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Research Notes

Effect of Milk Coagulants on the Quality of *Rasogolla* and *Sandesh*

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Effects of various milk coagulants on the physico-chemical properties of *Rasogolla* and *Sandesh*, the sweetmeat products of coagulated milk solids, were studied. On the basis of panel judging, *Rasogolla* and *Sandesh* prepared from the milk solids coagulated with aged whey and citric acid respectively were found to be very satisfactory. Citric acid coagulated milk solids resulted in *Rasogolla* containing high levels of total solids, fat, protein and sugar. Market *Rasogolla* samples contained higher total solids and lower fat and protein contents as compared to those prepared in the laboratory. Significantly higher sugar, acidity and specific gravity were found in market *Rasogolla* syrup. Higher yield was recorded in *Sandesh* prepared from lactic acid coagulated milk solids. Lactic acid as milk coagulant resulted in slightly higher total solids, fat, acidity, fat protein ratio and milk-solid : sugar ratio but lower sucrose content in *Sandesh* as compared to other milk coagulants. Market *Sandesh* was found to be poor in fat and protein.

Rasogolla and *Sandesh* are the trade names of two varieties of sweetmeats produced by processing the acid coagulated milk solids known as *Chhana*.[1] Among the indigenous milk sweets, *Rasogolla* is one of the most popular and delicious sweet available throughout the country. *Sandesh* is another very popular milk sweet produced in the eastern part of the country. The methodology of these *Chhana* based products are still in the hands of petty sweatmcat makers who keep the methods of preparation a trade secret leading to quality variation. There is a great scope to improve their production on the basis of modern science and technology. This paper describes an attempt to improve the quality of such products by evaluating the properties of these products prepared in the laboratory under controlled conditions.

Materials and Methods

Cow milk from the Institute herd was used for *Chhana* preparation using citric acid, lactic acid and sour *Chhana* whey (aged whey) as milk coagulants according to the method described previously.[2]

Preparation of Rasogolla: A syrup of sugar was prepared by dissolving 165 g cane sugar in about 200 ml water followed by heating in an iron pan. About 10-15 ml milk was added to the sugar solution and boiled for 5 min. The dirt settled on the side of the pan were removed with a laddle. Finally the syrup was filtered and diluted to 300 ml with water.

In the second step, 50 g of *Chhana* was initially kneaded with clean hand followed by addition of 10 g of white wheat flour and 5 mg of baking soda. The kneading process was repeated until the mixture was of uniform smooth dough. Small balls of this dough were then dropped in the boiling sugar syrup prepared earlier. The boiling process was continued till the balls expanded to maximum size. Spraying of water during boiling helped the balls retain the optimum size and the syrup maintain its sugar concentration. About 20-30 min boiling was found to be sufficient. The iron pan containing the *Rasogolla* balls and the syrup was removed from the heater and allowed to cool slowly such that maximum syrup may be absorbed by *Rasogolla* balls.

Preparation of Sandesh: Fresh *Chhana* (100 g) was kneaded thoroughly to make an uniform dough. Fine powdered cane sugar (30 g) was added to the dough and was kneaded again. The dough was then heated in an iron pan with continuous stirring. Heating was continued until the mixture acquired desired consistency with slightly cooked flavour. During the final stages of heating, the mixture developed slight cooked flavour and the sticking tendency to the pan disappeared. The cooking was completed in 15-20 min. The product was then transferred to a shallow pan, cooled and sliced into desired shapes.

Judging of Rasogolla and Sandesh: Three types each of *Rasogolla* and *Sandesh* prepared with the three milk coagulants were judged independently by a panel of judges selected from the personnel of this Institute. The products were evaluated in respect of general appearance, flavour, body and texture, taste and overall quality.

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TABLE 1. SCORE CARD FOR RASOGOLLA[1] AND SANDESH

Coagulant	Grade	General appearance		Flavour		Body and texture		Taste		Overall quality	
		Rasogolla	Sandesh	Rasogolla	Sandesh	Rasogolla	Sandesh	Rasogolla	Sandesh	Rasogolla	Sandesh
Citric acid	Good	12	15	9	17	1	14	3	14	3	16
	Moderate	2	4	4	2	6	6	6	7	9	4
	Fair	7	4	8	3	9	2	8	1	6	1
	Poor	2	—	2	1	7	1	6	1	5	2
Lactic acid	Good	11	12	8	18	6	11	6	9	5	9
	Moderate	4	6	3	8	6	8	5	9	6	2
	Fair	4	5	9	4	5	3	7	4	9	10
	Poor	4	—	3	1	6	1	5	1	3	2
Aged whey	Good	14	12	8	8	6	8	5	9	6	7
	Moderate	3	8	7	6	10	8	8	7	8	9
	Fair	4	3	4	7	3	7	5	6	5	5
	Poor	2	—	4	2	4	—	5	1	4	2

[1]Evaluation was made by a panel of judges consisting of ten members. The results are expressed as the number of *Rasogolla* in each group (out of total 23 samples) receiving the particular grade.

The grading parameters were good, moderate, fair and poor.

Chemical analysis: Laboratory as well as market samples of *Rasogolla* and *Sandesh* were analysed for their proximate composition as per standard procedures[3,4] for comparative quality purposes. Sugar content, acidity and *specific* gravity of each group of *Rasogolla* syrup were also determined alongwith that of market samples.[3]

Results and Discussion

Quality of Rasogolla and Sandesh based on panel judging: Chhana prepared with chemically pure lactic acid and aged whey as milk coagulant was harder than that produced by citric acid. *Rasogolla* samples of hard *Chhana* were satisfactory (Table 1). However, *Sandesh* made of soft *Chhana* (Citric acid coagulated) was of superior quality (Table 1). Lactic acid coagulated *Chhana* produced *Sandesh* of good quality also. These findings are in good agreement with those reported by De and Ray.[1]

Composition of Rasogolla and its syrup: The chemical composition of laboratory and market samples of *Rasogolla* is given in Table 2. *Rasogolla* prepared out of *Chhana* using citric acid as milk coagulant yielded higher total solids, fat, protein and sugar content as compared to those prepared by the other coagulants (Table 3). The high contents of these constituents except sugar was probably due to unsatisfactory swelling. On comparison with the composition of market *Raso-*

TABLE 2. COMPOSITION OF LABORATORY AND MARKET SAMPLES OF RASOGOLLA

	Rasogolla made of Chhana using			
	Citric acid	Lactic acid	Aged Chhana whey	Market sample
Protein (%)	6.24±0.14	5.49±0.02	5.46±0.11	5.43±0.70
Fat (%)	7.15±0.41	6.70±0.40	6.03±0.18	5.66±1.08
Sugar (%)	39.57±1.96	36.31±3.06	35.73±2.10	48.16±4.48
Total solids (%)	54.43±3.35	48.35±3.77	47.76±3.42	62.01±5.11
Fat to protein ratio	1.145	1.220	1.067	1.044

Data given are results of 6 experiments mean ± S.D.

TABLE 3. COMPOSITION OF RASOGOLLA SYRUP

	Syrup of Rasogolla from Chhana using the coagulants			
	Citric acid	Lactic acid	Aged channa whey	Market sample syrup
Sugar %	38.40 ±2.10	36.90 ±3.40	38.60 ±5.20	52.90 ±7.30
Acidity*	3.90 ±0.65	5.10 ±0.26	3.90 ±0.40	8.40 ±4.01
Sp. gr.	1.170±0.010	1.163±0.017	1.174±0.026	1.249±0.039

acidity expressed as ml 0.1N NaOH/100 ml syrup
Data given are mean of six experiments ± S.D.

golla, it was observed that higher total solids and sugar contents were found in these samples. It appears from the data in Table 3 that higher total solids in market *Rasogolla* was due to high sugar content. Indian Standard Institution (ISI) has recommended the minimum of total solids 45 per cent, fat 5 per cent, protein 5 per cent and maximum content of sugar 45 per cent for canned *Rasogolla*.[3] *Rasogolla* prepared in the laboratory and procured from the market were found to contain higher total solids, fat and protein than the minimum prescribed for canned *Rasogolla*. The sugar content of the laboratory samples of *Rasogolla* was found to be lower than the ISI standards. However, the average sugar content of market *Rasogolla* was higher than the ISI limitation.

