Batch IV	6.5	5.5	30.4
Batch V	8.0	7.0	31.8

Preheat treatment time and temperature are 5 min and 71°C respectively. Homogenization (double stage) was done at (1) 175 kg/cm^2 and 35 kg/cm^2 for all batches. Atomizer rpm was 25,000 and outlet air temperature range was 98–100°C

The volatile fatty acids were determined by direct steam distillation method[17] and bulk density by the method of Hall and Hedrick[16].

Results and Discussion

The results on the quality characteristics of the original blend are presented in Table 1. The comparison showed that batch I and II contained less moisture than the normal well ripened cheese probably due to the loss of moisture in cold store. The average pH of the blended batches was 5.6, which is normal. The average value of 1.02 per cent salt is significantly less. The values for total nitrogen, non-protein nitrogen, free fat and volatile fatty acids showed negligible variations from the normal composition.

The production data relating to the type of cheese

TABLE 3. AVERAGE CHEMICAL COMPOSITION OF DRIED PROCESSED CHEESE (SPRAY DRIED)

Particulars	Batch No. I	II	III	IV	V	Average
Fat %	45.85	47.81	41.82	42.55	47.91	45.19
Moisture %	3.50	3.0	3.24	3.43	3.38	3.32
T.S. %	96.50	97.00	96.76	96.57	96.62	96.69
Salt %	1.51	1.34	1.47	1.44	1.65	1.48
pH	5.35	5.40	5.30	5.35	5.45	5.37
Total nitrogen %	6.88	6.85	7.25	7.35	6.97	7.06
Non-protein nitrogen	1.23	1.60	1.63	1.52	1.72	1.60
Free fat (as % of total fat)	24.40	25.53	23.39	23.83	26.82	24.79
Volatile fatty acids (ml of N/10 NaOH/100 g)	7.7	8.1	8.4	8.3	8.3	8.26
Bulk density g/ml	0.259	0.296	0.265	0.285	0.270	0.275

TABLE 4. AVERAGE CHEMICAL COMPOSITION AFTER STORAGE OF SPRAY DRIED PROCESSED CHEESE AT 30±1°C

Particulars		0 day	30 days	45 days	60 days	75 days	90 days
Fat %	Average	45.19	45.21	45.21	45.22	45.21	45.24
	Range	41.8–47.9	41.8–47.9	41.8–47.9	41.9–47.9	41.9–47.9	41.0–47.9
Moisture %	Average	3.32	3.27	3.26	3.27	3.27	3.24
	Range	3.0–3.5	3.0–3.5	3.0–3.4	3.0–3.5	3.0–3.5	3.0–3.4
Total solids %	Average	96.69	96.73	96.74	96.73	96.73	96.76
	Range	96.5–97.0	96.0–97.0	96.6–97.0	96.5–97.0	96.6–97.0	96.6–97.0
Salt %	Average	1.48	1.49	1.49	1.48	1.48	1.51
	Range	1.3–1.7	1.4–1.7	1.4–1.7	1.3–1.7	1.3–1.7	1.3–1.7
pH	Average	5.37	5.30	5.27	5.26	5.21	5.15
	Range	5.3–5.5	5.2–5.5	5.2–5.4	5.1–5.4	5.1–5.3	5.1–5.3
Total nitrogen %	Average	7.06	7.04	7.01	7.00	7.00	6.99
	Range	6.9–7.4	6.8–7.3	6.8–7.3	6.8–7.3	6.8–7.3	6.8–7.3
Non-protein nitrogen %	Average	1.60	1.62	1.63	1.66	1.67	1.68
	Range	1.2–1.7	1.4–1.7	1.5–1.7	1.6–1.7	1.6–1.7	1.6–1.8

blend, processing treatment, homogenisation and details of drying are given in Table 2. The cheese slurry which was taken for drying, after homogenization, contained 27-34.7 per cent total solids (Table 2). It was found difficult to spray dry the slurry with higher total solids content.

A consolidated statement consisting of the analysis of spray dried cheese (fresh) has been included in Table 3. The following observations merit consideration.

The colour and flavour of all the five batches of the dried cheese were excellent. No cooked or burnt flavour was observed. The moisture content in all the batches of dried cheese was observed to be below the maximum prescribed limit of 3.5 per cent. A general trend of decreasing moisture content with decreasing fat content of dried cheese was also observed, with the exception of batch II. The pH of the dried cheese in all the batches varied from 5.30-5.45.

The total nitrogen varied from 6.85 to 7.35 per cent. Non-protein nitrogen ranged from 1.23 to 1.72. The free fat expressed as percentage of total fat varied from 23.39 to 26.82. A general trend of increase in free fat content with the increase in the fat content of the dried cheese was observed.

The volatile fatty acids were expressed as ml of N/10 Na OH per 100 g of dried cheese. The values obtained varied between 7.7 and 8.4 ml. A decrease of about 5-7 per cent in the volatile fatty acids content (on dry matter basis) was observed in the dried product. The bulk density did not show much variation with different batches of dried cheese.

The average range for analytical values of spray dried

TABLE 5. RECONSTITUTABILITY OF THE DRIED PROCESSED CHEESE AFTER STORAGE FOR VARYING PERIODS AT 30°C

Particulars		0 day	30 days	45 days	60 days	75 days	90 days
Reconstitutability		++++	++++	++++	++++	+++	+++
Body & texture	Average	6.95	6.95	6.90	6.65	6.65	6.65
	Range	5.5–8.0	5.5–8.0	5.5–8.0	5.0–8.0	5.0–8.0	5.0–8.0
Flavour	Average	7.0	6.65	6.60	6.50	6.35	6.15
	Range	6.0–8.0	6.0–8.0	6.0–7.75	6.0–7.5	5.5–7.5	5.0–7.0

Reconstituted product evaluated on maximum grade point of 10
++++ Excellent
+++ Good.

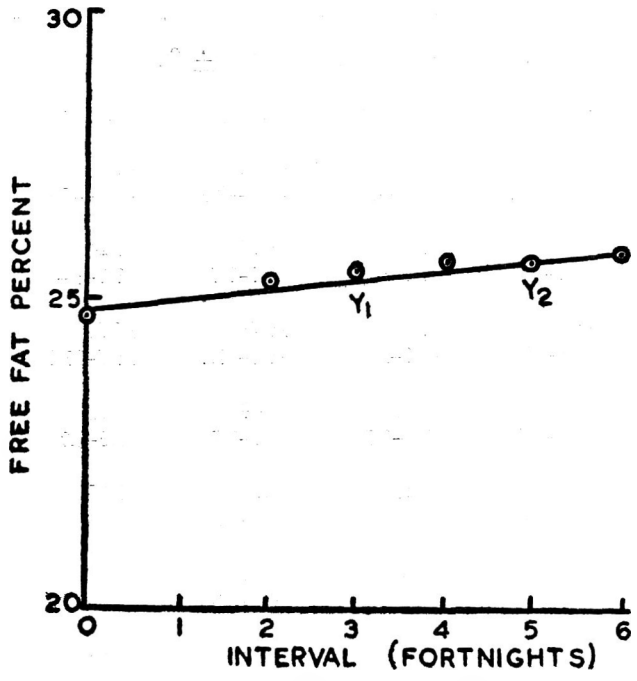

Fig. 1 Free fat content of dried processed cheese after storage (0-90 days) at 30°C.

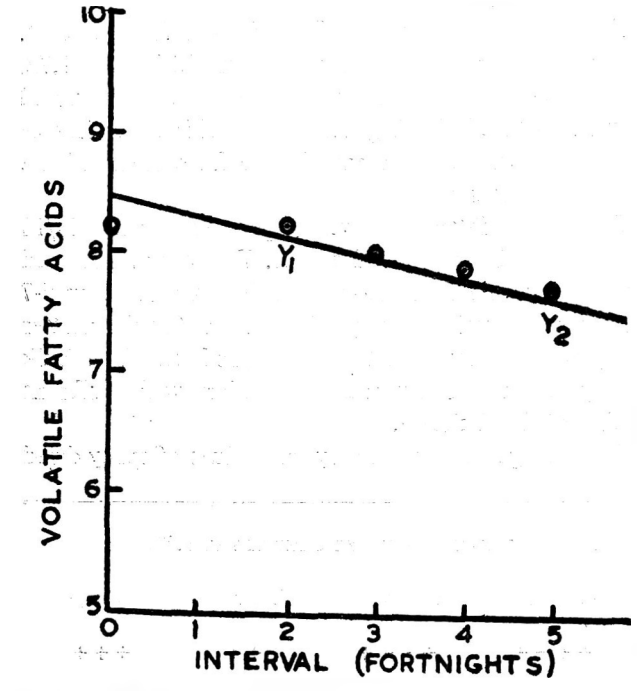

Fig. 2 Volatile fatty acid content of dried processed cheese after storage (0-75 dried).

cheese powder examined during the storage studies at 30±1°C have been presented in Table 4. There was no significant change in the moisture content of the dried cheese. The salt percentage and pH values remained almost constant throughout the period of storage. The

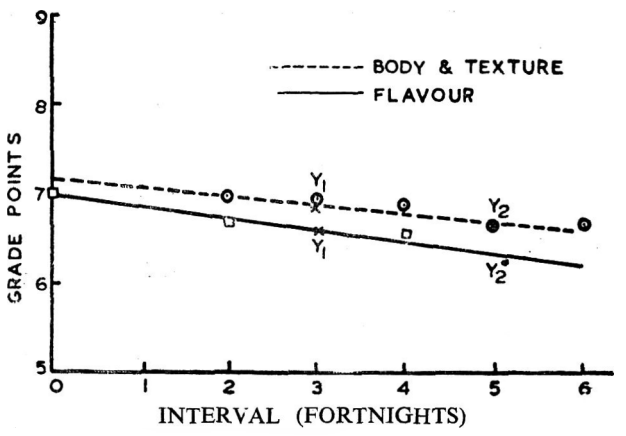

Fig. 3 Reconstitutability of dried processed cheese after storage (0-90 days) at 30°C.

variations in the total nitrogen and non-protein nitrogen contents of the dried cheese were very little. A general trend of increase in free fat content of dried cheese was observed. This may be because some of the fat globule membranes were weakened during earlier stages of processing and drying which might have caused ruptures due to expansion of dispersed air cells in the dried particles. Free fat increased faster during the first 30 days of storage than in the subsequent storage intervals. This may be due to melting of fat at elevated storage temperature.

The volatile fatty acids showed variations in their values with increasing period of storage. There was a gradual decrease in the volatile fatty acids content after 90 days of storage at 30±1°C.

The reconstitutability and the organoleptic quality of the reconstituted cheese (namely body, texture and flavour) have been presented in Table 5. Three experts were selected and were served with the reconstituted processed cheese on the day of manufacture, at one month storage and subsequently at fortnightly intervals upto 3 months. The experts were asked to score a maximum grade points of 10 for cheese of excellent body and texture and similarly for flavour. The average grade points of these 3 experts were taken as the representative grade of cheese.

Figures 1 and 2 show the trends in increase in free fat and decrease in volatile fatty acids during storage. It was observed that both the lines followed a linear trend. Figure 3 shows that the body and texture scores as well as flavour scores decreased linearly with the period of storage.

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Effect of Insect Infestation on the Chemical Composition and Nutritive Value of Bengal Gram (*Cicer arietinum*) and Field Bean (*Dolichos lablab*)

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A study was carried out to assess the nutritional and chemical changes occurring in Bengal gram (*Cicer arietinum*) and field bean (*Dolichos lablab*) due to insect infestation. The uric acid content of the samples was estimated and an experiment on weanling rats was carried out to determine the nutritive value of insect infested legume samples. Lysine, methionine, cystine, threonine and tryptophan contents were assayed microbiologically. A marked decrease was observed in the tryptophan content of Bengal gram (24%) and in the methionine content of field bean (50%) with increasing infestation. Results of the physical, chemical and biological tests showed that the losses due to insect infestation are not only quantitative but also qualitative.

Previous studies[1–3] on the nutritional and chemical changes occurring in insect infested food stuffs have shown the loss of thiamine and possibly other B vitamins, an increase in fat acidity and contamination with insect excreta and body fragments. The present study was carried out in order to determine the effect of insect infestation on the chemical composition and nutritive value of Bengal gram and field bean.

Materials and Methods

Samples of Bengal gram and field bean which were infested by the pulse beetle, *Bruchus chinensis*, were obtained along with control sample from the local market. The control sample of Bengal gram was sorted out from the infested sample by handpicking. In both cases, one sample served as the control while two other samples constituted the moderately infested and highly infested samples respectively. The different samples were subjected to various physical and chemical tests.

Physical analysis: For the assessment of insect infestation, the insect population, weight–volume ratio, kernel damage and viability of the seeds were determined.

Chemical analysis: The samples were thoroughly mixed, cleaned and ground in a flour mill and analysed for moisture, protein, nitrogen soluble in 3 per cent sodium chloride, non-protein nitrogen, fat and free fatty acids according to standard methods[4]. The calcium content of the ash solution was determined by the method of Clark and Collip[5], the phosphorus content by the method of Fiske and Subba Row[6] and the

iron content by the method of Wong[7]. Thiamine was estimated by the thiochrome method[8]. Uric acid was determined according to Venkat Rao *et al*[9].

Evaluation of protein quality: A growth experiment was carried out on young albino rats of the Wistar strain to determine the effect of insect infestation on the quality of proteins in the samples. Seven test diets at 10 per cent protein level were formulated, casein being the standard. The Bengal gram and field bean samples were powdered in a flour mill, steamed for half an hour in an *idli* steamer, dried in an incubator-drier at 60°C, and protein content analysed before incorporation into the respective test diets. The composition of the diets is given in Table 1.

Eight weanling male rats were assigned to each diet and distributed evenly among the diets according to weight. The animals were ear-marked and housed individually in raised wire screen bottom cages and were fed *ad libitum* for a period of 28 days. The daily food intake and weekly gain in weight were recorded. The protein efficiency ratio (PER) was calculated from the above data.

Amino acid analysis: The lysine, methionine, cystine, threonine and tryptophan content of the control and infested Bengal gram and field bean flour, as well as that of pure casein were estimated by the microbiological assay method at CFTRI, Mysore and the amino acid scores calculated.

TABLE 1. PER CENT COMPOSITION OF TEST DIETS

Ingredients	Diets						
	1	2	3	4	5	6	7
Casein	12.0	—	—	—	—	—	—
Bengal gram-Control	—	60.0	—	—	—	—	—
Moderately infested	—	—	59.0	—	—	—	—
Highly infested	—	—	—	56.0	—	—	—
Field bean-Control	—	—	—	—	54.0	—	—
Moderately infested	—	—	—	—	—	47.0	—
Highly infested	—	—	—	—	—	—	46.0
Arrowroot starch	68.0	20.0	21.0	24.0	26.0	33.0	34.0
Gingelly oil	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Non-nutritive cellulose	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Salt mix	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vitamin mix	1.0	1.0	1.0	1.0	1.0	1.0	1.0

1. Casein. 2. Bengal gram-control. 3. Moderately infested Bengal gram. 4. Highly infested Bengal gram. 5. Field bean-control. 6. Moderately infested field bean. 7. Highly infested Field bean.

Results and Discussion

Physical changes: In both Bengal gram and field bean, insect infestation caused a decrease in the weight–volume ratio and viability and an increase in the kernel damage. Data are presented in Table 2.

The decrease in weight–volume ratio indicates the loss caused by the pulse beetle, which during the process of infestation, bores through the grain keeping the outer shape intact; hence the weight of the grain decreases but the volume is unaffected. The decrease in viability was due to the fact that the insects had eaten away a large part of the germ. Field bean samples showed greater kernel damage than Bengal gram probably due to the fact that these grains present greater surface area for the development of insects.

Chemical changes: The data obtained for the changes in the chemical constituents of Bengal gram and field bean with infestation are presented in Table 3.

Moisture: In both the infested Bengal gram and field bean samples, as compared to the control, an increase in moisture content was observed.

Nitrogen: In Bengal gram and field bean, infestation caused a slight increase in total nitrogen and nitrogen soluble in 3 per cent sodium chloride. This increase may be due to the consumption of endosperm (rich in carbohydrates and poor in proteins) by the insects.

TABLE 2. INSECT POPULATION, WEIGHT–VOLUME RATIO, KERNEL DAMAGE AND VIABILITY OF CONTROL AND INFESTED BENGAL GRAM AND FIELD BEAN

Particulars	Bengal gram			Field bean		
	Control	Mod. infested	Highly infested	Control	Mod. infested	Highly infested
No. of insects/500 g	Nil	349	616	Nil	551	935
Weight–volume ratio, g/ml	0.827	0.707	0.673	0.800	0.640	0.560
Kernel damage, %	Nil	16.3	48.3	Nil	77.3	79.0
No. of holes*	Nil	93	363	Nil	189	279
Viability, %	97	39	18	88	29	Nil

*Calculated for 100g of sample.

TABLE 3. EFFECT OF INSECT INFESTATION ON THE VARIOUS CONSTITUENTS OF BENGAL GRAM AND FIELD BEAN*

Particulars	Bengal gram			Field bean		
	Control	Mod. infested	Highly infested	Control	Mod. infested	Highly infested
Moisture, %	10.4	11.0	11.4	7.8	8.1	8.5
Protein, %	16.6	16.9	18.0	18.7	21.2	21.9
Total N, %	2.659	2.714	2.885	2.998	3.393	3.507
N soluble in 3% NaCl						
Total, %	2.124	2.203	2.371	2.471	2.539	2.614
Non-protein N, %	0.225	0.427	0.513	0.261	0.484	0.597
Protein (by diff), %	1.899	1.776	1.758	2.210	2.055	2.017
Fat, %	4.18	4.61	5.99	1.29	1.45	2.89
Acid value**	28.0	93.0	129.0	30.0	53.0	125.0
Total ash, %	2.7	2.8	3.1	3.1	3.4	3.7
Calcium, mg%	149.0	191.0	196.0	65.0	69.0	76.0
Phosphorus, mg%	257.0	205.0	177.0	353.0	354.0	353.0
Iron, mg%	8.9	10.2	14.2	2.9	2.4	2.0
Thiamine, mg%	0.28	0.20	0.16	0.53	0.42	0.22
Uric acid, mg%						
Total	9.6	88.6	109.5	5.1	115.4	191.6
Apparent	5.4	10.2	12.1	4.9	9.3	10.8
True	4.2	78.4	97.4	0.2	106.1	180.8

*All analytical values are expressed on moisture-free basis.
**mg of KOH required to neutralize free fatty acids from 100g of grain.

In both these legumes, the non-protein nitrogen increased with infestation. This is possibly due to the addition of non-protein nitrogenous constituents of insect excreta and body fragments. Protein nitrogen decreased with increase in infestation.

Fat and free fatty acids: The fat and free fatty acid content of the infested samples showed an increase as compared to the control. This increase can be accounted for by the fact that the damage caused by the insects to the endosperm facilitates autooxidation of the fat present in the grain with a corresponding increase in free fatty acids.

Minerals: With increasing infestation, the ash content of both legumes increased slightly probably due to the fact that a greater part of the mineral matter is present in the husk. The proportion of husk is greater in infested grains since the insects eat a part of the endosperm leaving the husk intact.

The calcium and iron content of infested Bengal gram increased while the phosphorus content decreased. This relative increase is due to the fact that a greater part of the calcium and iron in Bengal gram is present in the husk while a greater part of the phosphorus is present in the germ. Similarly, the calcium content of field bean increased while the iron content decreased with infestation but the phosphorus content was not affected.

Thiamine: Insect infestation caused a considerable decrease in the thiamine content of both Bengal gram

TABLE 4. MEAN CUMULATIVE WEIGHT GAIN OF RATS FED THE SEVEN DIETS AND FROTEIN EFFICIENCY RATIO

Diet	Initial wt (g)	Final wt (g)	Cumulative wt gain (g)	PER* Mean ± S E
Casein	27.3	105.6	78.3	3.11 ± 0.02
Bengal gram-control	25.4	79.3	53.9	2.64 ± 0.03
Mod. infested Bengal gram	26.6	74.6	48.1	2.24 ± 0.02
Highly infested ,,	26.7	69.8	43.1	1.93 ± 0.03
Field bean-control	25.6	52.0	25.4	1.59 ± 0.04
Mod. infested field bean	25.7	45.4	19.7	1.24 ± 0.01
Highly infested field bean	—	—	—	—

*PER of 8 observations

TABLE 5. AMINO ACID COMPOSITION OF BENGAL GRAM AND FIELD BEAN SAMPLES

Amino acid	Samples						
	1	2	3	4	5	6	7
	(mg/g protein)						
Lysine	79.0	59.0	62.0	56.0	50.0	48.0	48.0
Methionine	37.2	17.0	15.8	15.5	12.6	9.6	6.3
Cystine	4.0	11.6	9.5	11.4	7.3	6.6	6.8
Threonine	49.9	31.4	30.2	30.6	31.9	31.1	32.7
Tryptophan	12.0	16.5	13.0	12.5	11.8	10.3	11.3

1 Casein 2. Bengal gram flour (control) 3. Moderately infested Bengal gram flour 4. Highly infested Bengal gram flour 5. Field bean flour (control) 6. Moderately infested field bean flour 7. Highly infested field bean flour.

and field bean. Fraenkel and Blewett[10] have shown that insects require vitamins of the B-complex for proper growth and development. The loss is heavy due to the progressive damage to the germ which, according to Hinton[11], contains 50 to 70 per cent of the thiamine in the grain.

Uric acid: Wigglesworth[12] has pointed out that in insects as in birds and reptiles, uric acid is by far the most important nitrogenous constituent of urine. Results showed that the 'total' uric acid values for the control samples were quite low as were the 'apparent' uric acid values due to the presence of compounds other than uric acid. However, there was a marked increase in the 'true' uric acid content of infested samples of both legumes in accordance with the high insect populations in these samples.

Evaluation of protein quality: This was done by noting the cumulative weight gain and protein efficiency ratio as well as amino acid analysis.

Cumulative weight gain: The mean cumulative weight gains of the rats over a period of 4 weeks are presented in Table 4.

The highest growth rate was found in rats fed the casein diet. The growth rate of rats fed the infested diets decreased as compared to the respective controls. Rats fed the highly infested field bean diet lost weight from the commencement of the experiment and died within two weeks of feeding. The rats became progressively weaker but there was no shedding of fur or diarrhoea. However, the urine excreted was very scanty and extremely yellow and the pH was around 6. On opening the body cavity, pale patches were observed on the livers of two rats. Venkat Rao[13] reported that histological examination of the livers of rats fed for six months on infested jowar diet showed different degrees of centrilobular fatty infiltration.

Protein efficiency ratio: A considerable decrease in the PER was observed with increasing infestation in the case of both Bengal gram and field bean (Table 4). Recent studies by Parpia[14] have shown that insect infestation significantly decreases the PER of split chick pea from 2.21 to 1.83 and pigeon pea from 2.04 to 1.66.

The differences between the PER of the seven test diets and cumulative weight gains of rats fed these diets were found to be highly significant ($P<0.001$).

Amino acid analysis: The amino acid composition of the seven samples of test protein foods is presented in Table 5. The amino acid content of the samples decreased slightly with infestation. However, a marked decrease of 24 per cent in the tryptophan content of Bengal gram and 50 per cent in the methionine content of field bean was observed with increasing infestation.

Gilmour[15] has pointed out that insects require, in general, the same ten amino acids in the diet for growth that are required by the rat. This decrease in amino acid content of the test samples was obviously due to the fact that the amino acids had been utilised by the insects for growth. These deficiencies in the essential amino acids or the presence of deleterious metabolites of infestation could have probably been the cause of retarded growth of rats fed the infested diets and also the death of rats fed the highly infested field bean diet.

The overall results obtained showed that the losses due to insect infestation are not only quantitative but also qualitative. In a developing country like India, there is urgent need for adequate protection of grains in storage in order to minimise nutrient losses. This is especially true with regard to legumes since they form a major source of protein in the Indian dietary.

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Studies on the Nutritive Value of Sundried Green Leafy Vegetables

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The effect of sundrying on the nutritive value of three green leafy vegetables viz. mustard, *raya*, spinach and their supplementary value to wheat flour diets with respect to growth rate, PER and effect on liver nitrogen, lipids and plasma protein was evaluated. The protein content in these leafy vegetables increased from 3 to about 32 per cent which was due to loss of moisture. The loss of ascorbic acid and carotene contents of sundried leaves varied from 34.4 to 63.5 percent and 48.0 to 89.8 percent respectively. The sundried leaves were supplemented to wheat flour at 5 percent level and the protein content of all diets was maintained at 9 percent level. The rate of growth was higher in case of leafy vegetable supplemented groups as compared to wheat fed group. Among the leaves supplemented groups, mustard leaf supplemented group showed the best growth. There was an increase in liver nitrogen and plasma protein and decrease in liver lipids in sundried leafy vegetable supplemented group as compared to whole wheat group.

Green leafy vegetables are a good source of carotene, calcium and ascorbic acid[1]. These are also a good source of high quality protein and many vegetables contain 30 per cent or more of protein on dry basis[2]. The Indian diets are deficient not only in protein but also in minerals[3]. The high supplementary value of green leaves of lucerne to poor rice diet has been shown by Sur[4] and attributed to its calcium content. Swaminathan and Bhagvan[5] have observed that green leafy vegetables can be a good supplement to Indian rice diet as source of minerals and vitamins. In Punjab, leafy vegetables like mustard (*Brassica compestris*) and *methi* (*Trigonella foenum graecum*) are commonly consumed during winter. These vegetables are sometimes sundried in winter to use them in summer. The object of the present investigations was to study the effect of sundrying on the nutritive value of three green leafy vegetables viz. mustard (*Brassica compestris*), *raya* (*Brassica juncea*) and spinach (*Spinacia oleracea*) and also to evaluate their supplementary value to wheat diets.

Materials and Methods

The fresh green leaves of mustard, *raya* and spinach were washed with tap water and leaves with 2 to 3 inches of stem were chopped. These were sundried at temperature of 23 to 25°C and at 55 to 65 humidity. The dried leaves were ground to fine powder and stored in air tight containers inside a refrigerator.

All the leaf samples were analysed for crude protein, crude fiber, ether extract, ash and calcium by AOAC methods[6]. These samples were also analysed for phosphorus[7], iron[8], oxalic acid[9], ascorbic acid[10], and carotene[11] and basic amino acids by automatic amino acids analyzer[12].

The supplementary effect of sundried leafy meals on the protein of wheat was studied using the protein efficiency ratio (PER) criterion. The leaf meal was incorporated at 5 per cent level to whole wheat flour diets. The protein content of all diets was maintained at 9 per cent level with adequate amounts of minerals and vitamins. Albino rats, about 4 weeks old, were individually weighed and randomly divided into five groups each consisting of eight rats. The animals were housed individually in cages having wire-mesh bottoms, and had free access to water. The diets were fed *ad libitum* for 4 weeks. The food consumption of rats within groups were recorded and the animals were weighed at weekly intervals. At the end of the experiment the animals were anesthesized with chloroform, livers were removed, weighed and dried. The dry powder of liver was analysed for total nitrogen and ether extract. The haemoglobin content of the blood was determined by acid hematin method of Wintrobe[13]. The blood was centrifuged at 2,500 rpm for 15 min and the plasma was separated and analysed for total protein[14]. Appetite quotient (AQ) of different diets was also calculated by Carpenter formula[15].

Results and Discussion

Data on the chemical composition of sundried leaves are given in Table 1. On sundrying the protein content of these vegetables increased from 3 to 32 per cent due to loss of moisture. The sundried mustard, *raya* and spinach contained 754, 475, and 380 mg/100 g of calcium and 344, 171 and 152 mg/100 g of phosphorus respectively on dry basis. These leaves were found to contain an

TABLE 1. CHEMICAL COMPOSITION OF SUNDRIED GREEN LEAFY VEGETABLES (ON DRY BASIS)

Leaves	Protein* (N×6.25)	Crude fibre %	Ether extract %	Ash %	Oxalic acid %	Calcium mg/100g	Phosphorus mg/100g	Iron mg/100g	Lysine g/16 gN	Histidine g/16 gN	Arginine g/16 gN
Mustard	32.20	15.00	2.40	25.90	Nil	754	344	100	4.30	1.40	3.90
Raya	31.80	11.90	2.90	20.70	Nil	475	171	53	4.20	1.70	4.70
Spinach	31.70	8.10	2.40	21.30	8.50	380	154	74	4.10	1.60	3.60

*The protein content in fresh leaves of mustard, *raya* and spinach was 2.71, 3.68 and 3.33 per cent respectively.

TABLE 2. ASCORBIC ACID AND CAROTENE CONTENT OF FRESH AND SUNDRIED GREEN LEAFY VEGETABLES

Leaves	Ascorbic acid mg/100 g on dry basis		Loss of ascorbic %	Carotene μg/100 g on dry basis		Loss of carotene %
	Fresh leaves	Sundried leaves		Fresh leaves	Sundried leaves	
Mustard	352	128	63	4929	503	89
		(117)	(66)		(399)	(92)
Raya	512	191	62	2414	766	68
		(172)	(66)		(600)	(75)
Spinach	310	187	39	3235	1680	48
		(177)	(43)		(1360)	(58)

Values in the parenthesis indicate data at the end of 6 month storage of sundried leaves in a refrigerator.

TABLE 3. FOOD INTAKE, WEIGHT GAIN, PER AND APPETITE QUOTIENT (AQ) VALUE OF DIFFERENT GROUPS OF RATS FED ON DIFFERENT DIETS FOR FOUR WEEKS.

Diets	Food intake (g)	Protein intake (g)	Initial body wt. (g)	Final body wt. (g)	Body wt. gain (g)	PER	AQ
Mustard + wheat flour (D1)	297.42*	26.76*	34.80	84.60	49.80*	1.84	0.469*
SD(±)	11.80	1.06	4.40	5.10	3.80	0.43	0.02
Raya + wheat flour (D2)	282.50	25.42	34.10	76.60	42.50	1.65	0.489*
SD(±)	17.50	1.62	4.40	8.00	6.69	0.55	0.02
Spinach + wheat flour (D3)	287.72	25.88	34.50	81.70	47.20*	1.81	0.465*
SD(±)	22.40	2.21	4.30	10.80	8.81	0.65	0.02
Wheat flour (D4)	272.23	24.54	34.10	71.10	37.00	1.50	0.521
SD(±)	23.99	2.18	5.60	9.50	4.33	0.10	0.03
Skim milk (D5)	339.98*	30.54*	34.00	120.20	86.20*	2.80*	0.405
SD(±)	9.70	0.88	4.00	8.42	8.42	0.74	0.01

*Significant difference at 5% level
SD: Standard deviation

appreciable amount of iron. Mustard and *raya* leaves were devoid of oxalic acid whereas spinach leaves contained 8.5 per cent. There was little difference in the basic amino acid content (Table 1) of these leafy vegetables except for arginine which was more in *raya* leaves as compared to other leaves. The lysine content of leafy vegetables is higher than that of cereals and would, therefore, provide a cheap supplement to improve the nutritive value of cereals.

Data on the effect of sundrying on the carotene and ascorbic acid content in these leafy vegetables are shown in Table 2. The loss of ascorbic acid and carotene content of leaves analysed immediately after sundrying, varied from 39 to 63 per cent and 48 to 89 per cent respectively. Slightly more loss in ascorbic acid and carotene content was observed when the sundried leaves were stored for 6 months in the refrigerator (Table 2).

Data on the effect of different diets on body weight gain of rats, PER and AQ are given in Table 3. The rate of growth was higher in case of leafy vegetable supplemented groups (D1 to D 3) as compared to whole wheat fed (D4) group. However the growth was muchless than with skim milk (D5) group. Among the leaf supplemented groups, mustard leaf supplemented (D1) group showed the best growth. There were statistically significant differences in gain in body weight of rats fed mustard, spinach, and skim milk as compared to that fed whole wheat flour. This may be attributed to the fact that the proteins of leafy vegetable supplement-

TABLE 4. LIVER WEIGHT, LIVER NITROGEN, FAT, PLASMA PROTEIN AND BLOOD HAEMOGLOBIN CONTENT OF RATS FED WITH VARIOUS DIETS.

Diets	Liver wt.		Liver		Blood analysis	
	Total (g.)	g/100 g body wt.	Total N g/100 g body wt.	Fat g/100 g body wt.	Plasma protein g/100 ml	Haemoglobin g/100 ml
Mustard + wheat flour (D1)	3.87	4.83	0.56*	0.41	6.10*	10.77*
SD(±)	0.55	0.51	0.06	0.07	0.98	1.13
Raya + wheat flour (D2)	3.41	4.40	0.49	0.38	5.06	9.17*
SD(±)	0.72	0.54	0.03	0.04	0.99	1.07
Spinach + wheat flour (D3)	3.78	4.18	0.52*	0.36*	5.15	8.53
SD(±)	0.61	0.41	0.06	0.07	0.63	0.77
Wheat flour (D4)	3.07	4.26	0.48	0.42	4.50	7.83
SD(±)	0.54	0.37	0.04	0.04	1.26	1.07
Skim milk (D5)	4.67	4.03	0.51*	0.33*	6.65*	9.05*
SD(±)	0.38	0.93	0.03	0.03	0.96	0.99

*Significant difference at 5 per cent level.

ed diets, may possess a better amino acid make up as well as acceptability. PER values for wheat diet and diets containing wheat supplemented with mustard, *raya* and spinach leaves were 1.50, 1.85, 1.65 and 1.81 respectively. Appetite quotient calculated for these groups indicated that the whole wheat flour diet (D4) had less acceptability as compared to other diets. The differences in the mean PER of experimental groups were statistically not significant except for the skim milk diet group (D5) but the AQ of different experimental groups were statistically significant when compared with wheat flour fed (D4) group.

Sure[16] reported that supplementation with 5 per cent dehydrated spinach and mustard to wheat diet increased the PER value from 0.61 to 0.94 and 1.25 respectively. The PER of jowar was significantly improved from 0.92 to 1.54 with the supplementation of *methi* at 2 per cent protein level[17]. Garcha *et al* [18] reported that diet supplemented with leaf protein showed an improvement over the wheat fed groups. There was an increase in PER value from 0.89 in wheat flour to 1.22 in case of mustard and 1.23 in case of spinach supplemented diet.

Total liver weights of animals fed leafy vegetable supplemented diets were slightly higher than those of control wheat diet (Table 4). Nitrogen concentration was significantly more in D1 (mustard), D3 (spinach) and D5 (skim milk diet) groups as compared toD4 (whole wheat group). There was more fat in the livers of wheat diet group (D4) than those of leaf supplemented groups. The values for plasma protein increased significantly when the wheat diet was supplemented with mustard leaves. There was more haemoglobin in the blood of animals fed supplemented (wheat plus leaf meal) diets and the lowest for the group fed wheat diet alone. The present study leads to the conclusion that diets supplemented with sundried leaf meals have shown an improvement over the wheat diet and the mustard leaves were found superior to *raya* and spinach in respect of their nutrient contents supported by the actual rat experiment. It may, therefore, be concluded that diets containing sundried leafy vegetables could be used as a supplement to cereal diets with beneficial effects.

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Effect of Addition of Different Chemical Additives to Milk upon the Quality of Freeze Dried Curd (*Dahi*) Powder

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Effects of addition of different commonly known food additives such as gelatin, pectin, lecithin, corn starch, glycerine, monostearate (GMS) etc., to milk upon the quality of freeze dried curd powder have been reported. Best result was obtained in the final quality of the reconstituted curd with corn starch and lecithin in equal proportion (0.375% w/v). Remarkable improvement in the reconstitution property was also obtained by using 0.375% each of corn starch and GMS in combination.

The effect of various chemical additives upon the quality of curd were reported by Baisya and Bose[1]. It was found that lecithin and glycerine monostearate (GMS) decreased the curd tension to a little extent whereas, pectin, gelatin and corn starch increased the tension significantly. These additives have also remarkable effect upon total acid and volatile acid contents of curd. The use of GMS and lecithin as colloid stabilisers, pectin and gelatin as gelling agents and gelatinised corn starch as thickener are well known[2].

It has been reported by Baisya and Bose[3] that none of the usual drying techniques gave a product which on reconstitution with water gave exactly the same texture as fresh *dahi*. These authors also reported[4] that there were significant differences in the gel structure of fresh and rehydrated freeze dried curd. The characteristic difference between the fresh curd gel and the gel obtained by rehydration of freeze dried curd powder were explained in terms of thermodynamic and physico-chemical properties.

Bhatia *et al*[5]. reported that lecithin, lactose, sodium citrate, sodium hexametaphosphate, etc., improved the quality of the accelerated freeze dried curd powder and best result was obtained by using a combination of 0.1 per cent sodium citrate, 0.02 per cent lecithin and 2 per cent lactose. But they have not given any data in support of their observations and practically no published data are available. So, it was thought worthwhile to study the effect of addition of other commonly known food additives in milk upon the quality of freeze dried curd powder.

Materials and Methods

Preparation of curd and addition of chemical additives: The chemical additives like glycerine monostearate, lecithin, pectin, gelatin and corn starch were added in various amounts as indicated in Table 1 to milk before inoculation as described by Baisya *et al*[1]. The inoculum (5 per cent, v/v) was an active culture of *S. thermophilus* grown on sterile milk (5 psig for 30 min) having 0.80 to 0.85 per cent acidity (lactic acid) and incubated for 16 hr at 40°C.

Freeze drying of curd: The freeze drying of curd was carried out in glass beakers (2.5 cm heights). The working pressure inside the chamber was 0.02 cm of Hg. The freeze drying unit used was of model No. 10-100, Sl. No. 1101, 220 volts, 50-60 c/s, 5 amphere, of Virtis Research and Equipment, Marconi Instrumentation, Graderer, New York.

Methods of analysis: Titratable acidity and total bacterial count of dry powder curd were determined according to the method of Indian Standards Institution[6]. Volatile acidity was determined according to the method of Hammer and Bailey[7], with 25 g of dried curd powder. The result was expressed as ml of N/100 NaOH required to neutralise 150 ml of the condensate collected from 2.5 g dried powder. Moisture was determined with 5 g of curd powder taken to a constant weight at 80°C. The reconstitution property and organoleptic quality for colour, flavour, homogeneity and taste was determined as described by Baisya *et al*[4]. All experiments were done in triplicate and the average results are reported.

Results and Discussion

The addition of chemical additives in milk upon the quality of freeze dried curd powder has been shown in Table 1. These additives seem to have some effect upon the volatile flavouring constituents of curd. Furthermore, pectin and gelatinised corn starch also imparted

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TABLE 1. EFFECT OF VARIOUS CHEMICAL ADDITIVES UPON THE QUALITY OF FREEZE DRIED CURD

Additives	Additive added to 100 ml milk	Moisture in dried product (%)	Bacterial count / g of dry powder	Total acid (as % lactic on dry basis)	Volatile acid (ml 0.01N NaOH)	Reconstitution property
Gelatin	1.0 ml	5.03	56×10^6	5.50	8.18	Texture and colour good, flavour
(1% solution)	1.5 ,,	5.95	71×10^6	5.76	8.34	poor
	2.0 ,,	5.30	75×10^6	5.50	7.02	
	2.5 ,,	5.36	101×10^6	5.77	6.66	
	5.0 ,,	5.12	86×10^6	5.78	6.95	
Pectin	0.1 g	3.62	7×10^6	4.75	7.64	Texture and colour good, flavour
(250 grade)	0.2 ,,	5.47	33×10^5	4.32	6.26	poor also imparted an aftertaste
	0.3 ,,	4.63	21×10^4	4.15	7.35	and slightly brownish colour to
	0.4 ,,	5.72	5×10^4	4.16	7.36	the powder
	0.5 ,,	5.03	85×10^3	3.80	7.11	
Lecithin	0.1 g	4.43	56×10^6	5.86	8.86	Colour and flavour excellent, texture
	0.2 ,,	5.15	68×10^6	5.92	8.98	good.
	0.3 ,,	4.49	101×10^6	6.53	10.32	
	0.4 ,,	5.01	135×10^6	5.31	9.59	
	0.5 ,,	4.15	86×10^6	5.58	8.80	
	0.6 ,,	4.98	95×10^6	5.96	7.65	
Corn starch	0.25 g	4.80	155×10^5	5.51	6.56	All had poor flavour and taste but
	0.50 ,,	4.95	103×10^5	5.32	6.30	excellent texture, also imparted
	1.00 ,,	5.02	150×10^5	5.08	5.32	brownish colour to the powder.
	1.50 ,,	4.35	28×10^5	4.98	4.89	
	2.00 ,,	4.45	17×10^5	4.88	4.76	
	2.50 ,,	4.12	20×10^5	4.76	4.32	
Glycerine mono-	0.1 g	4.5	103×10^6	6.66	6.76	All had good colour, flavour and
stearate	0.2 ,,	6.2	120×10^6	6.25	6.86	texture.
	0.3 ,,	4.9	95×10^6	6.32	7.95	
	0.4 ,,	3.6	135×10^6	6.54	8.15	
	0.5 ,,	4.1	151×10^6	6.15	7.93	
	0.6 ,,	3.6	128×10^6	6.37	6.70	
Control	Nil	4.46	139×10^6	5.01	5.98	Texture, colour and flavour-mode-
						rately acceptable.

a slightly brownish colour to the dried product. Probably pectin has got some antibacterial property and for that reason total bacterial count and total titratable acid production were reduced by the addition of pectin. Lecithin and GMS improved the volatile flavouring constituents, but did not have remarkable effect on retention of curd texture. Experiments were carried out by using combination of these additives in equal proportion and the chemical analysis of the final dried product has been shown in Table 2. Best result was obtained with regard to final quality of the reconstituted curd by using corn starch and lecithin in equal proportion at a concentration of 0.375 per cent of each. Remarkable improvement in quality is also achieved by using the same concentration (0.375 per cent w/v) of corn starch and GMS.