The maximum and minimum sugar contents (38.6 per cent and 36.9 per cent) in the syrup of laboratory made *Rasogolla* was found in the ones prepared by using aged whey and lactic acid respectively as milk coagulants (Table 3). Much higher sugar content (52.9 per cent) nearing the 55 per cent limit as prescribed by ISI was found in the syrup of market *Rasogolla*. The maximum permitted acidity of the syrup is 6 ml 0.1N NaOH/100 ml syrup. While the sugar content of the syrup of all the laboratory made *Rasogolla* were lower than the maximum permitted level. the acidity of the syrup of market ones far exceeded this limit (Table 3). Amongst the coagulants used in the laboratory, lactic acid produced comparatively higher acidity in the *Rasogolla* syrup.

Composition of Sandesh: The average yield of *Sandesh* per 100 g *Chhana* prepared by using citric acid, lactic acid and aged whey were found to be 94.0g, 96.4 g and 91.8 g respectively. The variation in the yield may be due to the amount of milk solids in *Chhana* and the loss of moisture during heat treatment. Lactic acid as milk coagulant resulted in slightly higher solids in *Chhana* and loss of moisture during heat treatment. Lactic acid as milk coagulant resulted in slightly higher solids in *Chhana* than citric acid and aged whey[5]. It is, therefore, concluded that the yield of *Sandesh* is affected by the type of milk coagulant in directly and by heat treatment directly. The average composition of laboratory and market samples of *Sandesh* is given in Table 4. Lactic acid coagulated *Chhana* resulted in higher total solids, fat and acidity in laboratory prepared

TABLE 4. COMPOSITION OF SANDESH

	Sandesh made of *Chhana* using			
	Citric acid	Lactic acid	Aged chhana whey	Market sample
Protein (%)	20.84 ±0.54	20.77 ±0.83	20.74 ±1.41	14.92 ±1.07
Fat (%)	25.67 ±1.58	25.98 ±1.81	24.46 ±1.79	10.69 ±2.06
Sucrose (%)	33.41 ±2.50	32.26 ±1.52	32.75 ±2.51	47.24 ±2.54
Total solids (%)	80.89 ±3.78	81.06 ±4.29	80.13 ±3.43	75.82 ±2.33
Acidity (%)	0.247±0.07	0.269±0.10	0.263±0.08	0.446±0.10
Fat to protein ratio	1.23	1.25	1.18	0.72
Milk solid to sugar ratio	1.42	1.51	1.45	0.59

Data given are mean of six experiments ± S.D.

Sandesh while aged whey yielded in lower total solids, fat and protein. Higher sugar, protein and lower acidity in *Sandesh* were observed with the samples prepared from *Chhana* using citric acid as milk coagulant. Lactic acid and aged whey coagulated *Chhana* produced *Sandesh* containing highest and lowest respectively of fat: protein ratio. Milk solids: sugar ratio was high in *Sandesh* prepared with lactic acid coagulated *Chhana*.

Market *Sandesh* contained low total solids, fat and protein and high sugar and acidity. The fat: protein ratio was less than unity indicating that the milk used for the market *Sandesh* preparation was either partially defatted or mixed with skim milk. Milk solids: sugar ratio in the market samples was also found to be less than one. High acidity in market Sandesh was perhaps caused by the use of aged *Chhana* and large quantity of poor quality sugar.

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Effect of Packaging Materials on the Keeping Quality of *Khoa*

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The effect of packaging materials, viz., parchment paper with and without impregnation with 20% potassium sorbate solution, aluminium foil, polyethylene and tins with and without nitrogen injection were studied on the keeping quality and microbial and chemical changes of *khoa* at 30° and 5°C. The keeping quality of *khoa* wrapped in parchment paper, aluminium foil and polyethylene was 4 days, however, impregnation of paper with potassium sorbate and injection of nitrogen into tins containing *khoa* enhanced shelf life upto 10 and 18 days, respectively at 30°C (relative humidity approximately 45%). At 5°C, (relative humidity approximately 84%) *khoa* in aluminium foil and polyethylene were of satisfactory quality upto 30 days whereas those in parchment paper and tins lasted for 60 days. The flavour deterioration was related to microbial and chemical changes occurring during storage.

Khoa is an important indigenous dairy product which provides a good means of conserving and preserving surplus milk solids. Under ordinary conditions *khoa* samples are of satisfactory quality for 2-4 days. Information regarding effect of packaging materials on the shelf life of *khoa* is meagre. This study was, therefore, undertaken to investigate the effect of various packaging and storage conditions on the keeping quality and microbial and chemical changes occurring in *khoa* during storage.

Materials and Methods

Khoa was manufactured from cow milk standardized to 4 per cent fat in a double jacketed stainless steel kettle under controlled steam pressure. The moisture content in *khoa* was adjusted to approximately 30 per cent. The *khoa* was stored in the following packaging materials; (*a*) tin cans—sterilized tin cans of 1 lb. capacity; (*b*) polyethylene film—non-transparent, low density, white film of 95 μ thickness. Bags of 150 g capacity were made from film which were exposed to uv radiation at a distance of one foot for 1 to 2 hr. Swabs of sterillized bags exhibited absence of microorganisms; (*c*) aluminium foil—the UV—sterilized aluminium foil; and (*d*) parchment paper with and without impregnation with potassium sorbate. The parchment paper with approximately 135 sq. in area was sprinkled with potassium sorbate solution with desired concentration and dried prior to wrapping the *khoa* samples. In case of tins, care was taken to ensure a minimum possible

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head space. The tins were sealed immediately. In case of other packaging materials, approximately 150 g of *khoa* was wrapped or sealed.

The nitrogen was filled in the tins by the following two methods:

(*a*) *Vacuum filling:* The procedure followed was modification of the method recommended by Hall and Hedrick[1] for packaging dry milk powder with nitrogen under vacuum. A hole of 1-2 mm in diameter was made in the lid of each filled tin. The tins were placed in a chamber under 29 in of vacuum. After holding for 2-5 min the pressure was restored with nitrogen of 0.03 to 0.07 kg/cm^2 above atmosphere. The containers were removed from the chamber and sealed by soldering the hole.

(*b*) *Nitrogen injection at atmospheric pressure:* Two pin holes were made on the lid about 1 in apart. Through one hole a sterile syringe needle was introduced upto the bottom of the tins and the other hole was left open for the explusion of the air. The nitrogen gas was passed through the needle for one minute at a pressure of 1 kg/cm.^{2} Towards the end of the nitrogen injection, the open hole was plugged with finger to create some nitrogen pressure in the tins by additional injection of the gas for about 30 sec. This was followed by immediate soldering of the holes.

The samples were stored at 30° and 5°C in an incubator (R. H. approximately 45 per cent) and a refrigerator (R. H. approximately 84 per cent), respectively. The former were analysed at 2-or 3-day interval. The organoleptic evaluation was conducted by a panel of five members on an arbitrary 8-point scale where 8 denoted an excellent product and 2 or less indicated an unacceptable product. Standard plate count was determined using nutrient agar. The plates were incubated at 37°C for 24-48 hr. For determination of spore count, dilutions of *khoa* suspension were heated at 80°C for 10 min prior to plating on Tryptone Dextrose Agar. The plates were incubated at 37°C for 48 hr. Potato Dextrose Agar was used to estimate yeast and mould counts with incubation at 22°C for 3-5 days. For chemical analyses, proteolysis, acid and iodine value and titratable acidity were determined according to the methods of Hull[2], Aggrawala and Sharma[3] and Rudreshappa and De[4], respectively.

Results and Discussion

The present investigation was conducted in two phases. In the first phase, attempts were made to find out optimum concentration of potassium sorbate to impregnate the parchment paper for wrapping *khoa* samples and also to find out a suitable method for nitrogen filling into the product stored in tins.

It was found that the *khoa* samples wrapped in parchment paper impregnated with 1, 5 and 10 per cent solution of potassium sorbate showed no improvement in keeping quality. However, spraying with 15 and 20 per cent potassium sorbate improved the shelf life approximately 3-fold. Therefore, a solution of 20 per cent potassium sorbate was selected for further study.