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TABLE 2. EFFECT OF CHEMICAL ADDITIVES UPON THE QUALITY OF FREEZE DRIED CURD

Additives*	Additive to added 100 ml milk	Moisture in dried product (%)	Bacterial count / g of dry powder	Total acid (as % lactic on dry basis)	Volatile acid (ml 0.01N NaOH) g	Reconstitution property
GMS+corn starch	0.25	4.962	65×10^6	5.34	6.53	Good texture, colour & flavour
	0.50	4.850	102×10^6	4.98	6.95	
	0.75	5.02	135×10^6	6.02	7.09	
	1.00	4.791	58×10^6	4.96	6.26	
	1.50	4.652	41×10^6	5.13	6.03	
	2.00	4.636	25×10^6	5.60	5.98	
Lecithin+corn starch	0.25	4.556	121×10^6	4.69	6.95	Good flavour, colour & texture
	0.50	4.962	130×10^6	5.30	7.02	
	0.75	5.350	132×10^6	5.62	8.36	
	1.00	4.860	82×10^6	4.97	6.85	
	1.50	4.782	56×10^6	4.39	6.77	
	2.00	4.72	31×10^6	4.36	6.32	
Pectin+corn starch	0.25	4.80	23×10^6	4.64	5.68	Good texture, poor flavour & colour.
	0.50	4.65	10×10^6	4.83	5.32	Imparted after taste & brownish
	0.75	5.35	69×10^5	4.59	5.21	colour to the product.
	1.00	5.12	53×10^5	4.36	4.98	
	1.50	5.21	39×10^5	4.99	4.86	
	2.00	5.305	27×10^5	4.90	4.73	
Lecithin+pectin	0.20	3.93	137×10^6	5.35	7.12	Good flavour & texture; poor colour.
	0.30	4.09	101×10^6	5.06	7.93	Imparted after taste.
	0.40	5.33	86×10^6	5.24	8.30	
	0.50	4.85	73×10^6	4.95	8.56	
	0.60	5.65	83×10^6	5.00	7.18	
	0.80	5.29	109×10^6	5.62	6.93	
Glycerine mono-stearate+pectin	0.20	5.61	76×10^6	4.88	5.78	Good flavour & texture; poor colour.
	0.30	4.79	38×10^6	5.12	5.93	Imparted after taste.
	0.40	5.04	150×10^6	5.08	6.79	
	0.50	3.97	98×10^6	4.97	6.98	
	0.60	4.65	88×10^6	5.35	6.13	
	0.80	5.02	109×10^6	5.68	5.95	
Lecithin+glycerine monostearate	0.10	3. 6	123×10^6	5.35	7.32	Excellent flavour & colour; slightly
	0.20	4.91	130×10^6	4.86	7.85	loose texture.
	0.30	5.13	103×10^6	4.92	8.86	
	0.40	3.93	91×10^6	5.01	10.30	
	0.50	4.88	113×10^6	5.01	9.15	
	0.60	4.67	97×10^6	4.99	9.08	
Control	Nil	4.46	139×10^6	5.01	5.98	Moderately acceptable product with respect to texture, colour & flavour

*In equal proporation.

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Studies on the Preparation of Intermediate Moisture Pineapple

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By the immersion equilibration procedure using a soak solution containing glycerol, sucrose, potassium sorbate, potassium metabisulphite and water, intermediate moisture pineapple chunks and rings were made. The product had moisture, 34.8; sucrose, 24.0; glycerol, 38.2; and potassium sorbate, 0.2 per cent; SO_2, 260 ppm and a water activity (a_w) of 0.79.
Samples packed in cans and paper-foil-polythene laminate pouches maintained their acceptability for more than 6 months at 0°C, upto 6 months at room temperature (25°–30°C) with slight browning and weakening of flavour beyond 4 months and upto 4 months at 37°C. Packing in high density polythene pouches shortened the shelf life by increasing browning and loss of flavour. The product was microbiologically sound for direct consumption. The soak solution could be economically reused without affecting the quality of the product.

Investigations were undertaken on the development of varieties of intermediate moisture (IM) fruits for use in combat rations in lieu of fresh, dehydrated or canned fruits with the object of provisioning troops deployed in operational areas inaccessible to regular supplies. Results of experiments on the preparation of the IM guava were reported earlier[1]. Data on the preparation, packaging and storage of IM pineapple are reported in this paper.

Materials and Methods

Preparation of fruit: Fully ripe pineapple procured from the local market was used. The fruits were washed, soaked in 0.1 per cent potassium permanganate solution for 15 min after removing the crown and washed thoroughly free of permanganate. The fruits were then peeled, cored and cut into either chunks of about 3 cm length, 2 cm breadth and 1 cm thickness or rings (slices) of about 1 cm thickness.

Preparation of IM pineapple: The IM pineapple chunks or rings were made by the immersion-equilibration procedure wherein the raw fruit chunks or rings were blanched and equilibrated in a soak solution having a composition identical with that used in the preparation of IM guava[1] using exactly the same method except that potassium metabisulphite was used at 0.1 per cent level instead of 0.05 per cent.

The IM chunks were packed in 301 × 206 (8 oz) SR lacquered cans and the rings in 401 × 300 (1 lb butter) SR lacquered cans. Both the samples were also packed in paper (kraft 60 gsm)-aluminium foil (0.02 mm)-polythene (150 G) laminate (PFL) pouches and in high density polythene pouches (300 and 500 G) for comparative evaluation.

Analytical methods: The proximate composition of the IM pineapple was determined by the AOAC methods[2]. Free sulphur dioxide was determined by the iodimetric method[3].

Sucrose was estimated by the AOAC method[2] and acidity by titration with N/100 sodium hydroxide solution. Potassium sorbate was determined by the method of Nusy and Bolin[4]. The glycerol contents of the finished product and the equilibrated infusion solution before and after concentration were computed by difference.

Water activity was determined by measuring the equilibrium relative humidity (ERH) by a modification of the graphical interpolation method of Landrock and Proctor[5] as done in the case of IM guava[1] at contsant temperature (35°C).

Storage studies: The IM pineapple chunks and rings packed in cans and flexible pouches as above were stored at 0°C, room temperature (25°-30°C) and 37°C and examined periodically by a taste panel for colour, flavour and texture.

Non-enzymatic browning was measured in the case of samples packed in cans and PFL pouches by a modification of the method of Hendel *et al.*[6] by extracting 5 g of the sample with 100 ml of 66 per cent alcohol and measuring the optical density of the clear extract in a Klett Summerson photo-electric colorimeter using filter no 42. The results were expressed as $E^{5\%}_{1\,cm}$ 420 mμ. Browning was also followed by measuring the colour directly using Lovibond Tintometer and the colour

TABLE 1. DATA ON THE PREPARATION OF INTERMEDIATE MOISTURE PINEAPPLE

Particulars	Prepared fresh fruit	IM product	Soak solution after equilibration	Equilibrated soak solution after concn.
Moisture (%)	84.9	34.8	34.3	13.4
pH	3.5	4.2	4.6	5.0
°Brix	11.5	—	—	—
Acidity (as % anhydrous citric)	0.87	0.45	0.19	0.15
Reducing sugar as dextrose (%)	4.8	1.9	1.3	4.0
Total sugar (%)				
as Dextrose	11.4	25.3	28.6	36.6
as Sucrose	10.8	24.0	27.2	34.8
Potassium sorbate (%)	—	0.2	0.24	0.34
Glycerol (by dif. %)	—	38.2	38.5	51.8
SO_2 (ppm)	—	260	340	146
ERH (%) (at 35°C)	—	79	—	—
Yield (%)				
Raw wt. basis	50	40	—	—
Prepared fruit wt. basis	—	80	—	—

TABLE 2. CHARACTERISTICS OF INTERMEDIATE MOISTURE PINEAPPLE DURING STORAGE

Storage temp. (°C)	Period (months)	Non-enzymatic browning: Extract ($E^{5\%}_{1\,cm}$ 420 mμ)	Non-enzymatic browning: Direct (Lovibond Tintometer units) Y	R	B	Organoleptic quality
0 (control)	2	0.05	9	2.3	1.9	Good colour & texture; excellent flavour
	4	0.05	9	2.3	1.9	,, ,, ,,
	6	0.05	9	2.3	1.9	,, ,, ,,
Room temp.	2	0.05	9	3.0	1.9	,, ,, ,,
	4	0.07	9	3.3	2.0	Very slight browning; as good as control in texture and flavour; acceptable.
	6	0.08		3.5	2.0	Light brown, weaker in flavour than control; just acceptable.
37	2	0.05	9	3.2	1.9	Slightly brown compared to control; comparable to control in texture & flavour; acceptable.
	4	0.08	9	3.5	1.9	Light brown; slightly weaker in flavour than control; just acceptable.
	6	0.09	9	3.8	2.1	Dark brown; scorched flavour; unacceptable.

TABLE 3. MICROBIOLOGICAL DATA ON INTERMEDIATE MOISTURE PINEAPPLE DURING STORAGE

Count (colonies/g)	0°C			RT			37°C		
	2m	4m	9m	2m	4m	9m	2m	4m	9m
Total plate count	2800–3300	3800–4500	310	1800–2300	1300–1500	235	1500–1800	1100–1500	210
*Staphylococcus**	420–480	190–230	Nil	130–190	90–110	Nil	90–110	30–40	Nil
Coliforms	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Moulds**	100	Nil	Nil	Nil	Nil	Nil	70	Nil	Nil
Yeasts†	170–220	490–610	Nil	150–210	360–370	Nil	70–130	150–210	Nil

**Staphylococci* wherever noticed were coagulase negative.
***Moulds:* Mostly *Rhizopus, Aspergillus niger, Cladosporium*
†*Yeasts:* Mostly *Saccharomyces*

expressed in red, yellow and blue units. The values recorded for the samples at 0°C were used as initial readings for comparison.

The samples packed in cans were also periodically tested for total plate count, *Staphylococcus*, coliforms, yeasts and moulds by the methods recommended by the American Public Health Association[7].

Reuse of soak solution: The soak solution after equilibration was reused by removal of about two-thirds of the water from the filtered solution by evaporation in a vacuum pan followed by adjustment of the water, sugar, glycerol and potassium sorbate contents back to the same level as in the original soak solution based on analysis. IM pineapple was made reusing the equilibrated soak solution after adjustment and its composition and shelf life studied simultaneously.

Results and Discussion

Data on the preparation of IM pineapple are given in Table 1. The product had excellent flavour, texture and colour comparable to the fresh fruit except that it was a little sweeter. Both the chunks and ring should be eaten as such without any further rehydration or preparation.

The IM pineapple had the following proximate composition (per cent):

Moisture	34.8
Total sugars (as sucrose)	24.0
Ether extractives	0.3
Protein (N×6.25)	0.7
Crude fibre	1.2
Total ash	0.8
Glycerol and other carbohydrates (by diff)	38.2
Calorific value (per 100 g) (Assuming 4.3 calories per gram for glycerol)	260
Sulphur dioxide ppm	260

The ERH of the product, as determined by the graphical interpolation method, was found to be 79.0 per cent at 35°C. The water activity achieved (0.79) was sufficient to prevent bacterial growth, while growth of yeasts and moulds was prevented by potassium sorbate.

Characteristics of the IM pineapple during storage at 0°C, room temperature and 37°C in cans upto 6 months are given in Table 2. Samples stored at 0°C were unchanged in organoleptic quality and highly acceptable even after 6 months. Samples kept at room temperature were found to be acceptable upto 6 months with a slight browning and weakening of flavour beyond 4 months, while those at 37°C were acceptable only upto 4 months beyond which there was considerable browning and weakening of flavour. No rancidity or off-flavour was noticed in any of the samples. Non-enzymatic browning measured both in terms of Lovibond Tintometer units and as optical density of the alcoholic extract showed significant increase in brown colour of samples stored at 37°C and a slight increase in samples stored at room temperature between 4-6 months.

The organoleptic quality and readings for non-enzymatic browning observed for samples packed in PFL pouches during storage for 6 months were more or less identical with those observed for the product packed in cans. They had a shelf life similar to the canned product.

Sensory evaluation of samples packed in high density polythene pouches showed that they suffered more browning and significant flavour loss than the corresponding samples in cans and paper-foil-polythene laminate pouches and became unacceptable after 3 months at 37°C and 4 months at room temperature.

Table 3 shows the microbiological status of the product after 2, 4 and 9 months. The data reveal that while total plate count in general decreased to a negligible

level during storage for 9 months, *Staphylococci* (coagulase negative) and moulds were reduced to nil and coliforms remained negative. Pathogenic organisms were absent. Yeasts showed a slight increase after four months but became nil after 9 months. The absence of pathogenic organisms and the reduction in the total microbial load is possibly due to the very nature of the environment (low water activity) which is not favourable to microbial growth. These observations confirm our earlier findings[1].

There was no significant change in the ERH, composition and organoleptic quality of the IM product prepared by reusing the equilibrated soak solution after concentration and adjustment of composition. Its shelf life was very similar to that of the material prepared by first soak.

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Effect of Heating and Chilling Buffalo Milk on the Properties of Fat Globule Membrane Proteins*

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Heating and chilling buffalo milk induced compositional changes in the fat globule membrane proteins. The most affected constituents were bound carbohydrates whose levels diminished during all treatments. Changes in the amino acid composition of fat globule membrane protein were more pronounced due to effect of sterilization than by boiling and pasteurization. Chilling of milk had little effect on the amino acid composition.

Gel filtration pattern revealed that pasteurization, boiling and chilling altered the molecular size of the minor components, whereas sterilization resulted in the formation of a major protein peak of higher molecular size. The fat globule membrane proteins of unprocessed milk were resolved by polyacrylamide gel electrophoresis into thirteen protein and six glycoprotein components. Boiling and sterilization altered the electrophoretic characteristics, whereas, chilling had no impact. It is proposed that heating and chilling of buffalo milk bring about compositional and structural changes in the fat globule membrane.

Milk fat globule membrane (FGM) which stabilizes the fat globules in milk undergoes myriad changes in its composition and properties when milk is subjected to processings[1–4]. Such changes lead to the destabilization of milk fat which is due to the loss of membrane materials from the globule surface. Lowenstein and Gould[5] demonstrated that heating milk to 82°C for 15 min resulted in the loss of recoverable membrane material and the loss of protein exceeded the loss of lipids. Brunner[2] reported that mild heat treatment alone did not cause excessive loss of membrane materials. The compositional and electrophoretic changes in the FGM of bovine milk as a result of ageing milk at 4°C for 24 hr were reported[6]. Recently, Tolstukhina and Aristova[7]

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reported the influence of processing on the destabilization of milk fat. Impact of chilling and freezing on the milk system has been reported by several workers[8–10]. From the foregoing it is obvious that very little information is available on the impact of heating and chilling milk on the properties of FGMP. Earlier reports from this laboratory were confined to the physico-chemical properties of buffalo milk fat globule membrane protein (FGMP)[11]. The aim of this study was to elicit the physico-chemical changes in FGMP on heat treatment and on chilling milk.

Materials and Methods

Buffalo milk (Murrah breed) was collected in the morning from Institute's herd and processed immediately.

Isolation of FGMP from different types of milk: FGMP was isolated from both raw milk and treated-milk. The procedure of Banerjee *et al*[11] was followed with suitable alteration in relation to the nature of treatment. The FGMP from raw milk served as the control.

For pasteurization, milk was treated at 63°C for 30 min. Boiled milk was obtained by heating milk over a flame and kept under boiling condition for 10 min. Sterilization of milk was performed at 10 lb/sq in. pressure for 15 min. Chilled milk refers to the milk sample cooled at 4°C within 10-15 min and kept at that temperature for 24 hr. FGMP was subsequently isolated from these treated milk samples.

Total nitrogen, sialic acid, phosphorus, hexose and hexosamine contents in the FGMP were estimated by the methods reported earlier[11]. Amino acid analysis was performed with a Beckman-spinco Model 120 C amino acid analyzer employing dual-column procedure of Moore and Stein[12]. For polyacrylamide gel electrophoresis under acidic conditions, a 10 per cent gel was prepared according to the method of Takayama *et al*[13] and the electrophoresis was done following the procedure of Winkler *et al*[14]. SDS-polyacrylamide gel electrophoresis was carried out according to Weber and Osborn[15] and the glycoprotein components were identified by the method of Fairbanks *et al*[16]. Gel filtration of FGMP was performed according to Majumder *et al*[17] using a Sephadex G-100 column of 50 × 3 cm size. The eluted fractions (5 ml each) were monitored for protein content by the method of Lowry *et al*[18].

Results and Discussion

Composition: The compositional data of FGMP is presented in Table 1. The level of nitrogen in the control and in the specimen isolated from chilled milk did not differ markedly. However, the specimens obtained from pasteurized, boiled and sterilized milk were higher in their nitrogen content. Hexose and hexosamine levels were considerably reduced on heat treatment and on chilling. Perusal of Table 1 further reveals that sialic acid content in FGMP diminished dramatically during all the processing treatments. The reduction was maximum (80 per cent) on chilling followed by sterilization (76 per cent), pasteurization (69 per cent) and boiling (46 per cent). These results suggest compositional changes in the FGMP during processing of milk. Sabarwal and Ganguli[9] also observed compositional changes in the casein micelle of buffalo milk on chilling. That heating the milk modifies the surface layer of fat globules has also been reported[19].

TABLE 1. COMPOSITION OF FGMP ISOLATED FROM HEAT TREATED AND CHILLED BUFFALO MILK

Nature of sample	N (%)	P (%)	Sialic acid (%)	Hexose (%)	Hexosamine (%)	Total carbohydrate (%)
Control	12.81	0.25	1.41	3.06	0.82	5.29
Pasteurized	13.72	0.34	0.43	2.84	0.62	3.89
Boiled	14.21	0.24	0.75	2.24	0.35	3.34
Sterilized	13.30	0.27	0.33	2.43	0.42	3.18
Chilled	12.95	0.19	0.28	2.69	0.60	3.57

Quantitative differences were observed in the amino acid composition of FGMP isolated from heat treated and chilled buffalo milk (Table 2). The levels of arginine, serine, glycine and phenylalanine were reduced during all the processing treatments. On the other hand, lysine, methionine, and leucine contents were increased on chilling, pasteurization and boiling. It was further noted that except methionine, the levels of all the amino acids diminished on sterilization demonstrating marked change in the amino acid composition. It was also evident from Table 2 that chilling did not appreciably alter the amino acid composition.

Molecular nature: Sephadex G-100 gel filtration patterns of FGMP from heated and chilled milk are presented in Fig. 1 B. Four well defined protein components were observed in the control, whereas, the specimens isolated from chilled, pasteurized and boiled milk had three components each. The major protein fraction in all the samples had similar molecular size, but differences were noticed in the minor components. The peaks at Tube No. 31 and 46 in the case of FGMP from pasteurized milk were absent in the control, and in the specimens of boiled and chilled milk. The FGMP of sterilized milk got resolved into two components. It is obvious from Fig. 1A that sterilization resulted in the formation of a major protein fraction of higher molecular size. The resultant increase in the molecular size could

TABLE 2. AMINO ACID COMPOSITION OF FGMP ISOLATED FROM HEAT TREATED AND CHILLED BUFFALO MILK

Amino acids	Unprocessed	Chilled	Pasteurized	Boiled	Sterilized
			(g/100 g sample)		
Lysine	5.26	5.53(+5.2)	5.61(+6.7)	6.46(+22.9)	4.98(—5.4)
Histidine	1.96	2.18(+11.5)	1.99(+2.0)	2.03(+4.0)	1.75(—10.8)
Arginine	4.76	4.61(—3.2)	4.32(—9.4)	4.19(—12.0)	3.64(—23.7)
Aspartic acid	6.99	6.50(—7.1)	6.50(—7.1)	7.29(+4.4)	6.30(—10 0)
Threonine	4.57	4.38(—4.3)	4.20(—8.3)	4.58(+0.65)	4.03(—12.0)
Serine	4.42	4.41(—0.50)	3.82(—13.8)	4.09(—7.6)	3.70(—16.3)
Glutamic acid	8.80	9.49(+7.9)	8.48(—3.7)	7.86(—10.7)	8.76(—0.5)
Glycine	2.52	2.32(—5.5)	2.22(—12.2)	2.09(—17.3)	1.83(—27.5)
Alanine	3.48	3.49(+0.50)	3.47(—0.20)	3.67(+5.7)	3.14(—9.9)
Valine	5.14	5.02(—2.4)	5.00(—2.8)	5.38(+4.8)	4.73(—8.0)
Methionine	0.68	0.70(+3.2)	0.89(+31.8)	0.73(+8.4)	0.74(+9.0)
Isoleucine	4.59	4.62(+0.8)	4.54(—1.1)	4.93(+7.5)	4.50(—2.0)
Leucine	7.60	7.77(+2.3)	7.67(+1.0)	8.43(+11.0)	7.55(—0.6)
Tyrosine	3.33	3.46(+4.2)	3.07(—8.0)	3.61(+8.9)	3.07(—8.0)
Phenylalanine	5.49	5.26(—4.2)	5.07(—7.8)	5.24(—4.6)	4.48(—18.5)

Figures in the parenthesis indicate the percent increase (+) or decrease (—) in the amino acid content of the sample from heat treated and chilled milk when compared with the control.

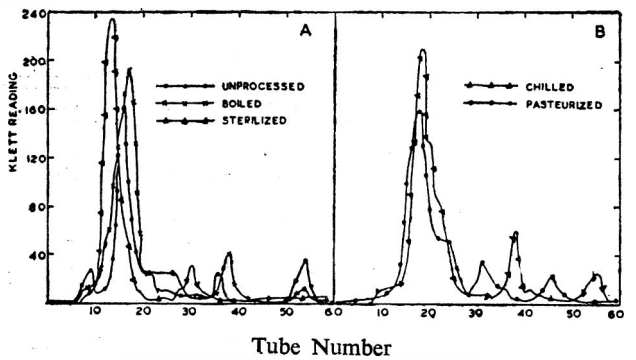

Fig. 1 Gel filtration pattern of FGMP isolated from heat treated and chilled buffalo milk on Sephadex G-100 using phosphate buffer, pH 7.0.

be due to aggregation of protein components during sterilization. However, the nature of the aggregation still remains to be elucidated. Changes in the aggregation properties of FGM due to high heat treatment to milk was reported by Klebanov and D'yachenko[20].

Electrophoresis: The FGMP specimens from heat treated and chilled milk were examined by polyacrylamide gel electrophoresis for determining the changes in protein and glycoprotein components during such treatments. Fig. 2 depicts the SDS-polyacrylamide gel electrophoretic pattern of FGMP. Thirteen protein and six glycoprotein components were observed in the control. One of the glycoprotein component (A) was clearly different from the protein components. Kobylka and

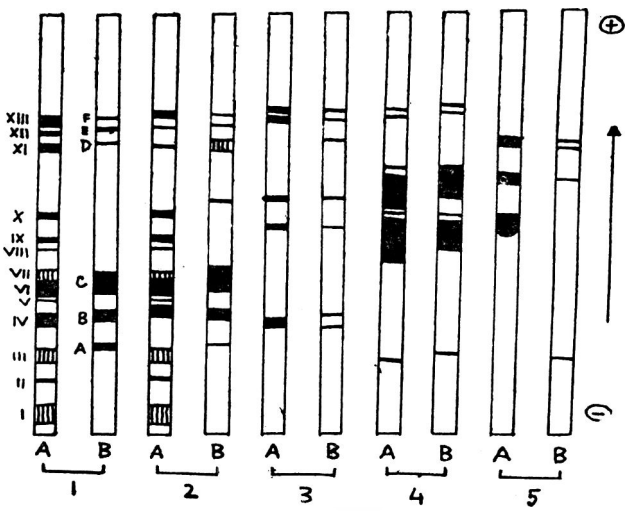

Fig. 2 Polyacrylamide gel electrophoretic pattern of FGMP of buffalo milk in SDS system. 1. Control 2. Chilled 3. Sterilized 4. Micellar casein 5. Micellar casein plus FGMP A and B are stained for protein and glycoprotein, respectively.

Carraway[21] observed six protein and six carbohydrate components in bovine milk FGM. Three of the carbohydrate components in the chromatogram were distinctly different from the protein bands.

The electrophoretic behaviour of FGMP from chilled milk was essentially similar to that of the control except that one glycoprotein band in the chilled specimen was absent in the control. The FGMP prepared from

sterilized milk had five protein and seven glycoprotein components eliciting remarkable changes in both proteins and glycoproteins. Glycoprotein components A and C of control could not be detected in the sterilized specimen. It is also evident from Fig. 2 that the major glycoprotein component and some of the protein components present in the control were missing in the sterilized specimen. The results suggest some reorganization in the FGM during sterilization of milk. One of the reasons for such changes in the electrophoretic behaviour could be due to an interaction between FGM and casein micelle[5,22]. However, in the present investigation major casein components could not be detected in the sterilized specimen (Fig. 2) indicating that casein micelle components do not form a substantial part of the membrane structure on sterilization. Skim milk protein components adsorbed on the FGM during high heat treatment might have been washed away during the isolation of FGMP from such treated milks.

There is, however, a possibility of some of the membrane components being stripped off into the skim milk phase as a result of interaction with the casein micelle. No attempt was made to prove such possibility. Hayashi and Smith[23] observed that part of the outer membrane of fat globule is easily removable by heating. It was observed that although boiling of milk altered the electrophoretic characteristics of FGMP, pasteurization had only minor impact on the resolution behaviour.

On the basis of the present experimental evidences, it is proposed that high heat treatments and chilling produce compositional and structural changes in the FGM of bufalo milk and that the changes are more prominent during high heat treatment.

Acknowledgement

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RESEARCH NOTES

ENTEROTOXIGENICITY AND PHAGE TYPING OF *STAPHYLOCOCCI* ISOLATED FROM *PEDHA*

Staphylococci isolated from _Pedha_ samples were examined for their ability to produce enterotoxin and phage typed. Three of the four coagulase-positive strains examined were enterotoxigenic, while one coagulase-positive strain failed to produce any enterotoxin. Seven out of the fourteen isolates were phage-typable, mostly by phages belonging to groups II and III suggesting the likely source of contamination to be of human origin.

Microbiological analysis of *Pedha* samples purchased from different sweet-meat shops in Bombay has been previously reported[1]. Fourteen staphylococcal strains isolated by direct plating on Baird-Parker's ETGPA medium were further examined for their ability to produce enterotoxin and phage typed.

Staphylococcal isolates were examined for the coagulase activity as described earlier[1]. Initially, attempts were made to develop the animal assay (kitten test) for the detection of enterotoxin in staphylococcal culture filtrates. The method has worked well with some workers[2,3] while others have reported variable to unreliable results[4,5]. Unfortunately, no emetic response was observed even when the cats were intraperitoneally administered ten times the usual dose required for the reaction. Injection of concentrated culture filtrates also yielded negative results.

In view of this, attempts were made to examine the culture filtrates for enterotoxin by polyacrylamide gel electrophoresis, according to a modification of the method proposed by Baier[6]. Sterile casein digest medium[7] was taken in Roux bottles, inoculated with 0.1 ml of a 24 hr old culture (100 ml) of the test isolate and incubated at 37°C for 72 hr. The cells were separated by centrifugation in a Janetzki K24 centrifuge and the culture filtrate was dialyzed at 4°C against distilled water containing merthiolate (1:100,000) for 24 hr, and then concentrated (35 to 40 times) by dialysis against polyethylene glycol. Aliquots of the concentrated broths (generally 0.1 or 0.2 ml) were taken for polyacrylamide gel (PAG) disc electrophoresis. Good resolution with clear sharp bands was obtained with a 15 per cent gel, a double strength buffer (β-alanine-acetic acid, pH 4.3) and a constant current of 3 milliamps per tube applied for 90 min at 25°C (column 2, Fig 1) than with a 7.5 per cent gel column and buffer strength as recommended[6] (column 3, Fig. 1). The faster moving band, (column 1, Fig. 1,) represents the protein band obtained from the uninoculated medium. Partially purified enterotoxins were employed as reference standards. All the enterotoxins—A, B, C and E exhibited lower electrophoretic mobilities and banded closer to the origin under the specified conditions (Fig. 2).

Thus it was possible to show that isolates 1, 2 and 16 which were coagulase-positive, are also enterotoxigenic (Table 1). Isolate 7, although coagulase-positive, was non-enterotoxigenic. Correlation of enterotoxin production with coagulase activity has been attempted in the past and is widely accepted as a reliable indicator of enterotoxigenicity. However, reports on coagulase-negative enterotoxin producing strains have also appeared[8,9]. Polyacrylamide gel electrophoresis, thus, provides a convenient presumptive test for the enterotoxigenicity of staphylococcal isolates. However, final confirmation of enterotoxin production would necessarily involve biological testing of the isolated toxin using monkeys.

Phage typing was carried out as recommended by Blair and Williams[10]. The isolates were typed with the basic set of phages given below:

Group	Phages
I	29, 52, 52A, 79, 80
II	3A, 3B, 3C, 55, 71
III	6, 7, 42E, 47, 53, 54, 75, 77, 83A
IV	42D
Miscellaneous	81, 187

Phage typing of staphylococcal isolates in relation to food poisoning is useful in identifying the source of contamination-human or environmental. *Staphylococci* from cheese, butter-milk, cream, ice cream, fermented milk, dried and condensed milk have been reported to be lysed by phages of group III and IV[11]. Also, enterotoxin production is primarily confined to these groups[12]. However, Ghosh and Laxminarayana[13] employing a different set of phages found that enerotoxigenicity was not restricted to any particular phage group. Recently, Kusch and Sinell[14] reported phage typing studies with 366 coagulase-positive *Staphylococci* from foods. Seventy-seven per cent of the strains were typable and consisted mainly of groups I, III and I/III. Ten per cent of the strains belonged to group II. In the present study all the four coagulase positive *Staphylococci* were typable (Table 1) two belonging to group III and two to group II. One coagulase-negative strain also belonged to group III and was typable at × 100 RTD. Of the total number of 7 typable strains six were type specific, i.e. lysed by only one phage while one strain exhibited 'a pattern of lysis'. Recently, Pasricha *et al*[15] have shown that of the 204 coagulase positive *Staphylococci* isolated from pyodermic lesions, nose, throat and skin of 200 patients, 147 strains belonged to phage groups II and III. This suggests that the typable strains isolated from *pedha* in the present study which belonged to group II

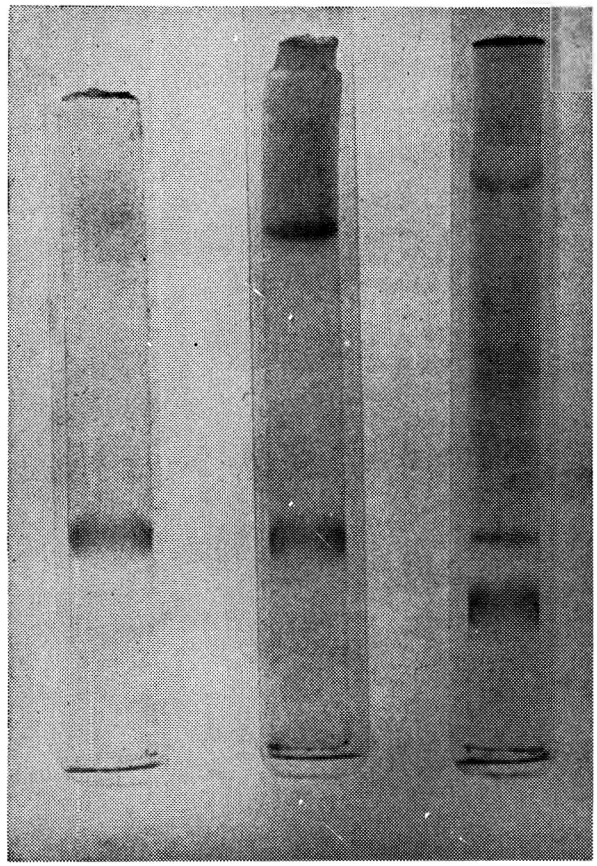

Fig. 1. Disc electrophoretic patterns. Concentrated culture medium (1) and culture filtrate on 15 per cent (2) and 7.5 per cent (3) PAG columns.

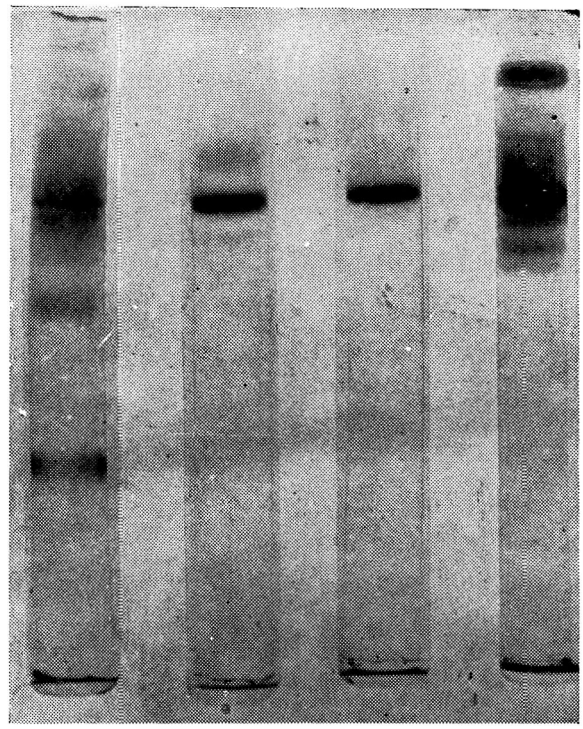

Fig. 2. Disc electrophoretic patterns. Standard (partially purified) enterotoxins A. B. C and E.

TABLE 1. CHARACTERISATION OF STAPHYLOCOCCI ISOLATED FROM PEDHA SAMPLES IN TERMS OF PHAGE TYPING AND ENTEROTOXIN PRODUCTION

Isolate No.	Phage type*	Phage group	Coagulase activity	Exterotoxin production
1	3	II	+	+
2	7.47.54	III	+	+
3	—	—	—	—
5	—	—	—	—
6	—	—	—	—
7	54	III	+	—
8	—	—	—	—
10	—	—	—	—
11	—	—	—	—
12	3	II	—	—
13	—	—	—	—
15A	3	II	—	—
15	54(×100 RTD)	III	—	—
16	3	II	+	+

*(–) Indicates non-typable strains.

and group III are of human origin irrespective of their coagulase activity. It is very likely that *Staphylococci* arising out of shedding from the bovine udder are completely destroyed by the severe heating given to milk during the manufacture of *khoa*, the basic ingredient in *pedha*. Further, very few strains of animal origin are known to produce enterotoxin[16].

Generally, foods implicated in this type of food poisoning have been reported to be contaminated with *Staphylococci* of the order of several thousands per gram. However, the presence of *Staphylococci* in a food by itself does not render it suspect. The suitability of the food ecosystem to support the growth of *Staphylococci* with consequent enterotoxin production has to be established. Results of these studies will be reported in subsequent papers.

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RENNET FROM BUFFALO, COW, GOAT AND PIG

A technique was standardized for the preparation of animal rennet from young calf stomach of buffalo, cow, goat and pig. The extraction of stomachs with 5% NaCl solution containing 2.5% boric acid produced the best results. The nitrogen content, pH and activity of buffalo rennet was higher than that from cow, goat and pig. The quality of cheese prepared from calf rennet was identical with that of Hansen's animal rennet.

Rennet may be prepared either from the stomach tissue or the fistulated calves. The abomasum tissue is the most potent source of rennin and it is necessary to have the calf maintained on milk. If the calf is given fodder then pepsin instead of rennin predominates in rennet.

Keil and Stout[1,2] and Tauber and Kleiner[3] prepared crude extracts of rennet from fresh calf stomachs. Various workers like Placek *et al*[4], Thornley and Stanley[5] Kalinowska Krystyna[6] have described the preparation of rennet from salted dried calf stomachs. Scandura[7] extracted the dried stomachs of kids and lambs while Quadri *et al*[8] prepared rennet from the stomachs of freshly slaughtered goats and sheep. Due to the shortage

of animal rennet in foreign countries and the import restrictions, it was considered desirable to standardize the preparation of animal rennet in India. Very little work appears to have been done in India on the preparation of animal rennet. In the present study, rennet extracts were prepared from the calf stomachs of cow, buffalo, goat and pig.

Four–weeks old calves of cow and buffalo required for the investigation were procured from Military Dairy Farm, Ambala Cantt and operated for preparing fistulated rennet. The stomachs of those cow calves that could not survive after the fixing of canula were taken. Precleaned stomachs of buffalo calves were also procured from Western Regional Station of N.D.R.I., Bombay, and had been dried and heavily salted to enhance their keeping quality. Two–to three–weeks old calves of goats and pigs were purchased from the local market.

Extraction of rennet: Thirty four rennet extracts were prepared from the fourth stomach of young suckling calves of buffalo, cow, goat and pig. These included nine stomachs from buffalo calves, six from cow, nine from goat and ten from pigs.

The method of extraction as described by Colowick and Kaplan[9] was modified at certain stages. The stomachs were cleared of their contents in cold running water and cut into small pieces (0.5 to 3 cm wide). The extractions of stomachs were carried out at room temperature using 200 ml of 5 per cent NaCl solution containing 2.5 per cent boric acid as a preservative. In the case of goat and pig stomachs, the weight of stomach was comparatively less and hence only 100 ml of 5 per cent NaCl solution was used instead of 200 ml. The blending was carried out daily for one minute in the Braun Multimix at 8,900 rpm. After 4 days, the extract was separated by centrifuging for 15 min at 3,000 rpm. The activity of the extract was determined daily and the extraction was discontinued after 3-4 days when the activity ceased to rise. The rennet extracts were stored in a refrigerator at 0-4°C.

In the case of dry stomachs of buffalo calves from Western Regional Station, Bombay, the stomachs were first freed of the salt and then extracted. Prorennin present was activated to rennin[9] by treatment with hydrochloric acid at pH 3.6 and temperature 0-5°C for 1-2 days. The pH was then raised to 5.4 to produce a stable and highly active but slightly viscous and cloudy solution.

The clarification of a few rennet extracts from all the species was done by the method of Van der Burg and Ven der Scheer[10]. A concentrated solution containing 0.8 to 0.9g $KAl(SO_4)_2 . 12H_2O$ for every 100 ml of rennet extract was added with slow stirring of the solution. A flocculent precipitate of aluminium hydroxide with rennin adsorbed on it was formed. This was confirmed from the coagulation time of milk using the clear solution. The adsorbed rennin was released by adding enough disodium hydrogen phosphate solution to raise the pH to between 5.3-6.3. Subsequently the mixture was filtered and the clear filtrate was found to possess good activity. But for preparing cheese this stage of clarification was omitted as the crude extract was considered suitable for cheese making.

Nitrogen content, pH and activity of rennet preparation: The rennet extracts were examined for pH, nitrogen content and activity. Estimation of nitrogen was carried out by Kjeldahl method[11] and pH by Cambridge pH meter. Rennet activity was determined by observing the clotting time of milk using the technique of Dastur *et al*[12] and Berridge[13]. The procedural details and calculations of rennet activity have been described by Singh *et al*[14].

Keil and Stout[2] used hydrochloric acid solution at pH 1 or less for the extraction of rennet from calf stomachs. Friedel[15] and Kalinowska Krystyna[6] extracted calf stomachs with aqueous calcium chloride solution under different conditions.

Vitoria[16] used extracting solutions of 10 per cent NaCl, 5 per cent glycerol and 2 per cent boric acid. The presence of NaCl helped in conserving the coagulating power. Van der Burg and Van der Scheer[10] macerated shredded stomach tissue with 10 per cent NaCl solution containing 2 per cent boric acid. Scandura[7] also used NaCl solution for extraction of dried stomachs of calves, kids and lambs. Quadri *et al*[8] extracted goats and sheep stomachs with 10 per cent glacial acetic acid. In the present study, extraction of

TABLE 1. NITROGEN CONTENT AND PH OF RENNET PREPARATIONS

Particulars		Buffalo (9)	Cow (6)	Goat (9)	Pig (10)
Volume of extract(ml)	Min.	152	150	62	76
	Max.	175	172	84	95
	Av.	163	159	75	87
Nitrogen content (mg)	Min.	362	226	270	112
	Max.	435	339	336	207
	Av.	408	288	297	137
Total N in extract (mg.)	Min.	684	384	193	91
	Max.	771	542	251	157
	Av.	724	456	222	119
pH	Min.	6.30	5.72	6.18	4.98
	Max.	6.98	6.94	6.70	5.80
	Av.	6.64	6.42	6.39	5.55

Note:—Figures in brackets indicate the no. of extracts prepared.

TABLE 2. ACTIVITIES OF RENNET PREPARATIONS

Particulars	Buffalo (9)	Cow (6)	Goat (9)	Pig (10)
Av coagulation time (sec.) using reconstituted milk	94	211	329	1245
Total activity (rennet units) in the extract	173.4	75.3	22.8	7.0
Total protein in the extract (mg)	4590	2891	1407	754
Specific activity (activity in rennet units/mg protein)	0.038	0.026	0.016	0.009

Note:—Figures in the brackets show the number of extracts and the average values have been reported.

the stomachs with 5 per cent NaCl solution containing 2.5 per cent boric acid produced good results.

The nitrogen content and pH values of animal rennet extracts from various animals have been given in Table 1. The data show that the nitrogen and pH contents of buffalo calf rennet were higher than those of cow calf rennet. The corresponding values for goat rennet were less, while for pig rennet the values were the least of all.