With respect to the selection of a suitable method for filling nitrogen into the tins, it was found that the nitrogen injection at atmospheric pressure resulted in a product with relatively longer shelf life of 18 days in comparison with 15 days for the samples filled under vacuum. It was, therefore, decided to follow the former method for further investigation.

The relative superiority of the atmospheric injection of nitrogen into the tins over that of vacuum filling may be due to more efficient removal of oxygen from the tins. In the former case the nitrogen is injected through a long sterile needle reaching upto the bottom of the tins whereas in the latter, the removal of air depends solely on vacuum. This may be further substantiated by the fact that the vacuum filling which is widely used in dry milk packaging, is accomplished in 2-3 instalments stretched over weeks. Moreover, the physical state of *khoa* in the tins may offer more resistance to the removal of air than the physical state of dry milk powder.

During the second phase, parchment paper with and without impregnation with 20 per cent potassium sorbate, aluminium foil, polyethylene and tin cans with and without nitrogen were selected to study, keeping quality and microbiological and chemical changes occurring in *khoa* stored at 30°C and 5°C.

Keeping quality: The *khoa* samples packed and stored at 30°C in parchment paper, aluminium foil and polyethylene bags exhibited a shelf life of 4 days. Generally the samples showed mouldy flavour defects. However, the samples stored in parchment paper impregnated with 20 per cent potassium sorbate and tins without and with nitrogen were of fair quality for 10, 12 and 18 days, respectively. *Khoa* wrapped in potassium sorbate treated parchment paper became flat and very hard. The *khoa* samples in tins generally developed stale flavour at the end of storage.

At 5°C *khoa* in aluminium foil and polyethylene exhibited a shelf life of 30 days whereas the remaining samples lasted for 60 days. The effect of potassium sorbate and tin cans with and without nitrogen was almost negligible at 5°C. The samples wrapped in parchment paper exhibited an increasing hardness with storage period. This was accompanied by a decrease in moisture content with storage time, e.g., from the initial 30 to 12 per cent at the end of storage. The development of mouldy and stale flavour defects were most common.

TABLE 1. EFFECT OF PACKAGING MATERIALS AND STORAGE TEMPERATURE ON THE STANDARD PLATE COUNT OF KHOA

Packaging materials	Plate count/g of khoa at the indicated temp. and days of storage 30°C						5°C		
	4	6	8	10	12	18	20	40	60
Parchment paper	9×10^6	—	—	—	—	—	84×10^3	117×10^3	131×10^3
Aluminium foil	12×10^6	—	—	—	—	—	85×10^3	165×10^3	—
Polyethylene	10×10^6	—	—	—	—	—	75×10^3	160×10^3	—
Potassium sorbate treated parchment paper	40×10^4	—	60×10^4	62×10^4	—	—	62×10^3	111×10^3	126×10^3
Tins	—	36×10^4	—	—	128×10^4	—	28×10^3	51×10^3	138×10^3
Tins with N.	—	31×10^4	—	—	87×10^4	36×10^5	22×10^3	46×10^3	130×10^3

Initial count under all treatments was 3×10^3/g of *khoa*

Ghodekar[5] reported an improvement in the keeping quality of *khoa* by wrapping it in parchment paper impregnated with 20 per cent potassium sorbate. However, in contrast to his observation of shelf life of 6-7 days at 30°C and over 45 days at 5°C, the values in this study were 10 and 60 days, respectively.

The packaging of *khoa* in this by itself enhanced shelf life of *khoa* from 4 to 12 days which was further enhanced upto 18 days by injection of nitrogen into the tins at 30°C. This enhancement of shelf life may be due to replacement of oxygen with nitrogen. Rudrashappa and De[4] observed that the *khoa* packed at room temperature in unsterilized tins had a shelf life of 7 days at 30°C in contrast to our result of 12 days at 30°C.

Microbial changes: The results in Table 1 show that the plate count of fresh *khoa* was 3×10^3/g. The count increased to a level of approximately 10^6/g in case of samples stored in parchment paper, aluminium foil and polyethylene at 30°C in 4 days. In contrast, the growth was greatly retarded by the spraying of 20 per cent potassium sorbate on parchment paper prior to packaging and by the canning of the product (62×10^4/g and 129×10^4/g at the end of storage). The effect of nitrogen injection into the product, was insignificant on bacterial growth. The storage of *khoa* at 5°C prevented bacterial growth markedly regardless of packaging material. The final bacterial number was restricted to only about 10^3/g of *khoa*.

The spore count of fresh *khoa* was 16/g which increased during storage reaching values from 370 to 420/g in case of *khoa* wrapped in parchment paper, aluminium foil and polyethylene at 30°C. Spraying of parchment paper with 20 per cent potassium sorbate and canning of product did not have significant effect on spore count. The spore count at 5°C was relatively lower (126–270/g) than that at 30°C, however, various packaging materials did not differ significantly in their effect on spore count.

The yeast and mould count of fresh *khoa* was 140/g (Table 2). The count increased during storage reaching values from 52×10^3 to 103×10^3/g at the end of storage at 30°C without any noticeable effect of packaging materials. The growth of yeasts and moulds at 5°C was

TABLE 2. EFFECT OF PACKAGING MATERIALS AND STORAGE TEMPERATURE ON THE YEAST AND MOULD COUNT IN KHOA

Packaging material	Count/g of *khoa* at the indicated temp. and days of storage 30°C						5°C		
	4	6	8	10	12	18	20	40	60
Parchment paper	70×10^3	—	—	—	—	—	11×10^3	14×10^3	14×10^3
Aluminium foil	85×10^3	—	—	—	—	—	21×10^3	74×10^3	—
Polyethylene	74×10^3	—	—	—	—	—	19×10^3	70×10^3	—
Potassium sorbate treated parchment paper	36×10^3	—	51×10^3	52×10^3	—	—	8×10^3	12×10^3	11×10^3
Tins	—	35×10^3	—	—	66×10^3	—	16×10^3	38×10^3	85×10^3
Tins with Nitrogen	—	25×10^3	—	—	50×10^3	103×10^3	13×10^3	36×10^3	82×10^3

Initial count was 140/g of *Khoa* in all treatments

TABLE 3. EFFECT OF PACKAGING MATERIALS AND STORAGE TEMPERATURE ON THE TITRATABLE ACIDITY (AS % LACTIC ACID) OF KHOA

Packaging material	Acidity of *khoa* at the indicated temp. and days of storage								
	30°C						5°C		
	4	6	8	10	12	18	20	40	60
Parchment paper	0.93	—	—	—	—	—	0.83	0.90	0.99
Aluminium foil	0.94	—	—	—	—	—	0.86	1.02	—
Polyethylene	0.94	—	—	—	—	—	0.85	1.00	—
Potassium sorbate treated parchment paper	0.86	—	0.90	0.94	—	—	0.82	0.89	0.98
Tins	—	0.91	—	—	1.12	—	0.83	0.89	1.03
Tins with Nitrogen	—	0.89	—	—	0.92	1.01	0.83	0.88	1.01

Initial acidity of Khoa was 0.77 in all treatments

relatively slower than that at 30°C, however, the final number was similar to those at 30°C. The yeast and mould counts observed in this study were similar to those reported by Ghodekar[5].

Chemical changes: The titratable acidity of free *khoa* was 0.77 per cent (Table 3) which increased upto 0.93-0.94 per cent after 4 days of storage at 30°C in case of *khoa* wrapped in parchment paper, aluminium foil and polyethylene. The product stored in parchment paper sprayed with 20 per cent potassium sorbate and tins showed comparatively slow acid production. There was no significant effect of nitrogen injection on acid development. The production of acid in *khoa* was relatively slower at 5°C, however, the final acidity level at the end of storage was approximately at par with those at 30°C. There was no distinct effect of spraying of parchment paper with potassium sorbate and tinning on acid content, at 5°C.

The titratable acidity was positively related to the flavour deterioration of *khoa*. Ahmed and Ranganathan[6] observed that the degradation in *khoa* was accompanied by sour smell, bitterness and rancidity. Davies[7] reported that the rapid spoilage of *khoa* was due to development of acidity.

The acid value of fresh *khoa* was 0.282 (Table 4). The acid value increased upto 1.070, 1.169 and 1.030 in *khoa* stored in parchment paper, aluminium foil and polyethylene respectively after 4 days at 30°C. The increase in acid value was markedly retarded in case of samples stored in parchment paper sprayed with potassium sorbate solution and tins (0.595–0.783 at the end of storage). Nitrogen injection into the product had retarding effect on the acid value. The storage of samples at 5°C markedly slowed down the free fatty acid formation, although the final values at the end of storage were similar to those at 30°C.

The acid value was closely related to flavour deterioration in *khoa*. The spoilage of samples was proportional to free fatty acid formation. It is well known fact that the lipolytic activity is one of the important factors in the spoilage of foods rich in fats.

The iodine number of frash *khoa* was 33.27 which

TABLE 4. EFFECT OF PACKAGING MATERIALS AND STORAGE TEMPERATURE ON ACID VALUE (AS % OLEIC ACID) OF KHOA

Packaging materials	Acid value of *Khoa* at the indicated temp. and days of storage								
	30°C						5°C		
	4	6	8	10	12	18	20	40	60
Parchment paper	1.070	—	—	—	—	—	0.485	0.720	0.893
Aluminium foil	1.169	—	—	—	—	—	0.642	0.970	—
Polyethylene	1.030	—	—	—	—	—	0.576	0.908	—
Potassium sorbate treated parchment paper	0.359	—	0.532	0.595	—	—	0.470	0.623	0.846
Tins	—	0.423	—	—	0.783	—	0.501	0.720	0.970
Tins with Nitrogen	—	0.358	—	—	0.548	0.752	0.485	0.705	0.908

Initial acid value of Khoa was 0.282 in all treatments

decreased slowly reaching values between 30.81 and 29.21 at the end of storage regardless of packaging materials. The rate of change was relatively faster in *khoa* stored in parchment paper, aluminium foil and polyethylene at 30°C. Treatment of parchment paper with potassium sorbate and injection of nitrogen greatly reduced the rate of oxidation at 30°C, though this was not so at 5°C.

The relationship between changes in iodine value and flavour deterioration was not as close as certain other chemical changes. Narang *et al.*[8] reported that the iodine value of fresh khoa was 33.52 which remained constant during storage.

The tyrosine content of fresh *khoa* was 14.10 mg/100g. At 30°C, the tyrosine content of *khoa* samples stored in parchment paper, aluminium foil and polyethylene increased to a level of 32.2–34.5 mg/100 g after 4 days in contrast to 34.8 mg/100 g in case of samples wrapped in parchment paper impregnated with 20 per cent potassium sorbate after 10 days of storage. In case of tinned *khoa* without and with nitrogen the tyrosine values were 32.6 and 33.6 mg/100 g after 12 and 18 days respectively.

At 5°C, the *khoa* samples stored in aluminium foil and polyethylene bags developed the tyrosine content of 36.1 and 32.1 mg/100 g. respectively after 30 days whereas similar levels (31.8–32.6 mg/100 g) were reached in *khoa* stored in parchment paper with and without impregnation in 60 days. The production of tyrosine was relatively faster in case of tinned *khoa*, the final values after 60 days being 37.8 and 39.9 mg/100 g with and without nitrogen, respectively. Rudreshappa[4] reported higher tyrosine values when *khoa* was incubated at 37°C than at 28°C.

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A Study on the Development of a New High Protein Fermented Food Using Buffalo Milk

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A method for the preparation of high protein, acidic milk product using buffalo skim milk was developed and standardized. The product adjusted to 3, 4 and 5 per cent fat with fresh cream was compared with some of the indigenous products already in use i.e. curd (dahi) prepared from 3, 4 and 5 per cent fat milk adjusted to 17 per cent S.N.F. and srikhand (an Indian sweet dish) from 4 per cent fat milk. All the products were tested for fat, SNF, total solids, protein, calorific value, titrable acidity, shelf-life and organoleptic properties. The developed product was found to be the best amongst all the products studied.

The rapidly increasing production of cultured milk products has been a major break-through in the dairy industry.[1] Bertelsen *et al*[2]. developed a concentrated cultured milk product-Laktofil containing about 5 per cent fat and 14-15 per cent total solids. The product had 1-2 weeks storage life at about 0-5°C. A milk protein paste 'Zdorove' developed by Bogdanova and Novoselova[3] in Russia and a Danish dairy delicacy-Ymer have been made from skim milk curd by the removal of its whey.[4] In the preparation of 'Ymer,' *Leuconostoc citrovorum*, *streptococcus diacetilactis* and lactic acid producing organisms have been used. Poulsen[5] developed a Danish protein-enriched fermented milk product. The product was concentrated by remov-

ing approx. 54 per cent of whey, cream was added to adjust fat and was homogenized. This product had a shelf-life of about 10 days. Concentrated Yoghurt with firm consistency has also been reported.[6]

Ten per cent water of the Yoghurt milk was evaporated, homogenized and was heated to 95°C. All these studies have been carried out using cow milk. The present work has been taken up, using buffalo milk and a systematic investigation on the development of a high protein, concentrated fermented milk product has been made.

Methods and Materials

Composite buffalo milk used in the present investigation was of the composition: fat-8.0–9.5 per cent, SNF-10.25–10.35 per cent with 0.14–0.15 per cent acidity and 6.5–6.6 pH.

Pure freeze-dried cultures of *Streptococcus lactis* C_{10}, *Streptococcus diacetilactis* DRC and *Leuconostoc citrovorum* 543 in ampoules were obtained from the Division of Microbiology, National Dairy Research Institute, Karnal (Haryana). Cultures were multiplied and were stored at refrigeration temperature at 4.4°–7.2°C. The cultures were grown separately to avoid dominence of one over the other, if grown together and were mixed just before use in a ratio of 1:1:1.

Experimental procedure: Six Kg of fresh skim milk was pasteurized, cooled to the desired setting temperature and placed in a double jacketed vat. In the same manner one Kg. each of 3, 4 and 5 per cent fat milk, adjusted to 17 per cent MSNF (milk solids-not-fat) were pasteurized and cooled to 30°C. In order to compare the developed product with dahi-having almost the same SNF and fat percentage, the SNF percentage of dahi was required to be adjusted at a possible level by adding skim milk powder.

All the samples of the milk were inoculated separately at the rate of 5 per cent with a mixed culture of *Streptococcus lactis*, *Streptococcus diacetilactis* and *Leuconostoc citrovorum* in a ratio of 1:1:1 as prepared previously.

The samples were incubated at 30°C for 12-14 hr When the pH was about 4.6–4.8, the coagulum was broken with 4-5 revolutions of a stirrer.

The curd prepared from skim milk was heated to 35°-36.6°C without agitation by circulating hot water in the jacket for about 1.5 hr. The heating resulted in the expansion of the carbon dioxide, thus rising the curd to the top. Heating was followed by the removal of whey. Total whey removed was about 50 per cent of the original volume of milk. Then the curd was cooled by circulating top water in the jacket and the cold curd was divided into three equal parts. Forty per cent pasteurized cream was added in all the three lots to adjust the fat of the final mixtures to 3, 4 and 5 per cent levels. The mixtures were then stirred and mixed properly and were packaged in polythylene bags of appropriate size and stored at a temperature of 4.4°–10°C till use.

Shrikhand manufacture; Buffalo milk (2 kg) with 4 per cent fat was pasteurized and was inoculated at the rate of 5 per cent with the mixed culture of *Streptococcus Lactis*, *Streptococcus diacetilactis* and *Leuconostoc citrovorum* in a ratio of 1:1:1 followed by incubation at 30°C for about 12-14 hr till sufficient acidity developed to give a pH of about 4.6–4.8. The shrikhand prepared from milk having 4 per cent fat has been standardized by Bhattacharya *et al.*[7] and, therefore, the 4 per cent fat level was selected for shrikhand manufacture in the present study. Curd was cut and whey removed by straining the curd in a muslin cloth and after stirring it properly the curd was packaged in Polyethylene bags. Newly developed product was compared with indigenous type of products of similar nature already in use in India. The curds at 3, 4 and 5 per cent fat levels and Shrikhand at 4 per cent fat level only were prepared, using standard techniques.

All these samples packaged in polyethylene bags were stored at 4.4°–10°C and were tested for the following:- Protein per centage, fat percentage, calorific value, Titrable acidity, Total solids, Shelf-life and organoleptic properties.