The data regarding the activity of rennet preparations have been presented in Table 2 which show that the rennet from buffalo calf possessed a greater activity than cow calf followed by goat and pig.

Using cow and buffalo rennet extracts, a small scale preparation of cheddar cheese from cow milk was conducted. The cheese samples were examined by a panel of judges familiar with the judgement of cheese quality. The quality of cheese from cow calf rennet was found to be identical with that of the imported Hansen's liquid animal rennet. Buffalo calf rennet did not produce cheese of comparable quality. No trials were made for making cheese from goat and pig rennets because of their low activity and less quantities.

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ALANINE AND VALINE PRODUCTION BY A PROTEUS STRAIN

A *Proteus* strain isolated from defatted soya-flour was examined for its amino acid production in a synthetic medium. Glucose as carbon source and sodium nitrate as nitrogen source were most efficiently utilised.

Bacterial production of alanine, valine, leucine and glutamic acid by *Achromobacter* and *Pseudomonas* has been reported in a French Patent[1]. Valine production by *Micrococcus glutamicus*[2], *Aerobacter cloacae*[3] and alanine production by *Mycobacterium album*-194[4] are reported. A large number of strains belonging to *Bacillus*, *Pseudomonas*, *Aerobacter* and *Micrococcus* were studied for the production of various amino acids in different media containing various carbon and nitrogen sources[5,7].

In the present work a *Proteus* strain isolated from defatted soya flour which was found to be a lone species, has been studied for its production of alanine and valine in a synthetic medium.

The stock culture was maintained on nutrient agar containing 0.1 per cent defatted soya flour at pH 7.0 and was subcultured at monthly intervals. The basal medium[8] was used with supplementation of carbon and nitrogen sources at varying concentrations. The inoculum was transferred aseptically to the main flask making the total broth of 50 ml taken in a 250 ml conical flask and incubated for 2 days at ambient conditions. The cells were separated by centrifugation for 10 min. The culture filtrate was used to estimate the amino acid formation. The observations in the Fig 1 and 2, are for 50 ml broth.

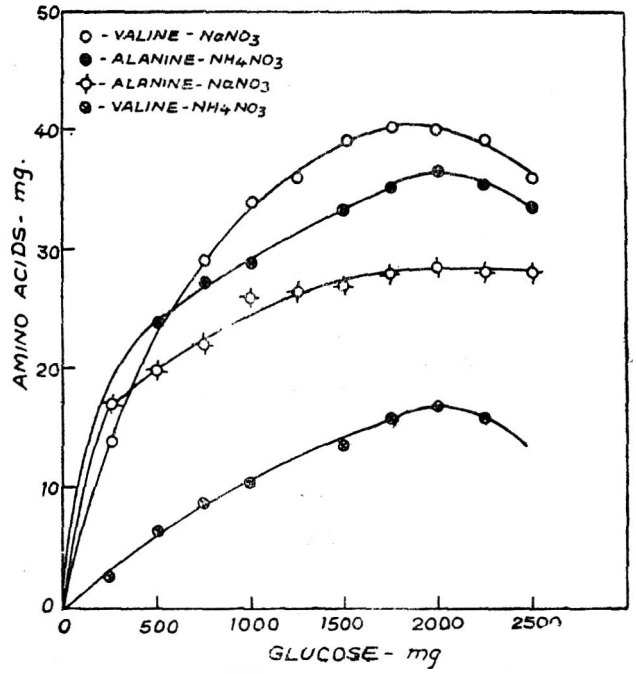

Fig. 1. Effect of glucose concentration on the yield of amino acids.

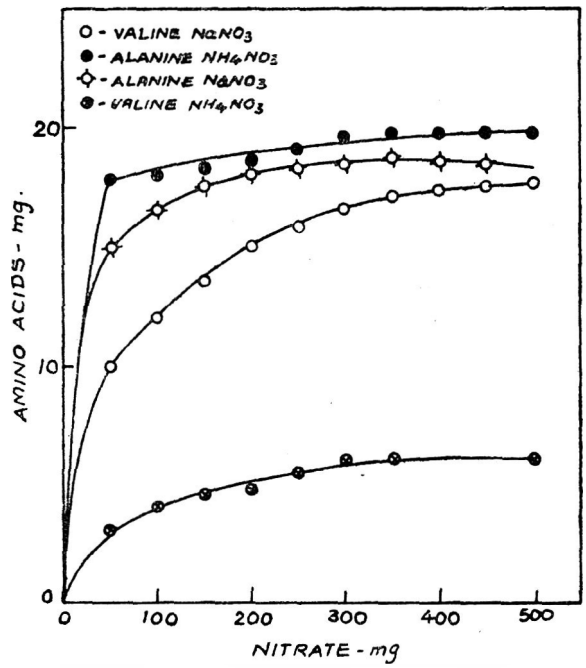

Fig. 2. Effect of inorganic nitrogen source on the yield of amino acids.

To get better separation of the amino acids on the chromatograph the culture filtrate was evaporated to dryness on a water bath and the residue was taken in 10 ml of 80 per cent ethanol and finally the dry residue again taken in 5 ml of 20 per cent isopropanol.[9] Descending paper chromatographic technique, which gave better separation with n-butanol, acetic acid, water (4:1:1)[10,11] was used. The amino acids were detected with 0.3 per cent ninhydrin in acetone and scanned in a Systronics densitometer type 201 with green filter (540 mμ). The amino acids were estimated quantitatively by calibrating with a similar experiment run using standard amino acids.

The composition of the medium greatly influences the yield of fermentation products. Complex nutrients used lowered the amino acid production and stimulated the cellular growth of *Micrococcus glutamicus*[7]. Most of the complex nutrients used were either sources of amino acids or of vitamins and amino acids. However, in the present studies the organism was allowed to grow on a well defined medium containing no complex nutrients which indicated a good control over the final results by the carbon and nitrogen sources. The carbon source-glucose was found to be the best for the amino acid production by the isolate as supported by the earlier findings[5,7]. It was also noted that no direct relation existed between the cellular growth and the amino acid production by the isolate. Amongst the nitrogenous compounds sodium and ammonium nitrates were the best. From the Fig 1 the optimum concentration of glucose needed in the broth appears to be around 3.5 per cent for valine and about 4.5 per cent for alanine in the presence of sodium nitrate at 0.1 per cent level whereas the same values appear to be 3.5 and 4 per cent in the presence of ammonium nitrate at 0.1 per cent level. In a similar observation optimum glucose concentration is reported to be 2.5 per cent for valine production by *Micrococcus glutamicus*[2]. Fig. 2 shows that the optimum concentration of $NaNO_3$ as 1 per cent and NH_4NO_3 as 0.9 per cent to give better yields of valine and alanine. Valine concentration steadily increased with $NaNO_3$ where as alanine concentration showed steep rise at low levels of $NaNO_3$ and remaining steady later. It has been noted that the strain *Micrococcus glutamicus*[2] did not produce any extracellular valine in the presence of KNO_3, $NaNO_3$, etc. In the present case even in the absence of the complex nutrients like peptone, yeast extract and meat extract, but in the presence of inorganic nitrates like $NaNO_3$ and NH_4NO_3 there is the formation of valine by *Proteus* which is of considerable interest.

We thank Dr P. S. Mene, Director, L.I.T., Nagpur for his kind interest in this work and the UGC for a research fellowship to one of the authors (V.G.P.).

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STUDIES ON THE COMPOSITION OF *SANDESH* (INDIAN SWEETMEAT)

The major constituents of *Sandesh* are milk fat, protein and sucrose. Soft cooked *Sandesh* contains a considerable amount of moisture (max 27.51 per cent). Hence, it is liable to be decomposed early. Sugar seems to be the only preservative in *Sandesh*.

Rasogolla and *Sandesh* are the most popular chhana based Indian sweetmeats. Mitra *et al*[1] reported the composition of *Rasogolla* but that of *Sandesh* has not been reported so far. The composition of *Sandesh* is reported in the present note. Normally *Sandesh* is of two kinds namely soft cooked (*Narampak*) and hard cooked (*Karapak*).

TABLE 1. CHEMICAL COMPOSITION OF SANDESH

Type		Moisture (%)	Acidity (as %lactic acid)	Fat* (%)	Total sugar (as sucrose)* (%)	Total proteins* (N×6.38) (%)
Soft cooked	Max	27.5	0.29	26.9	58.0	33.6
	Min	19.1	0.19	20.7	36.6	19.3
	Av	23.4	0.24	23.1	47.9	26.1
Hard cooked	Max	12.8	0.37	24.4	56.9	24.6
	Min	10.8	0.28	17.8	50.5	15.8
	Av	11.6	0.33	21.8	53.0	20.5

*On dry wt. basis.

Twenty samples of each kind of *Sandesh* were collected from different confectioners of Calcutta and subjected to detailed analysis. For analysis, about 50 g of the *Sandesh* was mixed thoroughly by triturating in a glass mortar with a glass pestle and preserved in a wide-mouth glass stoppered bottle. Moisture was determined by drying 5 g of the prepared sample to constant weight at 100°C. Fat[2], sucrose[3] and protein[4] were determined by standard methods respectively. For the determination of extractable acidity,[5] 10 g of the prepared sample was shaken for 4 hr with 250 ml of freshly distilled water at room temperature and filtered. The filtrate (100 ml) was titrated with 0.02 N sodium hydroxide solution using 1 ml of phenolphthalein solution as indicator. The acidity was expressed as lactic acid per 100 ml of filtrate.

Each sample was free from starch, saccharin and calcium carbonate.

It is suggested that the maximum values of moisture, acidity and sugar and minimum value for fat as found in the Table 1 may be fixed as standard composition.

Acknowledgement

The author is grateful to the authorities of the Corporation of Calcutta for providing facilities for conducting the present work and particularly to Sri K. P. Banerjee for his assistance.

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EFFECT OF DEHYDRATION ON THE STABILITY OF CHLOROPHYLL AND β-CAROTENE CONTENT OF GREEN LEAFY VEGETABLES AVAILABLE IN NORTHERN INDIA

The green leafy vegetables like mustard greens (*Brassica campestris* var. Sarson), Spinach (*Beta vulgaris*), mint (*Mentha spicata*) and coriander leaves (*Coriandrum sati-*

vum) could be dried successfully to a low moisture content (6 per cent). Blanching of leaves in 2 per cent sodium carbonate solution at 79.4°C for 5 min helped to retain the green colour of the dehydrated product. The reconstituted products had good colour and flavour.

Dutton *et al.*[1] have studied the dehydration of spinach and changes in colour and pigment during processing and storage. Goje[2] carried out investigations on the development of some spinach products. Kabigting[3] studied the stability of chlorophyll in processed foods. As information on the dehydration of indigenous green leaves is not available, this investigation was undertaken to dry leafy vegetables grown in Punjab. The results are presented in this paper.

Fresh mustard greens, spinach, mint and coriander leaves procured from the local market or from the vegetable farm of Punjab Agricultural University, Ludhiana were sorted, cleaned and washed in water. Only fresh leaves with soft stems having green colour and free of blemishes were chosen. One kg lots of clean trimmed leaves were taken in a muslin cloth and blanched in a solution of 2 per cent sodium carbonate at 79.4°C for 5 min, cooled in water and drained for 10 min on aluminium perforated trays[4,5]. Blanching at this temperature was found to be effective in retaining the natural green colour.

The blanched material was spread evenly on aluminium perforated trays (3′ ×2′) at the maximum rate of 0.5 kg/sq ft and dried in a hot air cabinet drier. The drying temperature varied from 62.8—68.3°C the time from 7–8 hr and the moisture content of the dried product was less than 6 per cent. The dehydrated leaves were cooled to room temperature, sealed in high density (500 gauge), and low density (200 gauge) polyethylene bags and in paper-aluminium-polyethylene laminates and stored at room temperature.

Moisture, chlorophyll and β-carotene were determined by the A.O.A.C. methods[6]. The dehydration data are given in Table 1. The dehydration ratio of mustard greens was 12:1, spinach 15:1, mint 13:1 and coriander leaves 12:1.

Moisture content, colour, flavour and texture of dehydrated products are given in Table 2. The products should preferably be stored in paper-aluminium-polyethylene-laminated bags to minimize the effects of oxygen and light which are permeable through polyethylene which would affect the flavour and the pigments naturally present.

Changes in chlorophyll and β-carotene in the dehydrated samples during storage are given in Table 3. On storage, the chlorophyll content of dehydrated green leafy vegetables decreased to some extent but not β-carotene (Table 3).

TABLE 1. PARTICULARS OF DEHYDRATION OF LEAFY VEGETABLES

Leaves	Edible portion (%)	Initial moisture (%)	Blanching time (min)	Drying time (hr)	Final moisture (%)	Dried product yield (%)
Mustard greens	73	89.0	6	8–10	6.00	8.7
Spinach	55–60	91.0	5	6–10	3.5	6.2
Mint	55	84.9	5	8–9	4.8	7.0
Coriander leaves	70	86.3	5	7–8	3.5	8.3

TABLE 2. EFFECT OF STORAGE CONDITIONS ON THE DEHYDRATED PRODUCT

Leaves	Packaging material	Storage period (months)	Moisture (%)	Colour
Mustard greens	a & c	0	6.0	Green
	a & c	4	6.0	,,
Spinach	b	0	3.5	Deep green
	b	4	4.00	Slightly affected
Mint	a	0	4.8	Deep green
	a	3	4.8	,,
Coriander leaves	a	0	3.5	,,
	a	3	3.5	,,

a) High density (500 gauge) polyethylene bags
b) Low density (200 gauge) polyethylene bags
c) Paper-aluminium-polyethylene-laminates
Flavour was normal in all cases.
Texture was crisp in all except 4 month stored spinach where it was slightly soft.

TABLE 3. EFFECT OF STORAGE ON THE STABILITY OF CHLOROPHYLL AND β-CAROTENE CONTENT OF DEHYDRATED GREEN LEAVES

Leaves	Storage period (months)	Chlorophyll content* (mg/g)	β-Carotene* (mg/100 g)
Mustard greens	Fresh	1.25	2.80
	7	1.01	2.70
	8	0.87	2.70
Spinach	Fresh	1.30	2.50
	0	1.09	2.17
	4	1.01	2.17
Mint	Fresh	1.78	1.62
	?	0.94	1.54
	2	0.87	1.40
	3	0.73	1.33
Coriander leaves	Fresh	2.27	3.20
	2	1.26	2.17
	3	1.16	2.17
	4	1.01	2.17

*Values are on equivalent fresh weight basis.

The dried samples reconstituted well in boiling water within 7 min. However, a further cooking is needed to overcome the raw taste. The reconstituted products had a good consistency, colour and flavour.

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BOOK REVIEWS

Fruit and Vegetable Juice Processing: Food Technology Review No. 21 by J. K. Paul, Noyes Data Corporation, Park Ridge, New Jersey, U.S.A. First Edition, 1975, pp. 277; Price: $ 36.00.

This book presents an advanced and technically oriented review of the Processing of Fruit and Vegetable Juices based entirely on about 170 U.S. Patents issued mostly during the last 10 years (1964–73).

The U.S. patent literature on the subject is claimed to be the largest and the most comprehensive collection of technical information in the world. There is more practical, commercial, and timely process information assembled here than is available from any other source. The technical information obtained from a patent is extremely reliable and comprehensive since sufficient information has to be included to avoid its rejection on account of "insufficient disclosure" therein. These patents include practically all of those issued on the subject in the United States during the period under review (1964–73). It is claimed that there has been no bias in the selection of patents for inclusion. The patent literature covers a substantial amount of useful information not available in the journal literature. The patent literature is a prime source of basic and commercially useful information. This information is overlooked by those who rely primarily on the periodical Journal literature.

It is generally realized that there is a lag between a patent application on a new process development and the granting of a patent, but it is felt that this may roughly parallel or even anticipate the lag in putting that development into commercial practice. However, it is claimed that many of these patents are already being utilized commercially. Whether used or not, they do offer us opportunities for the 'transfer of technology'. Also, a major purpose of this book is to describe the number of technical possibilities available, which may open up new profitable areas for research and development. The useful information contained in this book can allow the reader/researcher to establish a sound background before launching research programme in this field. Another important feature of patent literature is that it can serve to avoid duplication of research and development. Patents, unlike periodical literature, are bound by definition to contain new information, new data and new ideas. Besides, it can also serve as a source of new ideas in a different but related field, and may be outside the patent protection offered by the original invention. Patents literature also covers the difficulties associated with previous research, development or production techniques, and then offers a specific method of overcoming these very problems. This gives clues to current process information that has not been published in periodicals or books. Patents can also aid in new/improved process designs by providing a selection of alternate techniques. Moreover, patents provide a powerful research and engineering tool too. They also provide an excellent starting point for the next investigator. Frequently, innovations derived from research are first disclosed in the patent literature, prior to coverage in the periodical literature. Thus, patents offer the most valuable method of keeping abreast of latest technologies, serving an individual's own "current awareness" program. Besides, patent literature is a creative source of ideas for those original researchers who are blessed with imagination.

The large world market for fruit and vegetable juices, because of their relatively low cost and high nutritional value coupled with modern diet appeal, accounts for the sustained interest in these products and the continued development of improved methods of technology. It is the primary object of this technology to prepare fruit and vegetable juices in such a way that they are able to maintain their natural flavour and aroma under oridinary storage conditions over prolonged periods of time. Considerable progress has been made in this direction. Practically every process in this book is oriented toward the ultimate goal of every juice manufacturer—the retention of natural flavour and aroma and the retardation of unnatural flavours, aromas, or colours. Various preservatives of the past which, while stabilizing a beverage, also introduced undesirable off-flavors, have been replaced by approved modern additives which not only maximize stability, but also enhance natural flavors. The use of these additives in connection with advanced extraction and concentration techniques, which were especially designed for juice manufacture, constitutes the technology of this book.

The book is devoid of the usual Chapters, Sections or Parts. However, the entire subject matter is covered under the following heads: Manufacturing techniques, Concentration Processes, Dehydration, Freeze Drying, Stabilization Processes, Flavour from Fruit Juices, Juice Enhancers and Miscellaneous Processes.

After the unusually brief introduction of hardly 1/3rd of a page, the author straightaway plunges into the subject of different manufacturing techniques for the juices from apple, citrus, grapes, tomatoes and others including pineapple and vegetable carrot, celery and cabbage. In addition, single step process for polished juices or clarified juices, dialysis and ultrasonic treatment for juices have also been discussed.

Under *Concentration Processes*, several techniques such as 'Evaporation' using di-electric heating, Osmotic

transfer of orange essence from single strength juice to concentrate, addition of Frozen Essence to concentrated juice, Concentrates containing discrete pulp mass, Concentration without external heat application, Ultrasonic High Frequency Vibration, spray Concentration, Low viscosity concentrates stabilized with flavour emulsion, etc. The Osmotic Processes covered are semipermeable membrane of Hollow Fibre bundles, Concentration by Molecular Filtration, combination of 'Direct' and 'Reverse Osmosis', controlling the degree of liquid concentration during process, concentration using 'Indirect Heat at membrane, Blending of 'Vacuum' and 'Reverse' Osmosis concentrates, and Fruit juice concentrate prepared in its container by 'Dialysis'. Besides, the latest developments in the field of concentration of pineapple and tomato juices have been discussed. Lastly, different aspects of freezing concentration have been dealt with in considerable detail.

Dehydration of fruit juices into powders is covered under the following subheads: Drum drying (gasification prior to dehydration and addition of amylolytic enzyme), Foam-Mat processes, Spray Drying, Vacuum drying (including 'Slush drying' for flavour retention and 'In-package desiccation' and conditioning, and other techniques such as 'Drying Tower' for heat sensitive liquids and separation of juice into fractions before dehydration.

Under '*Freeze Drying*' of juices are covered 5 different 'Fluidized Bed Processes', 7 techniques of 'Spray Drying' and 5 techniques of 'Continuous Drying Processes', Foam Drying Processes and Thermal-shock Process. Then, the various apparatuses for Freeze Drying discussed relate to 'Vapour Velocity Limitation to achieve more rapid drying, reduced drying time and increased heat utilization efficiency, controlled 'Multi-Pressure Drying', new 'De-frost System' for condensor coils and use of 'Cryogenic Gas System' for initial freezing, etc.

The next subject covered relates to '*Stabilization Processes*' such as 'Antioxidant Compositions', 'Chemical Preservation with new Preservatives, 'Clarification of fruit juices,' Cloud Stabilization, 'De-aeration Processes and Sterilization by different techniques.

Essence recovery by continuous condensation or by distillation and extraction of flavours from fruits by different techniques have been discussed under the head '*Flavours from Fruit Juices*'.

Under the heads, '*Juice Enhancers*', the additives for improving or enhancing flavour and colour have been discussed. Lastly, *Miscellaneous* processes such as blending of fruit juices and milk beverages (or milk shakes) of fortified citrus juices and other juices, juice disbursers, etc. have been covered.

The processes are amply illustrated with figures, diagrams and flow diagrams, wherever possible. Several tabulated statements have also been presented and discussed. At the end, 3 indices have been given—Company Index, Inventor Index and U.S. Patent no. Index. The table of contents has been organized in such a way as to serve as a Subject Index, which is adequate for the purpose.