Total Protein content was estimated by micro-Kjeldahl method[8]. Fat was estimated by Mojonnier fat Extraction method. Calorific value was determined by Chromic acid oxidation method for gross energy estimations. Total solids were determined by using gravimetric method. Titrable acidity was estimated by titrating 10 ml of the sample against standard alkali using phenolphthalein as indicator. Results are expressed as per cent lactic acid. pH was determined directly with an ELICO pH meter. Organoleptic evaluation was performed by a constant panel of six judges by using a score card method, covering flavour, body and texture, appearance, acidity and over-all acceptability. The data were statistically analysed by using 'Student's 't' test' and analysis of variance.

Results and Discussion

During the preparation of the products, it was observed that the whey removal in case of developed product was very easy whereas the same was very difficult in case of Shrikhand. The time required to separate the same amount of whey from the curd during Shrikhand preparation was about four times that required by the whey removal during new product preparation. One of the reasons for this may be attributed to the presence of fat in the milk used for Srikhand.

There was 0.1 per cent fat loss through whey from the Shrikhand curd. In addition, about 0.1 per cent fat was

TABLE 1. AVERAGE COMPOSITION OF THE DEVELOPED PRODUCT, DAHI AND SHRIKHAND

Sample with fat content (%)	Protein %	Fat %	SNF %	TS %	Calorific value (K.cal/g)
Sample-3	9.42	2.96	19.10	22.06	1.113
Sample-4	9.60	3.98	19.38	23.36	1.201
Sample-5	9.59	4.72	19.55	24.57	1.289
Control-3	5.79	3.00	16.52	19.52	0.980
Control-4	5.65	3.91	17.17	21.08	1.099
Control-5	5.65	4.90	16.64	21.54	1.197
Srikhand-4	7.93	5.93	16.98	22.91	1.229
Poulsen's* products	5.00	3.00	11.0	14.0	0.883

*Reported by Poulsen (1970)
Sample: New product, using buffalo milk
Control: Dahi, using buffalo milk.

found lost as adherents with the muslin cloth while draining during Shrikhand preparation.

On the basis of the results obtained from five trials using dahi as control, the final average composition of the products was arrived at and is presented in Table 1.

Similar type of product prepared from cow milk has been reported by Poulsen,[5] the average composition of which has also been presented in table 1. While comparing the composition of the developed product with that reported by Poulsen,[5] it is revealed that the developed product with 2.96, per cent fat is far richer in the protein, solids-not-fat, total solids and calorific value (9.6, 19.31, 22.06 per cent and 1.113 K cal/g respectively) than the product reviewed, with 3.0 per cent fat (5.0, 11.0, 14.0 and 0.883 K cal/g respectively). This significant difference may be attributed to the low protein, SNF and T.S. percentage of cow milk used by Poulsen as compared with those of the buffalo milk used in the present investigation.

Comparison between the new product, the Shrikhand and Dahi: As is evident from Table 1, the new product had high protein and solids-not fat percentages of 9.60 and 19.38 respectively as against the corresponding values of 5.65 and 17.17 per cent in case of dahi prepared from milk with SNF adjusted to 17 per cent and 7.93 and 16.98 per cent in case of Shrikhand, all prepared from milk at 4 per cent fat level. Although all the three-new product, dahi and Shrikhand were prepared from 4 per cent fat milk, a significant increase in fat percentage (5.93) was noticed in case of Shrikhand as against slightly reduced values of 3.98 and 3.91 per cent in new product and dahi respectively. This may be due to an increase in the concentration of milk solids on whey removal. Its fat content would have increased still more if there had been no fat loss through whey and the adherents of the muslin cloth used for whey separation.

The developed product of 3, 4 and 5 per cent fat levels had calorific values of 1.113, 1.201 and 1.280 K cal/g respectively as against that of 1.229 K.cal/g of Shrikhand Although less than that of the new product at the same fat level, the high calorific value of Shrikhand may be attributed to its increased fat content during its separation, as a result of concentration.

Organoleptic evaluation: The results of the organoleptic evaluation of the products by the panel members were analysed statistically to draw conclusions on the comparison among the different samples.

All the samples of the developed product were preferred over the control-dahi, with regard to flavour, body and texture, appearance and over-all acceptability. However, the sample of developed product with 5 per cent fat was liked most with regard to flavour. Average score in case of all the samples of developed product was higher than those of corresponding controls-dahi.

Both the products-the developed product at 4 per cent fat level and Shrikhand at 4 per cent fat level of milk used for its preparation, scored almost equally well in respect of all the attributes. But the developed product excelled in other factors such as ease of whey removal, fat loss during preparation etc.

Storage life: The shelf-life of the developed product packaged in polyethylene bags and stored at the refrigeration temperature (4.4°–10°C) was found to be 12-14 days, whereas samples of dahi got spoiled after 8 days. This difference in keeping quality of both the samples can be attributed to many factors, such as amount of moisture, acidity etc. The acidity values of various products have been presented in table 2. In contrast to dahi, a fall in acidity of the new product and Shrikhand

TABLE 2. ACIDITY AS LACTIC ACID OF THE PRODUCTS DURING STORAGE

Storage period (days)	Fat levels	Sample 3%	Sample 4%	Sample 5%	Control 3%	Control 4%	Control 5%	Shrikhand 4%
Initial		0.95	0.95	0.95	0.95	0.95	0.95	0.95
2		0.90	0.90	0.90	0.99	0.99	0.99	0.91
4		0.91	0.91	0.91	1.00	1.01	1.00	0.92
6		0.91	0.91	0.91	1.08	1.07	1.09	0.94
8		0.92	0.92	0.92	1.08	1.07	1.09	0.97
10		0.94	0.94	0.93	—	—	—	1.00
12		1.01	1.01	1.00	—	—	—	1.02
14		1.02	1.01	1.01	—	—	—	1.02

Sample: New product, using buffalo milk.
Control: Dahi, using buffalo milk.

was noticed after 2 days of storage, which could be as a result of the removal of their whey during preparation.

The curds of 3, 4 and 5 per cent fat levels (i.e. controls) were declared as unacceptable by the judges on the 9th day of storage. The acidity values of these samples on the 8th day were found to be 1.08, 1.07 and 1.09 per cent respectively.

The samples of 3, 4 and 5 per cent fat levels and Shrikhand prepared from 4 per cent fat milk were acceptable upto 12th day of storage. They were found unacceptable on 14th day as a little mold growth was noticed on the surface of the product and the outer sides of the polyethylene bags. The acidity values of all the products on the 12th and 14th day of storage were found to be almost the same, ranging from 1.00 to 1.02 per cent.

The initial pH values of the developed product, control (dahi) and Shrikhand were found to be 4.65, 450 and 4.60 respectively. The pH of the Control samples on the last day of its acceptability (i.e. 8th day during storage) was 4.3. The development of acidity in all the samples on storage was, in general, found to be quite slow.

The storage studies revealed that the shelf-life of the developed product and Shrikhand is almost the same i.e. 12-14 days at refrigeration temperature (4.4°–10°C). The control sample (dahi), however, had poor shelf-life of 8 days only when stored at 4.4°–10°C.

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Development of an Industrial Process for the Manufacture of *Shrikhand**

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Shrikhand is traditionally produced by concentrating curd (dahi) and mixing sugar with the concentrated curd. The curd in this method is usually spread over a sand bed which facilitates the separation of moisture. An industrial process for the manufacture of Shrikhand has been developed. The process deploys centrifugal separation of whey from curd and subsequent mixing of sugar and flavourings in a planetary mixer. Satisfactory organoleptic, chemical and bacteriological quality of the product can be obtained by using the process. Process parameters have been standardised and a large dairy plant has satisfactorily adopted the process for the large scale manufacture of Shrikhand.

Shrikhand is a popular milk based dessert consumed largely in some parts of India. The raw material used are sugar and chakka. Chakka is concentrated curd (dahi) produced by the lactic fermentation of milk. Curd may be made from skim milk or whole milk. In home scale, curd is hung in a muslin cloth for draining out the whey till it attains a semisolid state. The process of draining out, the whey is hastened by the use of a sand/ash/straw/saw dust bed. The traditional method is not only unhygienic but also the quality of the finished product varies from batch to batch.

Ganguly *et al*[1]. reported the chemical composition of

*Process Patent applied for.

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the laboratory made chakka whereas Upadhyay *et al*[2]. studied the chemical and bacteriological quality of market samples of Shrikhand.

Chakka is used for the manufacture of an indigenous toffee known as Shrikhandvadi, which is prepared by mixing chakka and sugar in almost equal parts and frying in a pan till it attains a thick consistency. It is then spread in shallow plates and on cooling cut into cubes. Date & Bhatia[3] concluded that the longer shelf-life of *Shrikhandvadi* (prepared by mixing *chakka* and sugar in almost equal parts and fried in a pan) was due to both the acidity and low moisture content.

Puntambekar[4] concluded that the levels of fat and sugar did not have any significant effect on the quality of Shrikhand.

Bhattacharya *et al*[5] reported about the preliminary trials conducted for the manufacture of Shrikhand and Shrikhand powder.

Mahajan[6] developed a process for the manufacture of spray dried Shrikhand powder. The product was reported to yield satisfactory Shrikhand on reconstitution with hot water at 60-70°C.

A survey conducted in Baroda indicated that the total consumption of Shrikhand in Baroda varied from season to season; out of 426 tonnes the consumption is 290 tonnes in summer, 69 tonnes in monsoon and 67 tonnes in winter. It was estimated that out of a total annual consumption of 426 tonnes Shrikhand, 378 tonnes were bought from outside and 48 tonnes were made at home. Hence an attempt was made to develop and standardise a process for the large scale manufacture of Shrikhand.

Materials and Methods

Preparation of curd: Curd was prepared from skim milk containing 9 per cent SNF, and less than 0.05 per cent fat, unless stated otherwise. Skim milk was heated to 85°C for 16 seconds in a HTST pasteuriser, cooled to 30°C. and inoculated with 0.25-0.50 per cent dahi (curd) culture of mixed strains obtained from National Dairy Research Institute, Karnal. After 8 hours of adding the inoculation the final acidity of the curd was found to vary between 0.8 and 1.1 per cent lactic acid. When the acidity was 0.8 per cent the curd was transferred to cold storage.

Separation of whey: Unless otherwise stated, whey was separated out of the curd after warming it to 25-30°C. The separation of whey was carried out in a 28" diameter solid bowl basket centrifuge at 1100 rpm. The effect of various heat treatments for heating the milk for curd making and the temperature of curd on the yield of chakka and solids in the whey were studied. Unless otherwise stated, 120 kg of curd was centrifuged in one batch for 90 minutes. A horizontal desludging centrifuge (Westfalia SDA 230) was also found satisfactory for the separation of whey from curd.

Preparation of Shrikhand from Chakka: In the process described here, Shrikhand was prepared by adding sugar to chakka and mixing the two in a 100 litre planetary mixer. The effect of various levels of sugar added to chakka with varying degrees of acidity on the final quality of Shrikhand was studied. The effect of mixing speeds and time of mixing on the consistency of Shrikhand was also studied.

Plastic cream containing 80 per cent fat was added at the stage of mixing sugar with chakka. The effect of varying amounts of fat on the quality of finished product was also studied. Sugar was added at the rate of 80 per cent of the amount of chakka.

The following parameters were examined:

Total Solids: Total solids in skim milk, curd, chakka, Shrikhand and whey were determined as per ISI methods.[7] In case of curd, chakka and Shrikhand, 1 g. was taken and dispersed uniformly in dish by adding warm distilled water (5 ml.)

Acidity: Acidity of curd was determined by titrating 10 gms of curd as per ISI method. Acidity of chakka and Shirkhand were determined by diluting 10 g of product in 30 ml water.

Fat: Fat content of Shrikhand was determined by modified Gerber test for milk as suggested by Puntambekar.[4] Shrikhand was diluted 1:2.5 W/V and 80 per cent sulphuric acid, specific gravity (1.730 at 20°C) as per ISI Standard.[8]

Fat content of cream was determined by the Gerber method as per ISI Standard.[9]

Protein: Protein contents of chakka and Shrikhand were determieed as per ISI Standard.[10]

Microbiology: Shrikhand was examined for coliforms as per ISI Standard.[8]

Results and Discussion

The preparation of chakka primarily involves the separation of whey from curd. The yield of chakka would depend upon its moisture content and the amount of coagulable protein in curd. The effect of heat treatment of milk on the yield of chakka is shown in Table 1. The yield of chakka is maximum, when the milk used has been boiled or at least heated to 90°C for 10 sec. This can be attributed to the precipitation of heat denaturable protein in milk.

The effect of cooling/heating the curd before centrifugation on the yield of chakka was studied. Four different temperatures viz. 4, 20, 30 and 40°C were studied. It was found that yields go down at lower temperatures. The temperatures refer to the temperature of curd during the time of loading the centrifuge. The syneresis of curd

TABLE 1. EFFECT OF HEAT-TREATMENT OF MILK ON THE YIELD OF CHAKKA

Heating temperature (°C)	% of solids in whey	% yield of chakka
70	5.9	20
80	4.9	21
85	4.8	24
90	4.7	25
100	4.7	25

Holding time in all cases was 16 seconds except at 100°C.

at higher temperatures possibly accounts for higher yields at 30-40°C. However, the texture of chakka obtained by centrifugation of the curd at 40°C was coarse and unsatisfactory.

The traditional method of preparing chakka usually takes 12 hr to drain whey by hanging in muslin cloth. The process is speeded up by the traditional traders by deploying ash/sand/straw/saw dust bed etc. and even then it takes about 6-8 hr. In these methods the atmospheric temperature directly affects the acidity of the chakka, uniformity of the acidity of the chakka cannot be maintained. The traditional method takes longer time and there is no control over the development of acidity. By using the basket centrifuge the time required to make chakka will be about 90 min.

The yield of chakka could be increased by increasing the SNF of skim milk by the addition of skim milk powder. Skim milk powder was added to fresh skim milk before heat treatment for curd making. It was observed (Table 2) that the increase of SNF to about 10 to 11 per cent increased the yield of chakka without affecting the acceptability of the final product.

TABLE 2. EFFECT OF RAISING THE SNF ON YIELD AND QUALITY OF CHAKKA

% SNF in skim milk	% Yield of chakka	Total solids % in chakka	Quality of Shrikhand
9	20	25.0	Good
10	22	25.2	Good
11	24	24.8	Good
12	25	26.0	Very slightly powdery flavour
14	27	25.5	Unacceptable powdery flavour
16	30	25.0	Unacceptable powdery flavour

TABLE 3. THE EFFECT OF VARYING QUALITY OF CHAKKA AND THE SUGAR ADDED TO IT ON THE QUALITY OF SHRIKHAND

Acidity of curd	Acidity of chakka	% of sugar added as % of chakka	Quality of Shrikhand
0.8	1.9	70	Not satisfactory
0.9	2.2	80	Satisfactory
1.0	2.4	80	,,
1.1	2.5	80	,,
1.2	2.7	85	Not satisfactory

The effects of acidity of curd and the acidity of chakka on the quantity of sugar required was ascertained (Table 3). It was found that an acidity of about 0.9 to 1.1 per cent in the curd and an acidity of 2.2 to 2.5 per cent in the chakka required sugar in the proportion of about 80 per cent by weight of chakka to make satisfactory Shrikhand.

Investigations were carried out to find out the optimum rpm for mixing within a minimum time without impairing the consistency of the Shrikhand. It was observed that with a speed of about 110 rpm, a mixing time of 40 min. was required to obtain a smooth consistency for the Shrikhand. A slower speed of 58 rpm, took about 60 min. to give a similar consistency to the Shrikhand. These experiments were carried out on 100 kg batches of Shrikhand. The planetary mixer used for these experiments could be used only at these two speeds of 58 rpm and 110 rpm. The over mixing of the product, beyond the optimum periods mentioned above, resulted into a thinner product. The over mixing was therefore considered undesirable and unnecessary. On the other hand inadequate mixing resulted in unsatisfactory dissolution of sugar in the product.