The presentation of matter and the quality of printing, paper and binding are excellent. As patent literature provides an excellent source for starting new investigation or for improving the existing techniques, this compilation should serve as a very useful compendium for all those research institutions and commercial establishments engaged in R&D work or in manufacturing programmes of fruit and vegetable juice processing. This book also provides an excellent source to the Post-Graduate Teachers and Students in Fruit and Vegetable Technology. It will be a useful addition to any library attached to any institution in Food Technology or Food Research.

J. S. PRUTHI

Composite Flour Technology Bibliography: by D. A. V. Dendy, R. Kasasian, A. Bent, P. A. Clarke and A. W. James. Tropical Products Institute, London, 2nd Edition. 1975, pp 124; Price: £ 1.50

Composite flour technology developed through the ages in several countries not only aim at amileorating the protein deficiency but also assist in extending the food supply of the country. Much effort has gone into developing these technologies, but very little has been done in exploiting them for commercial purposes and making them available to the needy sections of the populations.

This annotated bibliography, gives an exhaustive reference list regarding the composite flour technology developed in different countries supported by the research done as regards its nutritional and related aspects. It contains nearly twice the number of references as compared to the first edition. The titles have been arranged under the appropriate product and raw material sections; each section is made complete by giving exhaustive cross references to the relevant articles in other sections. Search aids like author and subject indexes have also been provided. Although this bibliography is mainly intended for those areas where bread constitues the staple dietary, still many of the rice eating regions will find relevant and useful titles in this bibliography.

K. A. RANGANATH

Fish and Shellfish Processing: by M. T. Giles, Noyes Data Corporation, Park Ridge, New Jersey, U.S.A., 1975, pp. 338. Price: $ 36.

This book is a coherent review and a co-ordinated presentation of technical literature contained in the U.S. patents 1960 onwards in the field of fish and shellfish processing. The commendable merits of the book are freedom from the legalistic phraseology of patent language, layout of the subject matter in an academic and almost text-book style, and above all, its content of detailed technical information of potent commercial applicability.

The subject matter of the book is presented in sections entitled Seafood preservation and struvite prevention, Tuna and tuna-like fish, Fish other than tuna, Mollusks, Crustaceans, Animal feeds, and Fish protein concentrate. Each section, and each subsection, has at its beginning an introductory and background note on the practical relevence to industry of the patent information to follow. This helps to render a systematic account.

Among the 15 points listed in a preliminary page of the book on the importance of this compilation of U.S. patent literature, it is worthwhile to state the most relevent here. There is more practical commercial process information in this book than in any other source, it can serve as a source of new ideas in related fields and it can aid in process design. The compilation is a valuable source and reference book to research and development department and workers.

Apart from the above description of the salient merits of the book, one could add that the book has a nice get-up and is well indexed. What follows now is a description of section and main subsection titles to give an idea of the width of subject matter coverage in the publication.

The section on Seafood preservation and struvite prevention includes refrigeration on board ship, chemical methods, edible coatings, irradiation and prevention of melanosis in shellfish.

The second section on Tuna and tuna-like fish covers thawing, treatments before cooking, precooking, skinning, cooling after precooking, butchering and canning.

In the third section which deals with fish other than tuna are featured processing of carp for human consumption, fish roe, fish steaks, fish sticks and similar preparations, batter-coated fish foods and other consumer products.

The section on mollusks covering clams and oysters, scallops, squid and mollusk products and the next ection on crustaceans covering shrimp, crabs, lobsters, rawfish and crustacean-based consumer products gives wide range of process and product information.

The section on animal foods comprises feed for poultry and livestock, for pets, for mink, for dolphins and seals.

The last section on fish protein concentrates covering preparation by physical, chemical and biological methods and including stick water treatment will be found useful by those working on development of FPC or related products.

The publication is sure to be found useful as it is a good collection of valuable information.

N. V. SRIPATHY

Fishery Products: Edited by R. Kreuzer, Fishery News (Books) Ltd., London, 1974; pp. 451. Price: £ 19.75.

This book summarizes the papers presented at the technical Conference on Fishery products held in Japan, December 1973. This is in sequence to the earlier Conferences on Fish and Fishery Products organised under the auspises of Food and Agriculture Organization (F.A.O.) held at the Netherlands 1956, Washington 1961, W. Germany 1964 and Halifax 1969.

This Conference is one more example where FAO has been instrumental in bringing together fish technologists from all over the world to discuss problems of great concern.

The Conference on fishery products considered in great details the pertinent problems that beset the world fisheries situation today and for the foreseable future. The participants from 55 countries including a good number from developing countries presented many scientific papers and participated in meaningful delibrations.

A good number of the papers focus attention to markets and marketing of fish and fishery products handling, preservation and processing. Apart from processing of fish and crustaceans etc., into a great range of products, full efforts are indicated to make the fullest and most rational use of the aquatic resources by intensified cultivation of fish, shell fish and seaweeds as well as raising fry for release into the sea.

The entire book is divided into eight chapters on

1. *Influence of tradition and change:* Traditional products are in vogue in many countries and their improvement requires attention. Emphasis is laid on devising improved processes which give a better yield from the catch; development of methods and equipment to simplify fish processing and thereby reduce operating costs; development of fish products with intermediate moisture content; increased attention on laying standards to obtain products of uniform quality and efficient disposal of waste.

2. *Handling and chilling of fish:* This chapter focusses attention concerning the bulk preservation of some Pelagic fish and on the new approach of containerized mobile service. Also considerable attention has been given on the functional properties or FPC. There is considerable scope for research and technical work on commercial use of FPC with desired attributes. The other aspects discussed are on the use of preservaties in fishery products, fish meal and oil, liquid fish silage and value of latest equipment in the preparation of new products.

3. *Problems and trends in the utilization of specific resources:* It has been stressed that socio-economic problems of the developing countries should be taken into account when establishing a fish processing industry. Future progress of the industry to a considerable extent depends upon the implication of research work. Also it is suggested that joint ventures will serve the best interests of the countries. Handling and processing of tropical fish received considerable attention and it is even suggested therein that FAO could consider sponsoring the publication of a handbook for fish technology for warm water fisheries.

4. *Product development:* It is recommended that in view of the lack of expertice and research facilities in some of the developing countries, there is an urgent need for high level training of staff in government institutions and fish processing industries. While seeking to transfer products from one country to another, those which suit local tastes can be developed. In many cases the products and the processes have to be modified to meet the requirements of the consumers in the adopting countries.

5. *Quality requirements in product development and trade:* Since minced products are already popular in some countries they will soon find a wide world market. Also there is the possibility of introducing fish analogues based on FPC with improved functional properties. As such the need to look into the problems of quality control and standards have been stressed. Possibly an ad-hoc Working Group will be set up to exchange and pool information on this aspect.

6. *Markets:* It has been pointed out that the developing countries require information on market dimensions, price levels, packaging, supplies, consumer demand, regulations controls, and presentation. It is suggested that there should be international exchange of information about the products available for export and demands prevalent in importing countries.

7. *Training in fish processing technology:* Considerable stress was given for extension service and provision of infrastructure in developing countries, if practical training in improving fish products and selling fish for domestic purpose is to become a success. Practical warning was given that to teach for the sake of teaching and to do research for the sake of research are activities without practical value. The most important problem is to transfer knowledge and skill by all available means and to develop extension services such as has been done in Japan, Norway and U.S.A. The training should include practical approach to problems and also related subjects such as refrigeration, electrical engingering, maintenance of equipment, etc. FAO has been requested to investigate the situation to find out which industry in various member countries would be willing to receive such trainees for giving them further practical on the job training.

8. *International co-operation:* Need for foreign aid for small-scale fisheries was stressed. Particularly joint ventures for this purpose were recommended. Small fisheries need training to improve processing and distribution techniques. An example was cited of the training work done by the University of Rhode Island with the help of a grant from U.S. Agency for International Development. It has established an International Centre for Marine Research Development (ICMRD) which is involved in multifarious activities relating to fisheries, processing, sociological factors of fishermen, etc. Holding of Seminars for the development in fisheries and on quality control were pointed out.

The book is beautifully printed though the quality of the paper is not comparable with the earlier books brought out by FAO. As a suggestion, some more emphasis could have been given on the traditional methods of fish handling and processing in different countries. The book will be of great value to all connected with fish and fish products.

M. N. MOORJANI

Vegetable Protein Processing: L.P. Hanson, Noyes Data Corporation, Park Ridge, New Jersey, London, England, 1974 p. 308; Price: $ 36.

The book under review is a compilation of information gleaned out from various US Patents on Vegetable Protein Processing. It is divided into 15 Chapters; these are (1) Introduction; (2) General Processes for Vegetable Proteins; (3) Processing Whole Soybeans; (4) Processing Full-Fat Soy Products; (5) Defatted Soy Products; (6) Soy Protein Concentrates; (7) Soy Protein Isolates; (8) Soy Hydrolysates; (9) Cottonseed Protein; (10) Grain Proteins; (11) Processing Other Vegetable Proteins; (12) Extruded Fiber Processing; (13) Other Protein Fiber Production Methods; (14) Tetxured Protein Gels and Expanded Products; and (15) Consumer Products. As is evident from the titles soybean and

soybean products occupy an important place in the coverage of subjects.

The Introduction states the object of the compilation. The Chapter on "General Processes for Vegetable Proteins" reviews in a general way various processing methods such as (1) removal of lipids; (2) isolation of protein; (3) protein treatment processes and (4) protein hydrolysates. After these two introductory chapters, the subject under each chapter is dealt with in greater detail. The chapter on "Processing other Vegetable Proteins" includes oilseeds such as sunflower, safflower, sesame, castor, groundnuts (peanuts), rapeseed and mustard and coconut. It deals with preparation of leaf protein concentrate from alfalfa also.

As mentioned earlier all the information is obtained from US Patents. Because of this limitation, only important steps in each process are described. For obvious reasons essential details such as yields, material balance and other "tricks of the trade" are not included. The value of the book lies in the fact that in a single compilation information on a number of processes, especially on soybeans, is available. The coverage on other oilseeds such as groundnut, rapeseed and mustard, sunflower etc. is limited since these are not as important crops in USA as soybeans or cottonseed. The book fulfils admirably its "major purpose" of describing "the number of technical possibilities available, which may open up profitable areas of research and development". All R&D workers interested in the area of vegetable proteins will find this book a useful addition to their Library.

M. S. NARASINGA RAO

Practical Meat Cutting and Merchandising Vol. 2: Pork, Lamb and Veal. Thomas Fabricante & William J. Sultan, The AVI Publishing Company, Inc, Westport, Connecticut, 1975. Price:?

In the U.S.A. meat cutting is a vocational course since most of the meat sold is in the form of preformed and packaged cuts. The detailed instructions given to break the pork, lamb & veal carcasses into these wholesale and retail cuts would be immensely useful as a practical guide for the student and a teching aid for the instructor. Apart from this primary group, it would also be useful for all others involved in meat trade.

The purpose of meat cutting is said to make available cuts suitable for different types of cooking and dishes. While this may be the objective from the angle of the consumer, the book does not say anything about the advantage from the producer or processor's angle. Probably it is to obtain the highest proportion of the carcass as salable cuts. The value of the book would have been more particular to those interested in evaluation and quality of the meat carcass if data on yield in terms of proportion of the various cuts in the different grades of carcasses had been included. Ratio of lean and bone in each of the retail cuts would have clearly brought out the differential pricing of the cuts.

The future trend of sale of meat in India is as preferred and packaged cuts. The book can be expected to be helpful in this development of a cutting methodology incorporating local preferences.

B. R. BALIGA

Some Methods for Microbiological Assay: Edited by R.G. Board and D.W. Lovelock, Academic Press Inc. (London) Ltd., London, 1975; pp. 286; Price: £ 7.80.

This volume is Number 8 in the Technical Series of the Society for Applied Bacteriology and includes contributions to the Autmn Demonstration Meeting held in October, 1972, at the Unigate Central Laboratories, Western Avenue, London, W 3. This book contains 17 papers on different aspects of microbiological assay, each topic being dealt with by eminent workers in the field.

With the rapid expansion of antibiotic and other fermentation industries, automated analyses is gaining importance and is rapidly replacing manual analysis. New techniques are constantly being developed for the assay of antibiotics, vitamins, amino acids and other organic substances. Automated methods have also been extended to serodiagnostic tests. The first four chapters of this book deal with automatic analytical procedures or the equipment useful for such analyses.

Many people, have designed automated systems for microbiological turbidemetric assays. In the first paper dealing with vitamins, the authors Berg, denBurger and Behagel, describe a method which consist of two systems, one for automated dilution of samples and another for turbidity measurements. This system is applicable for use in microbiological, turbidemetric, two-point parallel assays of many vitamins and certain antibiotics.

The second paper in the book by Palmer and Hamilton deal with an automatic dilution apparatus for use in vitamin and antibiotic assay. The dilution system developed by the authors is a modified version of a commercially available variable diluter coupled with the use of disposable plastic collection vessels.

The third paper entitled "Application of Automated Assay of Asparaginase and Other Ammonia Releasing Enzymes to the Identification of Bacteria" by Bascomb

and Grantham, pertains to a modified system based on the Nessler reaction. The system consists of three analytical channels running simultaneously, one for measuring ammonia present in the substrate (control), the second for ammonia released from the enzyme action and the third to measure protein content of the suspension. The automated system reduces overall testing time by 3-12 days.

Sykes and Evans, in their paper on "An Automatic Plating-out Machine for Microbiological Assay" describe an instrument which can overcome the problems associated with manual plating. The instrument is completely automatic and dispenses antibiotic solutions into 64 cups in a 12 inch square assay plate. It is programmed by punched tapes which control the sequence of filling, duration of the rinse-cycles and other factors. In designing the assay, a random latin-square design or quasi latin square design can be followed involving in all 64 cups. Other equipment used in the assay and their operation details are also included.

The fifth chapter is devoted to the detection and estimation of viral pathogens in river and other water supply points. The authors could not recover all input virus from the membranes and suggest that inactivated viruses remained inversibly bound to the membrane components or formed stable aggregates and lost the plaque forming activity.

The next article by Ashworth *et al.* describes assay techniques used in the investigation of the inhibitory components produced in thermally processed canned foods containing nitrites. The inhibitory compound is estimated by agar diffusion bioassay method. Roussin black salt (ammonium heptanitrosyl trithiotetraferrate) is used as a standard and *Cl. sporogenes* as the test organism. The authors themselves are of the opinion that the assay is very time-consuming and therefore not very successful.

Many countries have permitted nisin as a food additive. For estimation of nisin in foods, the most commonly employed procedure is the reverse phase disc assay technique. Fowler, Jarvis and Tramer have proposed a new enzymatic method wherein the active preparation of the enzyme is reacted in buffer against unknown and standard preparations of nisin followed by assay of initial and residual antimicrobial activity. They have discussed this method in detail, comparing it with reverse phase assay and agar diffusion assays.

The eigth article in the book by Holbrook and Baird-Parker relates to serological methods for the assay of Staphylococcal enterotoxins. Strains of *Staphylococci* forming enterotoxins, types of enterotoxins, detection and extraction of enterotoxins from foods, and various methods available at present for their estimation are discussed. The authors are of the opinion that the radioimmuncassay procedure or other sensitive and specific techniques are the future methods of choice in well equipped laboratories.

The next paper by White and Black refers to the bioassay of myo-inositol using *Kloeckera apiculata* (*K. brevis*) as the test organism. This yeast has an absolute requirement for inositol in the presence of other essential nutrients. The assay is based on turbidity measurements and is highly reproducible.

The tenth paper of the book deals with an important topic of the preservation and checking of bacteria commonly employed in the bioassay of vitamins. The authors, Perry, Bonsefield and Shewan outlined the necessity of preservation and checking of assay cultures. The culturing techniques and suitable media for growth and maintenance are discussed. The authors feel that freeze-drying and freezing are becoming popular and very efficient for the preservation of cultures. The choice between the two depends on the behaviour of individual strain of microorganism.

Periodical checking of cultures for any variation is a necessity and especially so when mutants have to be maintained. The authors also describe different methods used in NCIB for checking the assay cultures. A table showing the vitamins assayed, the test organism used and sources of their availability has been appended.

Concentrations of antibiotics in human serum is conventionally assayed by agar diffusion method or a tube dilution technique. This takes 16–18 hrs. In the circumstances where a potentially toxic antibiotic is to be administered to a seriously ill patient, or in patients with impaired renal function, a simple and rapid assay procedure is of great advantage. Noone, Pattison and Slack have developed a method which is particularly suitable to find out the level of gentamicin in human serum. The system involves the hydrolysis of urea by *Proteus* spp. and change in the pH of the medium is recorded. The test organism is progressively inhibited by increasing concentration of antibiotic and therefore the breakdown of urea is proportional to the growth of the bacteria. It is also reported that the method can be successfully adopted for estimating other antibiotics like Kanamycin, streptomycin, chloromphenicol and tetracyclines.

The next four papers deal with various biocides used in agriculture, paints and wood preservation. The paper by Hislop and Clifford gives a documented list of bioassays reported elsewhere by other workers. Testing and evaluation of an agricultural fungicide involves three steps viz. laboratory evaluation, glasshouse evaluation and field tests. Methods available for evaluation under each step is discussed.

The paper by Springle concerns the testing of biocidal paints. Fungicidal activity is tested in a test cabinet made of stainless steel base tank and perspex partitioned top. Similarly an algal test cabinet is used to find out the algal growth. After incubation, the degree of growth is measured by a numerical rating (0-5) by observation of the paint surface under a streoscopic microscope.

Bravery's paper on microbiological assay of chemicals used as wood preservative describes different tests presently in vogue which are categorized in a chart. Agar plate tests are useful for rapid screening but has not found favour because of certain discrepancies. Wood block tests have to be carried out against four groups of fungi. The wide range of recent developments in the assay of wood protective chemicals are discussed.

The last two papers are devoted to herbicides, one concerning their effect on soil microflora and the other devoted to the studies on the use of micro-algae for assaying herbicides. The method described by Grossbard refers to the effect of herbicides on symbiotic nitrogen fixing *Rhizobium trifolii*, and their effect on cellulose decomposing organisms. Both the methods have been dealt with in detail.

Algae have been used for bio-assay of herbicides, since they mainly affect photosynthesis. Herbicides are also conventionally assayed by measuring the parameters of growth and vigour in sensitive plants grown in treated substrates. Wright describes a method where micro-algae are employed for herbicidal assay. The assay may be conducted in liquid cultures or on agar plates. The details of these procedures are given by the author.

Thus, the book is very informative and deals with various systems where microbiological assay are adopted. Since the methods employed are given in detail, this book will be a great asset to the laboratories where organic products and chemicals have to be assessed microbiologically.

In the preface, the year of the Autmn Demonstration Meeting is printed as 1962, instead of 1972.

In page ix,under the heading, 'Contents' in the title of the first paper, the words 'vitamins and' are repeated. These may be rectified in the subsequent printing.

K. R. SREEKANTAIAH

Honey: A Comprehensive Survey: edited by Eva Crane. William Henemann, London pp. 608; Price: £ 15.00

A comprehensive survey written by eminent world experts covering the whole subject of Honey, its plant sources, production marketing and economics thereof.

Various contributors have dealt the subject matter under five different sections wherein Honey production, its various physical, chemical and biological characteristics, modern methods of processing, storing and quality control, legislations, world trade, the manifold uses of honey, including its fermentation has been narrated in exhaustive detail in 19 chapters.

The book is quite descriptive indicating in detail the part played by Honey—before the existance of man, among primitive peoples in ancient civilisation, in mediaeval Europe and upto the present day.

It will be an interesting reading for Bee keepers, honey producers and traders, quality control chemists and Biochemists, entomologists and botanists as well as social historians and language students.

O. P. KAPOOR

Whey Processing and Utilisation: Economic and Technical Aspects. M. T. Gillis, Noyes Data Corporation, 1974, pp. 211; Price: £ 24.

The Book under review is one of the Pollution Control Technology Review (No. 15) dealing with the economic and technical aspects of whey processing and utilisation.

Whey the watery part of the milk separated from the curds in the process of cheese making presents a problem in its disposal. It contains 6-6.5% solids, mostly soluble vitamins and minerals of whole milk. The biological oxygen demand is of the order of 30,000 to 40,000 parts per million and as such costly waste treatment plants are needed. Since the whey solids contain 64–70% lactose and 11–13% protein besides 89% minerals, they could form a useful feed supplement. In view of production of about 22 billion pounds of whey in US, it is imperative to employ practical methods of converting whey from a costly effluent to useful feed supplement.

The Review has brought out the whey processing in various aspects like pollution and disposal acts, recovery of whey solids and direct utilisation of whey in fermentation industries.

Chapter 1 discusses the Utilisation versus Pollution aspects of Whey, its magnitude in U.S. Cheese Industry, Pollution Control Act and Economics of Whey Treatment.