TABLE 4. EFFECT OF INCREASING FAT CONTENT ON THE FINAL QUALITY OF SHRIKHAND

Fat %	Shrikhand
1	Coarse, not satisfactory
2	Gummy, not satisfactory
3	Gummy
4	Slightly sticky
5	Smooth
6	Smooth and satisfactory
8	Over smooth
10	Very smooth
12	Very smooth, buttery flavour, not satisfactory.

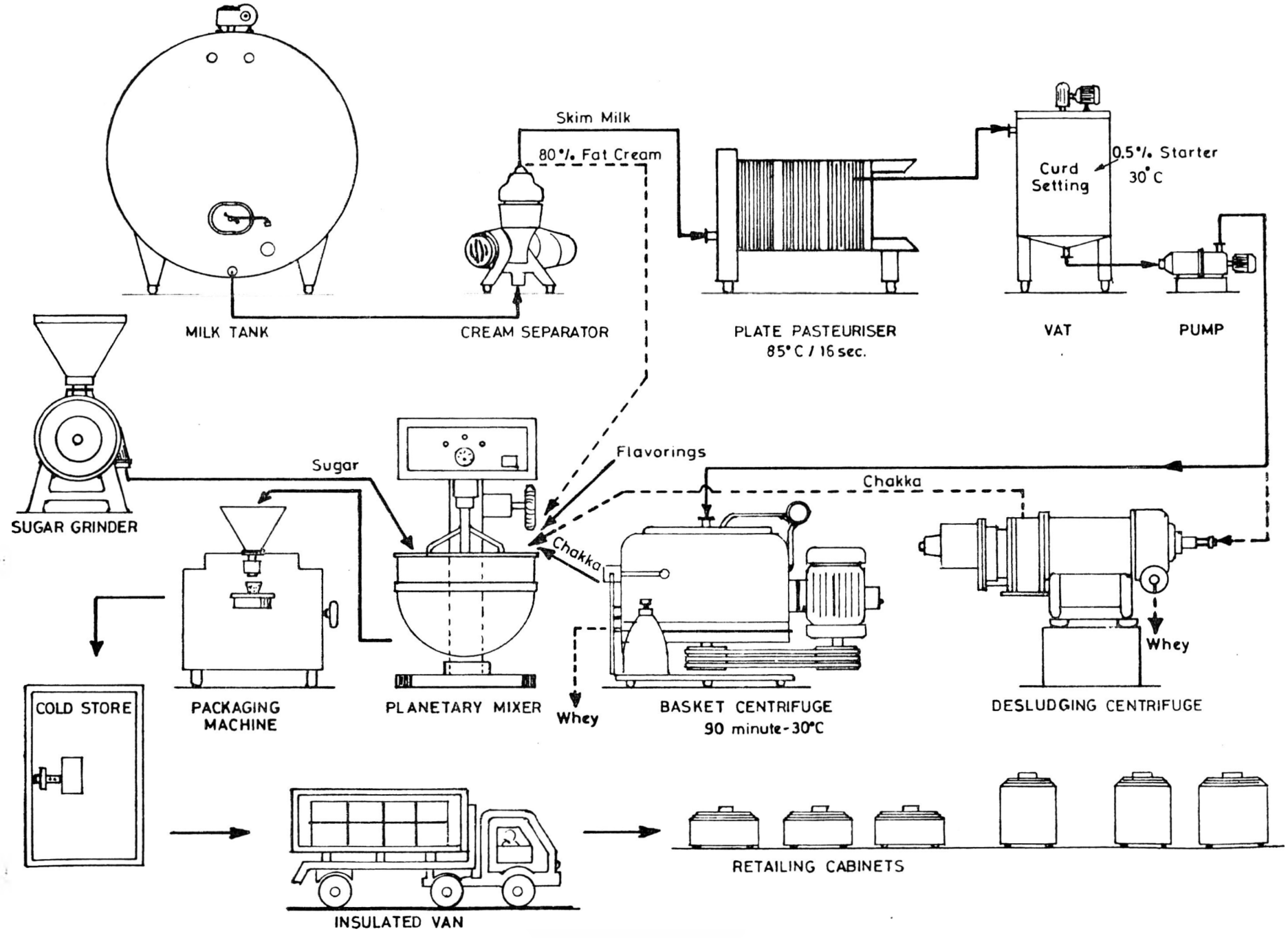

Fig. 1. Process for manufacture of Shrikhand

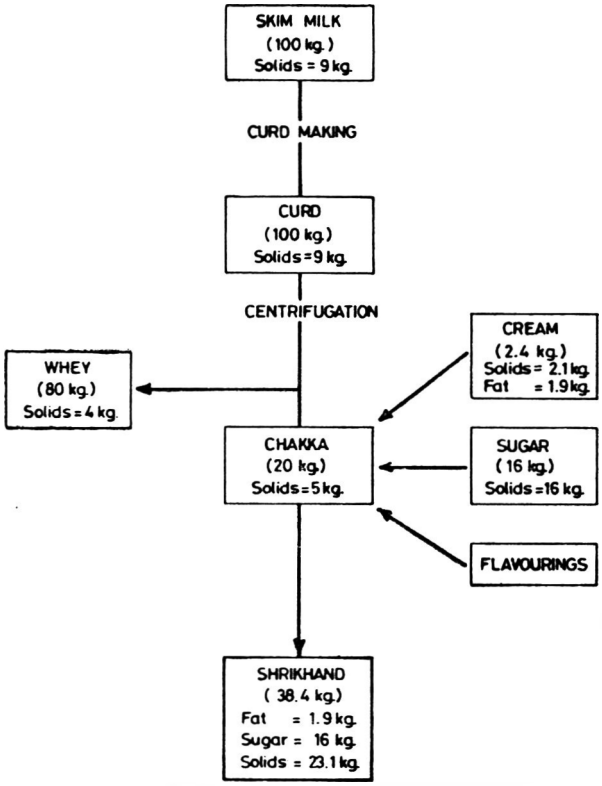

Fig. 2. Shrikhand manufacture—material balance

Investigations were carried out to find out the optimum level of fat required to be added to achieve a satisfactory quality of Shrikhand, keeping in mind the economical aspects of fat addition (Table 4). It was found that about 5 to 6 per cent fat was most satisfactory as well as economical.

Shrikhand prepared from skim milk tends to become gummy and sticks to the plate or dish in which it is stored or served. The presence of a larger proportion of fat in the chakka makes the Shrikhand smooth. However, if curd is prepared from milk containing fat, the time required for draining off the whey from the curd is appreciably increased. While the preparation of chakka by the traditional method from skim milk takes about 4-6 hours, it takes 6-8 hours to produce chakka from whole milk.

The processing conditions for the manufacture of Shrikhand were standardised and the process layout is shown in Fig-1. The final product contains 5 per cent fat, 42 per cent sugar and 60 per cent total solids. The acidity of the product was usually between 1.10 per cent and 1.20 per cent (expressed as lactic acid). The protein content of the product was 10 per cent, The material balances and solid recovery are shown in Fig-2.

One hundred fifty samples of Shrikhand produced by this process were examined for coliform organisms and were found to be free from them. (This is considered very satisfactory as compared to the coliform counts found in market samples as reported by Upadhyay[2].) From the results, it was concluded that it was possible to produce Shrikhand free from coliform provided good sanitary practices are adopted in the dairy during handling and processing.

The process was successfully tried in a large dairy. The product was packed in 100 and 500 g waxed paper cups. The uniformly good quality of the product helped the dairy in capturing a commanding share of the Shrikhand market. Shrikhand is usually sold unpacked or in cardboard boxes lined with butter paper. The availability of Shrikhand in attractive paper cups helped in promoting the marketing of the product.

Acknowledgement

Large scale trials for the manufacture of Shrikhand using this process were carried out at the Baroda Dairy, Baroda whose assistance and cooperation is gratefully acknowledged.

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Copper and Iron in Ghee and their Influence on Oxidative Deterioration

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The influence of the method of preparation on the contaminant copper and iron contents of ghee is investigated. Only small proportion of the copper and iron had migrated to ghee prepared by cream butter and prestratification processes when the cream was contaminated with these metals; direct cream process resulted in ghee with high copper and iron contents. It is indicated that copper and iron migration to ghee was not entirely as phospholipid bound. Both copper and iron produced oxidative rancidity in ghee; the effect was more pronounced in buffalo ghee. Owing to its higher metal contents, direct cream ghee from cream contaminated with copper and iron developed peroxides at a faster rate than cream butter ghee. However, direct cream ghee showed slightly better keeping quality compared to ghee prepared by cream butter processes, when the samples were contaminated after the preparation.