Chapter 2 surveys industrial processing methods for concentration and drying of whey by roller drying, spray drying, whey fermentation to produce yeast, methods of drying acid wheys like reverse osmosis, ultra filtration methods of whey solid recovery. The techniques of evaporation and spray drying employed in various parts

of the World like New Zealand, New York, Japan and Western European countries are discussed.

Chapter 3 deals with lactose removal methods, electrodialosis of whey, spray drying aspects of whey as developed by Niro Atomisers Ltd., Denmark.

Chapter 4 provides analytical information on whey, nutritional aspects of whey and chemical problems of using whey, specific uses of whey in human food and in animal food.

Chapter 5 brings out the details of potential processes for using whey in animal feeds, confectioneries, flavourings, edible yeast cell mass, whey beverages and baked goods.

The Book includes company index, patent index and inventer index at the end.

Unlike similar Noyes Data Books which are mainly collections of patented literature, the subject matter is presented in an educative and concise form, in the present book.

As a comprehensive and authoritative report, the book furnishes valuable data highlighting the technical aspects of whey processing, utilisation and profitability. A useful book for Dairy and Food Technologists, it provides practical ideas for waste utilisation in allied food industries.

P. K. RAMANATHAN

Report of the Tropical Products Institute, London, 1972–74 Edited by Melba Kershaw and J. B. Davis, pp. 96. 1974.

The report records and analyses the activities of Tropical Products Institute, under 7 major heads, i.e. economics and planning, food commodities, non-food commodities, industrial development, storage, information and general facilities. Some areas of activity are bound to attract immediate attention of food scientists and technologists from India. Special mention may be made of studies on the lipid deterioration in food stuffs and its prevention; carcass quality of tropical breeds of goats and beef animals; a technique for the storage of fresh tubers of cassava upto 3 months; physiology of ripening in plantain bananas, which are major carbohydrate foods in tropics; development and evaluation of a fungicide applicator working on "cascade" principle of drenching, for banana; isolation and identification of mango flavour principles; publication of a comprehensive bibliography of published information of mangoes; and synthesis of three sex pheromones and their effectiveness in the control of *Ephestia cautella.*

The style of presentation is crisp and simple, while printing provides a strainless reading.

J. V. SHANKAR

The Market for Cashew-nut Kernel and Cashew-nut shell Liquid: by Roger J. Wilson, Tropical Products Institute, London. Report G 91. 1975; pp. 120; Price: £ 1.40.

This publication is one of the several published by Tropical Products Institute on post-harvest aspects of tropical commodities with a view to help developing countries to derive greater benefit from their renewable resources. The report has three parts, besides a summary in 4 European languages including English, and Appendices.

Part I deals with Production, Processing and Trade in raw cashewnuts. It covers briefly cultivation, harvesting, processing and primary marketing. A mention about the development of processing and trade of raw nuts in individual main processing centres in the world is also made. Part II concerns marketing aspect of processed kernels. The marketing pattern in America and other Western Countries are covered adequately. However the marketing in East European countries are given only briefly. The part also includes consumption patterns of importing countries and export figures of leading exporting countries with useful tables. Part III describes the market for cashewnut shell liquid (CNSL).

The entire information of the book is abstracted truthfully in a neatly compiled summary. Appendices include 23 Tables concerning the export and import figures of leading countries in cashewnut, trade specification for kernel and CNSL and addresses of leading agents in importing countries.

From an Indian angle the reports on the threat of competition from African countries, consequent difficulty for import of raw-nuts, dwindling demand for CNSL, etc. are of special significance. While the superiority of hand processing is acknowledged, it is rightly emphasised that the position may not last long with improvements in the design of mechanical mints. This is clear from the appendix concerning location and installed capacities of two well known processing plants, viz., Oltremare and Sturtevant. India, though sitting pretty at the moment with a superior hand processing, will defenitely benefit from a study of the salient features of these processes and adoption of a better modernised technique as modified to suit our social conditions. The need to grow our own raw-materials by giving incentives to develop plantations and to create adequate internal

market for CNSL can be understood from the relevant discussion.

The report will be useful for processing centres and Government agencies concerned with cashewnut industry. It is modestly priced. Besides no charge is made for the report to official bodies in developing countries.

A. G. MATHEW

ERRATA

Studies on the Physico-chemical Characters of Some Important Commercial Varieties of Mango of North India in Relation to Canning and Freezing of Slices, by P. G. Adsule and Susanta K. Roy, *J. Fd. Sci. Tech.*, 1974, **11** (6), 273.

In page 273:

Fig. 1. Organoleptic evaluation of canned and frozen mango slices. A. *Safeda*, B. *Bombay green*, C. *Dusheharai*, D. *Langra*, and E. *Chousa*. The two ratings indicated for each period on the left and right correspond to the canned and frozen slices respectively.

NOTES AND NEWS

ASSOCIATION FOR SCIENCE COOPERATION IN ASIA (ASCA).

I. Seminar on Food—Postharvest and Processing Technology held at C.S.I.R.O. Division of Food Research, Delhi Road, North Ryde, N.S.W., Australia, from 7–9 April, 1975.

A Seminar on Postharvest and Processing Technology was held at C.S.I.R.O. Division of Food Research, from 7th to 9th April 1975.

Delegates from Australia, Bangladesh, India, Indonesia, Korea, Newzealand, Philippines and Thailand participated. Dr. B. L. Amla, Director, CFTRI and past president of the Association of Food Scientists and Technologists of AFST was the Indian delegate. The Seminar deliberated extensively on (*i*) Storage of Cereals and Grain Legumes, (*ii*) Drying Technology, (*iii*) Fruit & Vegetables—Control of Postharvest Wastage (*iv*) Low-cost Storage Facilities (*v*) Protein Foods and (*vi*) Low-cost Food Packaging.

Dr. F. H. Reuter, Editor, Food Technology in Australia and Chairman of the Food Standards Committee, National Health and Medical Research Council, former Head of the Department of Food Technology, University of New South Wales, was the General Chairman of the Seminar.

Summary of the Proceedings

The Seminar laid down a priority list of subjects in postharvest technology of food. The subjects were indentified based on the request of one nation and seconded by another. A few others also indicated their interest in the subject area. The priority was assigned to the subjects by inviting votes from the delegates. The Seminar discussed at great length the subject areas which were amenable for cooperative investigation within the framework of ASCA countries or to be assigned to other organisations working in the area. Four projects in tune with the wishes of the countries concerned were designated to be implemented by the Asian group of countries. One project was recommended tobe referred to the Indo-pacific Fisheries Council for their serious consideration. Four areas were indentified tobe considered as ASCA projects. They were:

1. Controlled atmosphere storage of cereals and grain legumes at (*a*) farm level—small scale storages and flexible film packages and at (*b*) market level—use of carbon-dioxide atmosphere with depleted oxygen, provided by natural respiration or by combustion, and of nitrogen atmosphere. The points to be investigated and defined are limits of atmosphere composition to inhibit insect growth and limits of moisture content to avoid migration and condensation problems.
2. Development of Weaning foods.
3. Improved sun-drying methodology—(*a*) Range of foods: Fruits Vegetables, Spices, Condiments, Fish and Fish Silage (*b*) Processing trials—application of improved techniques and sun drying trials of new products (*c*) Quality assessment, initial acceptance and keeping quality (*d*) Extension—demonstration of improved techniques.
4. Maturity standards for fruits.

Some countries expressed the desire to have a systematic determination of maturity standards for fruits with a view to improving their marketing quality and ensure better returns to the growers.

The proposed project involves determination of harvest indices such as soluble solids, acidity, solids to acid ratio, and number of days from bloom for each of the major fruits of the ASCA nations. It was considered to determine these indices in each major producing areas keeping in view the effect of agro climatic conditions.

II. Seminar on Scientific Information held under the auspices of Association for Science Cooperation in Asia (ASCA), 10–12 April 1975 at C.S.R.I.O. head Office, Canberra (Australia).

The holding of the Seminar was originally proposed by the delegates of the Republic of the Philippines to the last ASCA conference held in New Delhi. It was suggested that the possibility of establishing a regional union of Asian Science and Technological Studies be explored. A format and mechanism for the interchange of scientific and technological information among ASCA countries and the possibility of setting up a Regional Training Centre for Documentation and Information in Asia, was also to be considered.

Aims and Objectives

To examine in sectors of interest to national, economic and social development.

(*a*) the need for scientific and technical information system. (*b*) the sources of science and technical information in developing countries (*c*) the problems of acquiring science and technological information in ASCA countries at national and regional levels, in order to distribute this science and technology information to those who need to use it, in the most appropriate form and (*e*) the opportunity for national and regional action to provide appropriate organisation of the science and technology information services required and other infrastructural activities such as education, training, and adaptation to local requirements.

The Seminar was inaugurated by the Hon'ble Minister for Science W. L. Morrison, Government of

L to R: Mr. K. Fuller, Secretary, Department of Science, Australia.
Hon'ble W. L. Morrison, M. P., Minister of State for Science, Australia.
Dr. B. L. Amla, Director, CFTRI, Mysore.

Australia. Delegates from India, Japan, Thailand, Newzealand, Malaysia, Australia, Indonesia, Philippines were participated.

The Seminar was conducted by Mr. Peter Judge, Officer-in-charge CSIRO. A brief regarding national information system for science and technology in India was presented to the Seminar by the Indian delegate (Dr. B. L. Amla).

Dr. Amla, outlined the role of NCST in India and its plans in formulating projects for the application of science and technology relevant to national development. Essentially it involved identification of pressing problems, listing appropriate priorities and investments required for research and development in industry. In regard to import of technology, a more realistic policy was stressed. It was pointed out that Western technology was highly capital intensive and labour saving whereas the need in developing countries was for development of relevant technology with a greater emphasis on development of agrobased industries.

The Seminar divided itself into two groups dealing with (*a*) Agriculture Sector Group and (*b*) Manufacturing Industry Sector Group. The deliberation and recommendations of these two groups were then discussed in a Plenary Session and a list of recommendations made.

Summary and Recommendations of the Seminar

The Seminar recommended that

(*a*) each ASCA country compile a national directory of scientific and technological research institutes, listing their fields of research interest; such directories are considered vital for science policy and planning and for facilitating access by the community to the knowledge developed by the scientists and engineers in these institutes;

(*b*) each ASCA country nominate, for the benefit of other ASCA partners, a centre which will provide information about institutes listed in the national directory. This is necessary for two reasons: to overcome language problems, since the directories will usually be in the national language and to provide an up-do-date referral service which will be far more current then any printed directory. These centres will together form an ASCA information network which at minimum cost can provide countries immediately with the kind of information on current research which had been proposed in the "Regional Catalogue";

c) each ASCA country support international initiatives such as FAO's "CARIS" project on current agricultural research, which seeks to list research projects in key areas of their economies.

II. Training of Information and Documentation Personnel

(*a*) each ASCA country develop its training facilities for information and documentation personnel;

(*b*) an ASCA standing committee be established to promote and coordinate seminars and workshops on specific topics of information and documentation to ensure an efficient distribution of these seminars, throughout the ASCA region and throughout the year;

(*c*) all ASCA countries noted the Philippine training initiatives described above, and seek to support and use these as appropriate;

(*d*) a Seminar be convened before the 5th ASCA conference to consider the problems of selection, training and management of personnel for liaison and extension work, and for small-scale consultancy.

Development of National Information Service

The Seminar recommended that

(*a*) the Government of each ASCA country develop a policy mechanism (a "National focus") of promoting,

coordinating managing national information services within the framework of the National Plan. This was considered to be vital for each country and also a necessary enabling factor in tackling cooperative projects in this field at the International level;

(*b*) each ASCA country compile a directory of national information sources and services, which will be made accessible to other ASCA countries through a referral centre such as that proposed in 1(*b*). These centres will collectively make up an ASCA referral network through which exchange of scientific information can be facilitated across the region;

(*c*) those ASCA countries operating computerised information systems, offer their ASCA partners the possibility of using them. This will enable all ASCA countries to have immediate access to the information in these systems and to the experience, software and training potential that they embody.

III. Fourth Meeting of the Association for Science Cooperation in Asia (ASCA)

At the invitation of the Government of Australia, the Association for Science Cooperation in Asia (ASCA) held its fourth meeting in Canberra from 15th to 17th April 1975. All Sessions were held in the Lake Michigan Room of the Lake-side Inernational Hotel, Canberra. Delegates from the following countries participated.

Australia; Peoples Republic of Bangladesh; Republic of India; Republic of Indonesia; Japan; Republic of Korea; Newzealand; Islamic Republic of Pakistan; Republic of the Philippines; Republic of Singapore; Kingdom of Thailand. Delegates from UNESCO and Malaysia were observers.

There were 3 technical Sessions and a Plenary session on 15th and 16th April 1975, followed by three Technical Sessions and a final Plenary Session.

A brief Resume of the Fourth Meeting

The meeting was opened by Dr. B. L. Amla, leader of the delegation of the Republic of India. The Hon. W. L. Morrison, Minister for State for Science in the Australian Government, and leader of Australian Delegation, was elected as Chairman. Dr. Sanga Sabhasari (Thailand) and Professor Mafijuddin Ahmed (Bangladesh) were elected vice-chairmen, Dr. David Kear (New Zealand) and Mr. Domindor O. Reyes (Philippines) were elected as Rapporteurs. In his initial remarks, the Chairman stressed the need for ASCA to enter into a phase of its development by promoting more direct channels of communication between the scientists and technologists of each country, and by focussing the attention of ASCA on what were the areas where the objectives of the region were not being achieved because of a failure to marshall adequately its scientific and technological resources. He emphasised that each country must identify its problem areas and determine how cooperative activities might best address the problem.

The recommendations of the Seminar on Low-cost Housing and Fire Research held in New Delhi 3-4 March 1975 were adopted. Information will continue to be exchanged and the Central Building Research Institute, India, is to set as focal point for the receipt and dissamination of information on these areas of interest. Several countries will act as coordinators on a number of joint projects which were identified in the Seminar.

The Seminar on Food—Postharvest and Processing Technology, held in Sydney, 7-9 April 1975, identified the three topics—weaning foods, sun drying methodology and maturity standards for fruit as suitable areas for cooperative action within the framework of ASCA. The meeting accepted Thailands offer to host a further seminar at which the progress on the three topics would be reviewed. On the subject of edible protein the Meeting agreed that further papers should be sent to the Philippines, which would then develop a joint project in collaboration with other interested ASCA countries.

The meeting had a valuable discussion on a detailed proposal dealing with medicinal and aromatic plants, presented jointly by Indonesia and India. The meeting also agreed that national institutions with research interests in any of the specific projects should communicate with the designated lead country giving information on its capabilities and current interests.

The meeting discussed forms of renewable energy sources and suggested Astralia, Japan and New Zealand as lead countries. Australia will circulate to all ASCA countries regarding the holding of a seminar on renewable energy sources prior to the next ASCA meeting.

On marine resources it was agreed that the philippines be the focal point for information in marine fauna and flora, fish breeding and hatchery management, aquaculture research and seaweed research. Mechanism for cooperation which were adopted comprised the establishment of an information system, a program of visiting scientists and training programs.

The meeting again *stressed* the desirability to bring scientist together with economic planners to ensure that science and technology contributed fully to the development plans of ASCA countries. The meeting *accepted* therefore the offer of India to convene a conference on the Integration of Science and Development Planning. For this purpose, India was further requested to organise a Working Group for the Conference in which both

scientists and other development planners would participate.

The meeting acknowledged the past and present efforts of Japan in organising relevant information available in ASCA countries and in purusing actual inter-institutional cooperation envisaged in the scheme for "Institutional Partnership and Method of Providing Scientific Research Cooperation among ASCA Countries". It also adopted recommendations aimed at further strengthening this scheme of cooperation in promoting scientific and technological research and development in the region.

FAO 'Ceres' Medal to Thangam Philip

Miss Thangam E. Philip, Principal, Institute of Hotel Management, Catering Technology & Applied Nutrition, Bombay, has been recently conferred the honour of being portrayed on the FAO 'Ceres' medal.

FAO has since 1971 been issuing 'Ceres' medals. The social purpose of these medals is to underline the role of women in meeting world food needs, and to serve as symbols to million of hungry people that the world's most distinguished women are in an important sense on their side.

The persons invited to represent 'Ceres' are not necessarily connected directly with food and agriculture but they are all prepared to go on durable public record as sharing FAO's ideal of a world freedom from hunger and want. The different 'Ceres' have achieved their distinction in many fields.

The only two others invited from India to be portrayed on the 'Ceres' medals are Smt. Indira Gandhi and Mother Teresa.

Miss Philip has been actively involved in the development of Hotel and Catering Education in India from its inception.

She is a Master of Science in Institutional Management from Kansas State University, USA; is a fellow of Hotel, Catering & Institutional Management Association, U.K.; Fellow, Cookery and Food Association, U.K. and Member, Royal Society of Health, U. K.

She has several publications to her credit. The most important is '*Cookery for Teaching & the Trade*' published by Orient Longmans Ltd., She has also compiled several brochures—'*Indian Cuisine*' (a gastronomic tour of India), '*Cooking with Substitutes & Imagination*' '*Curry Flavour*' and '*Protein is Life*'. She was one of the Sub-committee members for compiling and editing '*Standardidzed Diets for Hospitals in India*'.

She is a regular contributor to the Cookery Section of Femina published by the Times of India. Miss Philip is well known to many housewives. She also contributes to other technical Journals.

She broadcasts regularly on Food & Nutrition problems from the All India Radio, and also has appeared on T. V. to discuss similar problems.

She is a member of several national and local committees, such as the National Nutrition Advisory Committee, Permanent Committee of the Hotel and Restaurants, Advisory Committee (Hotels) Industrial Finance Corporation of India, Co-ordination Committee for Hotel and Catering Education of the Ministry of Food and Agriculture, Dietary Advisory Committee of some hospitals and institutions.

Miss Philip has travelled extensively and presented papers at several International and FAO Conferences on problems related to her field of specialisation.

In 1974 she was the recipient of the Firestone award for her presentation of a paper on 'Balanced Diet and the Industrial Worker' based on studies undertaken by her.

Miss Philip acts as Consultant to the Hotel & Catering Industry and gives advice on Layouts, equipment, menus, standardisation of recipes.

She guides research studies in formulation of high protein pre-mixes and in formulation standardisation of recipes for new processed foods and commodities such as Soyabean, Kulti dal, Peanut flour, Multi Purpose Food, Balahar, etc., to help in supplimentary feeding programmes in trial areas, school feeding programmes, mass feeding centres.

Dr. D. B. Jelliffe—the Recipient of "Gopalan Oration Award".

Dr. Derrick B. Jelliffe is currently Chairman, Division of Population, Family and International Health and Professor of Public Health, School of Public Health and Professor of Pediatrics, School of Medicine, University of California, Los Angeles, California.

He is considered one of the foremost and front rank nutritionists with a practical and pragmatic approach towards solving problems of malnutrition. He is an expert on ecology of malnutrition in the tropics and has first-hand knowledge of problems of public health, community nutrition and nutrition rehabilitation programmes in most developing countrites. His wide experience in public health nutrition is reflected in his book 'Assessment of Nutritional Status'. The book is an authentic source material and has been published as a monograph by W.H.O. Some of the books published by Dr. Jelliffe include; Infant Nutrition in Tropics; Diseases of Children in the Sub-tropics and Tropics; Mother and Child Health, etc. He has to his credit several scientific papers on varied problems of public health nutrition.

Dr. Jelliffe has held coveted positions in several countries. He is not new to India having spent one year as W.H.O. visiting Professor of Pediatrics at the All India Institute of Hygiene and Public Health, Calcutta (1955–1956).

"Gopalan Oration Award" Lectures

Dr. D. B. Jelliffe will deliver the first "Gopalan Oration Award" lecture on "World Trends in Infant Feeding" on Saturday, the 31 January 1976 at the National Institute of Nutrition, Hyderabad.

Indian Standard Institution Publications

Following Indian Standards have been published by the Indian Standards Institution, New Delhi.

Ziram, Technical Rs. 6.00 IS:3900–1975

Carbaryl, Technical Rs. 6.00 IS:7539–1975

Gelatin, Microbiological Grade Rs. 5.00 IS:7590–1975

Liver Extract, Microbiological Grade Rs. 5.00 IS:7535–1975

Edible Coal Tar Colours

Amaranth Food Grade Rs. 5.00 IS:1696–1974

Indigo Carmine Food Grade Rs. 5.00 IS:1698–1974

Carmoisine Food Grade Rs. 5.00 IS:2923–1974

Reference Food Colour Boxes Rs. 5.00 IS:7584–1975

Soluble Starch, Microbiological Grade Rs. 5.00 IS:7536–1975

Method for Estimation of Folic Acid in Foodstuffs Rs. 5.00 IS:7234–1974

Methods of Test for Determining Preservatives in Fruit and Vegetable products Part I. Benzoic Acid. Rs. 5.00 IS:7254 (Pt. I) 1974

Code of Practice for Fumigation of Agricultural Produce Rs. 4.00 IS:7247 (Pt. I) 1974

Code of Practice for Fumigation of Agricultural Produce Rs. 4.00 IS:7247 (Pt. II) 1974

Code of Practice for Fumigation of Agricultural Produce Rs. 3.00 IS:7247 (Pt. III) 1974

Mutton & Goat Meat Canned in Brine Rs. 10.50 IS:1743–1973

Carbonated Beverages Rs. 5.50 IS:2346–1973

Methods of Sampling and Test for Spices and Condiments Rs. 8.00 IS:1797–1973

Tragacanth Gum, Food Grade Rs. 3.00 IS:7238–1974

Wheatmeal Bread Rs. 3.00 IS:1960–1973

Ice-cream Cones Rs. 2.50 IS:7187–1974

Guide for Storage of Citrus Fruits Rs. 3.00 IS:7192–1974

Methods for Estimation of Tocopherols (Vitamin E) in Foodstuffs Rs. 5.00 IS:7236–1974

Tryptone, Microbiological Grade Rs. 2.50 IS:7127–1973

Proteose, Peptone—Microbiological Grade Rs. 4.00 IS:7128–1973

Code for Hygienic Conditions for Sago (Saboodana) Manufacturing Units Rs. 4.00 IS:7003–1973

Condensed Milk Rs. 9.00 IS:1166–1973

Copies of the standard are available from the offices of the Indian Standards Institution located at New Delhi, Ahmedabad, Bangalore, Bombay, Calcutta, Chandigarh, Hyderabad, Kanpur, Madras and Patna.

ASSOCIATION NEWS

All India Seminar on "Fruits and Vegetables: Production, Processing and Marketing of Processed Products" Organised by Northern Zone.

The Seminar was held from 25-27th April, 1975 at New Delhi under the joint auspices of the Association of Food Scientists and Technologists (India) and All India Food Preservers' Association. Dr. M. S. Swaminathan Director-General I.C.A.R. and Secretary, Department of Agricultural Research and Education in his inaugural address pointed out the vast potentialities for the promotion and development of fruit and vegetable processing industry in India. To achieve quick results he stressed the need to integrate production of fruits and vegetables with processing and the marketing of processed products. This could be better done by agencies like Agro-industrial complexes. He emphasized the need to develop quality consciousness among the manufacturers for capturing and retaining new export markets.

About 250 participants consisting of food scientists and technologists, representatives of the industry, research organisations, universities and various government agencies actively participated in these deliberations. Thirty scientific and technical papers were presented and discussed on different aspects of production, processing and marketing of fruit products. Food and Nutrition Board organised an exhibition displaying industrial samples of different fruit and vegetable products which gave a realistic appraisal of the potentialities of this industry both for home markets as well as for export. Further development of this industry was considered essential to utilize seasonal gluts of fruits and vegetables for diversification and improvement of poor dietary and meeting defence needs and export requirements. The following conclusions/recommendations emerged from the deliberations in different Sessions of the Seminar.

I. The existing gap in information and statistics should be immediately filled by a systematic survey on acreage and production of principal fruits and vegetables in the country. A horticulture map, based on agro-climatic and other factors, should be prepared to serve as a guideline to develop fruit and vegetable industries.

II. A systematic programme for the selection and improvement of the varieties of fruits and vegetables should be undertaken in the country to meet the specific requirements of the fresh markets as well as the processing industry. Vast tracts of arid and semi-arid zones in the country need also to be profitably utilized for growing fruits like dates, ber, phalsa, figs, bael, etc. and adding to the meagre income of farmers there.

III. To avoid heavy post-harvest losses of fruits and vegetables adequate facilities for packaging, transport and storage of the produce should be created through agencies like agro-industrial corporations. This will include development of packing houses, arranging quick and appropriate transport, providing cool stores at the marketing centres and even opening new roads in horticultural areas.

IV. It may be necessary to organise production cooperatives by bringing together small growers to observe modern technology and integrate production efforts. To eliminate middlemen, ensure better returns to the growers and guarantee fair price to the consumers action should be taken to link above cooperatives to processing and marketing centres. It may also be desirable to organise agro-industrial complexes in horticultural areas for achieving the desired targets for quality fruits and vegetables and ther products.

V. The production level in fruit and vegetable processing industry has reached a stalemate due to high cost of these products. To reverse these trends and bring these products within the reach of a larger section of the population a cheap, locally oriented processing technology needs to be evolved by developing on methods like sun-drying, chemical preservation and introducing resuable glass containers in place of sanitary cans. The less sophisticated technology, as discussed at the Seminar, indicated a possibility of its being used by the established food processors as well as the housewives.

VI. Suitable post-harvest practices like wax coating of certain fruits, storing them in the form of pulp for use in jams and beverages can be profitably adopted in fruit growing areas to retain their quality, cut down on cost of transport and utilize peels, cores and stones for by-products.

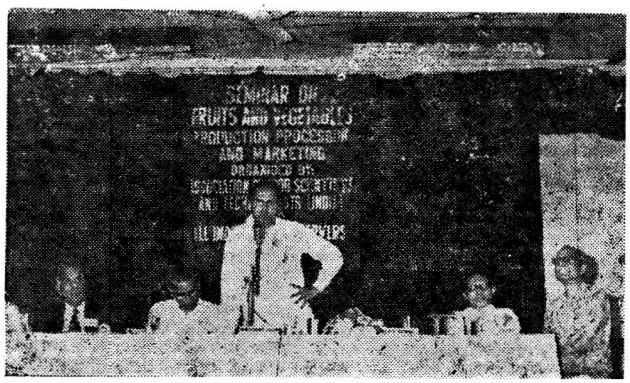
VII. Bulk storage facilities, bulk storage system and evolving suitable bulk storing equipment and its possibilities, need to be seriously taken up to help growers and processors.

VIII. There is an urgent need to study, improve and encourage technology used for traditional products like pickles, murrabbas and candies.

IX. Services of trained food technologists should be made use of for quality improvement of fruit and vegetable products. Future needs for trained food technologist for the next 5-10 years should be defined.

X. To augment the sale of fruit and vegetable products the industry should take a fresh look at the possibilities available to them to reduce prices, improve quality and market appeal of products. Products from certain minor fruits like bael, phalsa, Jaman, ber should also be introduced.

Shri Daya Nand showing fruit products to Dr. M. S. Swaminathan



Dr. M. S. Swaminathan, Chief guest giving his inaugural address' Seated from L to R: Shri P. N. Narang; Shri D. D. Desai M. P.; Dr. P. K. Kymal; Dr. J. C. Anand

XI. Fruit and vegetable processing industry should be declared as a priority industry and provided with necessary incentives like tax/duty relief for a certain period to raise their production.

XII. A unified pattern of quality standards and specification should be adopted for fruit and vegetable products to meet all situations and requirements. It should be enforced by a single agency either PFA or FPO.

Meeting of the Bangalore Chapter held on 15th July at the Food Crafts Institute, Bangalore

The Secretary informed the members of the progress made with regard to the starting of the course of Training in Prevention and Detection of Food Adulteration. She also informed that a curriculum had been drawn up and the Training programme was scheduled to commence from the Ist September 1975 for the students of Food Crafts Institute. The Secretary sought the approval of the members for combining the monthly meeting of August with the inauguration of the course. It was readly accepted.

Shri N. K. Panduranga Setty, President of the Bangalore Chapter introduced Dr. K. S. V. Sampath Kumar, Manager, Research and Development Centre, Brooke Bond India Limited, Bangalore.

Dr. Sampath Kumar spoke on the *approach that was adopted for mass feeding programme during Maharashtra drought*. "Shukadi"—preparation of wheat flour and jaggery fried in fat was enriched with a protein concentrate of high protein efficiency ratio. The protein blends from the concentrate were evolved by a linear programming exercise. Given the essential amino acid compositions of various available ingredients, blends were evolved which had an essential amino acid composition approaching that of egg (with the least occurring amino acid present in the maximum amounts). These blends were tested out in animal feeding experiments for the determination of their protein efficiency. Some of the constraints that were examined in detail were the availability of amino acid from the ingredients, the influence of the carbohydrate constituents on nitrogen utilisation, the need for amino acid supplement, the use of skim milk powder in minimal amounts, the availability of the ingredient and the cost. The exercise was successfully utilised in the mass feeding which was the result of effective coordination between industries, private organisation and the Government. The problems of maintaining quality of the various ingredients were also highlited.

Mr. Panduranga Setty thanked the speaker for his very enlightening and revealing talk.

Meeting of the Bangalore Chapter held on 16th September 1975 at Food Crafts Institute, Bangalore

The Secretary informed that the course in 'Prevention and Detection of Food Adulteration' had met with very good response and there were 29 students, including two from the teaching staff of the Food Craft Institute. The faculty consisted of Miss Padmasini Asuri, Regional Home Economist, Dr. V. L. Pandit, Jt. Director (Health Department), Scientists from CFTRI and SIS, Mr. C. P. Hartman, Food and Water Analysis Laboratory and other guest lecturers. Mr. J. Victor Emanuel gave an interesting talk on "Production and Quality Control of Ice-cream.

Mr. Panduranga Setty thanked the speaker for very informative talk that generated a lively discussion.

Meeting of Bangalore Chapter held on 21st, October 1975 at the Food Crafts Institute, Bangalore.

Dr I. J. Puri presided over the meeting. Mr. M. V. Sharangapani of Infestation Control Discipline CFTRI, Mysore was the speaker of the day.

Mr. Sharangapani spoke on the various infestation control methods developed at CFTRI and outlined the salient features of Minifume tablet, a fumigant particularly suited to small-scale storage in house-holds and farms. This easy to use tablet was one of the effective and economical fumigants. About 20 to 25 fumigants had been screened and 2 to 3 of them have been passed, taking into account the various factors such as efficacy cost per unit, ill effects, etc. Methyl bromide a high vapour pressure fumigant requires absolute air tight cover and diffusion control. Aluminium phosphide does not control the egg stages. Repeat fumigation assured efficacy but resulted in increased costs.

Following an interesting discussion on improved storage methods and better containers Mr. Sharangapani said gunny bags were still the best containers, especially for transport. Apart from low cost the other factors in its favour are (1) suitability for high moisture commodities (2) easy sampling facility (3) repeat use, though there was access to external infestation including endemic infestation. Treating of gunny bags with emulsified insecticides was found to be most effective and economical for controlling infestation. The efficacy for storage was about 8 to 10 months and the cost was about 30 to 32 paise per unit. Since emulsified insecticide was used it formed secure link and the danger of the grains coming in contact with the chemicals was eliminated.

Dr Puri thanked Mr Sharangapani for the very interesting talk on infestation and household pests control.

List of New Members

Sri D. M. Khadkar, 220 New Hostels-4, I.A.R.I. New Delhi-110 012.

Sri P. G. Adsule, c/o J. C. Anand, Fruit Products Order Div. of Horticulture & Fruit Technology, I.A.R.I., New Delhi-110 012.

Sri Y. Y. Kikon, c/o Mr. N. Ovung Vankhosung, P. O. Wokha Nagaland.

Sri S. B. Channakeshava Das, JSA, CFTRI Library Mysore-570 013.

Miss Bhupinder Kaur, Dept. of Processing & Agrl. of Structures Punjab Agril. University, Ludhiana (Punjab).

Mrs. Sudha Vardan, Community Canning & Preservation Centre, 108 Shiva Krupa, Magadi Chord Road, Hosahalli Extension, Bangalore-560 040.

Dr. D. Narasimha Rao, MF & PT Discipline, CFTRI Mysore-570 013.

Capt. A. Pappu Raja, Jawan L. Kissan Gas Services, Rajapalayam P.O., Tamilnadu.

Sri N. G. Amudan, Research & Development Centre, Brooke Bond India Limited, Main Road Whitefield Bangalore.

Sri B. K. Ramaiah, Production Manager, Miltone Project, Bangalore Dairy, Bangalore-560 029.

Sri Gaur Hart Guchhait, Chemical & Metallurgical Design Co (P.) Limited, A-60 Kailash, New Delhi-110 048

Sri D. G. Hapse, Professor of Botany, College of Agriculture, Dhulia (Maharashtra).

Sri P.T. Raju, Tata Oil Mills Co. Limited, Madras-600081

Sri N. Radhakrishna Pillai, Tata Oil Mills Co. Limited, Tondiarpet, Madras-600 081.

Sri P. S. Venkataraman, 97 Karpagam Gardens, IIIrd Cross Besant, Avenue, Adyar, Madras-600 020.

Sri P. Sundararajulu, Office of the Deputy Technical Advisor, Department of Food, Shashtri Bhavan, 3rd Floor 35 Haddows Road, Madras-600 006.

Sri T. M. Saraswat, P.O. Box No. 4519, Madras-600 006.

Mr. Rajendra Singh Thakur, P. O. Box No. 4519, Madras-600 006.

Sri B. Saravanabhavan, Technical Assistant, 1/140 A, Mount Road, P.B. No. 4519, Madras-600 006.

Sri Kailash Nath, Managing Proprietor, Harnarain Gopinath, 18-A Connaught Place, New Delhi.

Dr. T. Ganapathy, 24, 5th Cross Street West, Madras-600 030.

Sri G. P. Ranganathan, Deputy Director (Stg. & Res.) Save Grain Campaign, P.O. Box No. 4519 43, Model School Road, Thousand Lights, Mount Road, Madras-600 006.

Mr. Abdul Wahab, 47 Gajalakshmi Colony, Shenoy Nagar, Madras-600 030.

Chitralekha D. Mehta, Mentmore Chambers, 9-A McNichols Road, Chetput, Madras-600 031.

Dr. Sankar Kumar Mukherjee, Department of FT & BE Jadavpur University, Calcutta-700 032.

Sri P. M. Satyanarayana, Bharat Industries, 239 Old Tharagupet, Bangalore-560 053.

Sri John Mathai, Small Industries Promotion Officer (Food Industry) Branch, S.I.S.I. (Govt. of India) Bamuni Maidan, Gauhati-21 (Assam)

Miss A. P. Shanthy, Asst. Professor, Dept. of Food, Tamilnadu Agril University, Coimbatore-641 003.

Sri Manimagalai G., Dept of Food Technology, Tamilnadu Agril University, Coimbatore-641 003.

Miss A. Susheela Thirumaren, Dept. of Fd. Technology, Tamilnadu Agril University, Coimbatore-641 003.

Sri S. K. Garde, Factory Manager, MAFCO Factory, Koregaon, P.O. Satara Dist. (Maharashtra).

Sri Krishna Kumar Seth, Oceanic Dehydrates Pvt. Ltd. P.O. Box No. 81, Jamnagar-361 001.

Mr. Lim Toh Hoy, c/o Shariket Metal Box TM BHD, P.B. No. 6, Petaling Jaya, Malaysia.

Dr. S. K. Khanna, Scientist Industrial Toxicity Res. Centre, P.B. No. 80, Lucknow (U.P.).

Mr. Jagmeet Singh Ghulla, Factory Manager, Kabazi Canners Ltd., P.O. Box No. 1000, Nakuru (Kenya).

Mr. Jibananda Mukherjee, 12, Haricharan Chatterjee St. Ariadaha, Calcutta-700 057.

Mr. Amares Kumar Mitra, c/o B. B. Ghosh, 5B Madan Futta Lane, Bowbazaar, Calcutta-700 012.

Sri F. T. Itengeja, c/o Moproco P.O. Box 17, Morogoro, Tanzania.

Mr. Prabhakar Manjunath Honavar, 4 Polychem Officers Quarters, Nira (Poona District).

Miss Shakuntala Manay, 69, IInd Cross Road, Basavanagudi, Bangalore-560 004.

Mr. Harihar N. Patel, D/19 International Hostel, CFTRI Mysore-570 013.

Mr. Nongnuan Cheeptongkum, A/10 International Hostel, CFTRI, Mysore-570 013.

Mr. G. S. Pathak, Topioca Products, Chalakudi-680 307 (Kerala).

Dr. Sheo Ram Agarwal, Saras Foods, P.B. No. 25 Nadiad (Gujarat)

Sri Tapan Kumar Majumdar, 19, Suresh Mitra Road, P.O. Naihati, Dist-24 Paraganas.

Mr. Epitacio Robledo, International Hostel, CFTRI Mysore-570 013.

Miss Thresiamma Antony, Kerala Food Packers, Shertalla, P. O. Alleppey.

Sri D. Seeni Mohaned, Senior Assistant Manager, Food Corporation of India, Operation 'J' Ware House, Harbour-Madras.

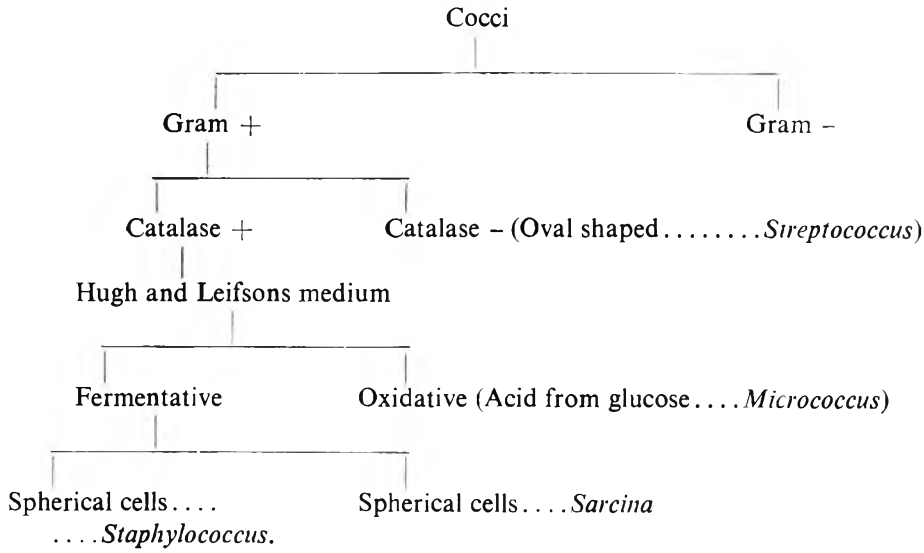
Dr. S. Balakrishna, c/o Hoechst Dyes & Chemicals Limited, 4-C Pattulos Road, Madras-600 002.

Dr. K. N. Nazir Ahmed Khan, Manager-Marketing, 14, MacNicolos Road, Chetput, Madras-600 031.

ERRATTA

Pathogenic *Staphylococci* Associated with Contamination of Market Eggs, by **P. C.** Panda and **B.** Panda, *J. Fd Sci. Tech.*, 1975, **12,** 165.

In page 166 the flowsheet is to be corrected as follows:



INSTRUCTIONS TO CONTRIBUTORS

1. Manuscripts of papers should be typewritten in double space on one side of the paper only. They should be submitted in **triplicate.** The manuscripts should be complete and in final form, since no alterations or additions are allowed at the proof stage. The paper submitted should not have been published or communicated anywhere.

2. Short communications in the nature of Research Notes should clearly indicate the scope of the investigation and the salient features of the results.

3. Names of chemical compounds and not their formulae should be used in the text. Superscript and subscripts should be legibly and carefully placed. Foot notes should be avoided as far as possible.

4. **Abstract:** The abstract should indicate the scope of the work and the principal findings of the paper. It should not normally exceed 200 words. It should be in such a form that abstracting periodicals can readily use it.

5. **Tables:** Graphs as well as tables, both representing the same set of data, should be avoided. Tables and figures should be numbered consecutively in Arabic numerals and should have brief titles. Nil results should be indicated and distinguished clearly from absence of data.

6. **Illustrations:** Line drawings should be made with *Indian ink* on white drawing paper preferably art paper. The lettering should be in pencil. For satisfactory reproduction, graphs and line drawings should be at least twice the printed size. Photographs must be on glossy paper and contrasty; *two copies* should be sent.

7. Abbreviations of the titles of all scientific periodicals should strictly conform to those cited in the World List of Scientific Periodicals, Butterworths Scientific Publication, London, 1962.

8. **References:** Names of all the authors should be cited completely in each reference. Abbreviations such as *et al.*, should be avoided.

   In the text, the references should be included at the end of the article in serial order.

   Citation of references in the list should be in the following manner:

   (*a*) *Research Paper:* Menon, G. and Das, R. P., J. sci. industr. Res., 1958, **18,** 561.

   (*b*) *Book:* Venkataraman, K., The Chemistry of Synthetic Dyes, Academic Press, Inc., New York, 1952, Vol. II, 966.

   (*c*) *References to article in a book:* Joshi, S. V., in the Chemistry of Synthetic Dyes, by Venkataraman, K., Academic Press, Inc., New York, 1952, Vol. II, 966.

   (*d*) *Proceedings, Conferences and Symposia:* As in (*c*).

   (*e*) *Thesis:* Sathyanarayan, Y., Phytosociological Studies on the Calcicolous Plants of Bombay, 1953, Ph.D. thesis, Bombay University.

   (*f*) *Unpublished Work:* Rao, G., unpublished, Central Food Technological Research Institute, Mysore, India.

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