A large number of elements have been detected in trace amounts in normal milk. Of these, copper and iron assume special importance as they have been recognised as potent catalysts of oxidative reactions in milk and dairy products resulting in off-flavour development. However, reports on the role of these metals in ghee, the indigenous Indian product are scarce. Vachha *et al.*[1] reported both the metals to be catalysts in the oxidation of ghee. Ghee obtained by heating butter for longer period has higher keeping quality.[2] It is not known whether this effect is due to the increase in phospholipid content, the production in large quantities of other antioxidants such as sulphydryls as suggested by El-Rafey *et al.*[3] or due to the increased effect of heat on the association of copper and iron. Phospholipids are liberated from the phospholipid-protein complex and transferred to the oil phase when butter is heated to 120-130°C[3]; however, transfer of copper, if any, is not reported. The present study was taken up to show the influence of the method of preparation of ghee on the content of contaminant copper and iron as also the influence of these metals on the oxidative stability of buffalo and cow ghee.

Materials and Methods

Milk of individual animals from the Institute Farm was directly collected in clean glass bottles, with necessary precautions to avoid metal contamination. These samples were centrifugally separated at room temperature (~ 25°C) in an International Centrifuge model SBV, Size 1 at 1500×g. The centrifuged samples were cooled in ice water bath and the hardened cream layer was punctured with a pointed glass rod and the skim milk was drawn off. Fat in the cream was adjusted to 55 per cent in all cases by adding required quantity of skim milk obtained during the separation.

Different methods were employed for the preparation of ghee. In all the methods employed, the starting material was the cream obtained as described above. In these processes, it was essential that the souring of the cream to be carried out for the development of full flavour characteristics in ghee, since ghee from sweet cream was without flavour. Rangappa and Banerjee[4] had demonstrated that a milky flavour of ghee produced by direct cream process could be avoided by the addition of 0.1 per cent citric acid to the cream before boiling down. Moreover fat yield was maximum when such acid cream was washed.[5] Therefore, in the preparation of ghee, the cream was subjected to one of the following treatments: (*i*) ripening; (*ii*) addition of 0.1 per cent lactic acid: (*iii*) addition of 0.1 per cent citric acid; and (*iv*) washing and addition of citric acid. In one method cream was directly clarified to give ghee (direct cream ghee). In another method, the separated cream was churned into butter which was thereafter converted into ghee (creamery butter ghee). In a third method, the creamery butter was melted and allowed to stand at 80°C for 30 minutes and the aqueous layer drawn off before the heating for clarification. In all methods, clarification was carried out in beakers over a bunsen burner with continuous stirring at a temperature not exceeding 120°C at the end. The molten ghee was filtered through a Whatman No. 42 filter paper.

In one set of experiments copper as cupric sulphate or iron as ferrous sulphate was added to cream as aqueous solution to a concentration of 2.0 and 20.0 ppm

respectively. Another set of samples was contaminated with copper or iron after the clarification and filtration processes. Filings of copper or iron were added to filtered ghee samples which were stirred for 30 min at 45°C by means of a magnetic stirrer. After the filings had been separated from the ghee by filtration, the content of copper or iron was estimated. By mixing the contaminated ghee with portions which contained original metals only, samples were prepared with required level of copper or iron.

Copper in ghee was estimated colorimetrically using zinc dibenzyl dithiocarbamate[6] while iron was estimated using 1, 10 phenanthroline.[7] Peroxide value of ghee was determined by the method suggested by Indian Standards Institution[8] and is expressed as meq/kg of ghee.

Results and Discussion

Copper and iron contents: Copper contents of uncontaminated ghee of buffaloes and cows were below 0.02 ppm irrespective of the method of preparation. No influence of the method of preparation on the copper content of these samples could be detected, However, when the cream was contaminated, the method of preparation determined the copper content of the resultant ghee. The copper contents of ghee prepared by different methods from cream contaminated with 2.0 ppm copper are shown in Tables 1 and 2. Data show that only a small proportion of the 2.0 ppm copper added to cream had found its way to ghee prepared by either cream-butter or pre stratification process. While ghee prepared by the prestratification process had the lowest copper content, direct cream process resulted in ghee of very high copper content. However, washing of the cream sample before boiling reduced the copper content of the resultant ghee. Still, the ghee prepared by this method was richer in copper compared to ghee prepared by the other two processes. Difference in the treatment of the cream, that is, ripening or addition of lactic acid did not influence the copper content of the ghee prepared by any of the three methods employed; so also the addition or citric acid, a known copper complexing agent.

Narayanan *et al*[9] had observed that ghee prepared from butter had a higher phospholipid content than that prepared from cream. Menger[10] believed that a part of the added copper was bound to phospholipids and that the phospholipid-bound copper entered the butter. It is possible, therefore, that this copper entered the ghee in combination with phospholipid. If the copper had migrated to ghee as phospholipid-bound, then the copper content of the ghee would be expected to be proportional to its phospholipid content. Data presented show that this was not the case. While prestratified ghee was richer in phospholipid content[11] its copper content was the lowest. Non-fatty solids such as sulphydryl compounds produced during the prolonged heating are

TABLE 1. EFFECT OF THE ADDITION OF 2.0 PPM. Cu^{++} TO CREAM ON THE COPPER CONTENT AND OXIDATIVE DETERIORATION OF BUFFALO GHEE*

Treatment	Cu^{++} in ghee(μg/kg)	Peroxide value (m.eq./kg) at indicated storage period (weeks) 2	4	6	8	10	12	14
Direct cream								
Ripening	438	3.2	7.8	13.2	18.6	22.8	26.0	27.6
Lactic acid	440	2.8	7.8	13.2	19.0	22.4	25.8	27.2
Citric acid	429	2.2	7.8	13.2	18.6	23.2	25.4	26.6
Washing+citric acid	188	1.6	3.0	5.6	9.6	13.8	17.8	20.6
Cream butter								
Ripening	120	1.0	2.0	3.2	5.2	9.0	13.6	18.4
Lactic acid	118	0.8	1.6	3.6	5.0	8.8	13.0	18.4
Citric acid	110	0.8	1.8	3.2	5.0	9.2	13 6	18.0
Washing+citric acid	98	1.0	1.8	2.8	4.6	8.2	13.0	17.2
Prestratification								
Ripening	96	1.2	1.8	3.4	5 2	8.8	12.6	16.8
Lactic acid	96	1.0	1.8	3.4	4 8	8.6	12.8	17.6
Citric acid	92	0.8	1.6	3.2	4.8	8.0	12.0	16.4
Washing+citric acid	80	0.6	1.2	2.4	4.0	7.2	10.8	13.4

*Copper contents of uncontaminated ghee samples were below 0.02 ppm in all cases and peroxide value less than 0.8 after 14 weeks of storage.

Results are averages of 4 samples.

TABLE 2. EFFECT OF THE ADDITION OF 2.0 PPM. Cu^{++} TO CREAM ON THE COPPER CONTENT AND OXIDATIVE DETERIORATION OF COW GHEE*

	Cu^{++} in ghee (μg/kg)	Peroxide value (m.eq./kg) at indicated storage period (weeks) 2	4	6	8	10	12	14
Direct cream								
Ripening	428	2.2	5.0	9.2	13.8	18.0	21.6	24.4
Lactic acid	436	2.0	5.2	9.2	13.6	18.0	21.2	24.0
Citric acid	425	2.2	4.8	9.2	14.0	18.0	21.0	24.0
Washing+citric acid	185	1.4	2.4	4.0	6.0	10.0	14.4	18.2
Cream butter								
Ripening	110	1.0	2.0	2.8	4.2	7.0	10.0	13.6
Lactic acid	112	1.2	1.8	3.0	4.4	7.0	10.0	13.4
Citric acid	104	0.8	1.8	2.8	4.6	6.8	10.4	13.2
Washing+citric acid	95	1.0	2.0	2.6	3.8	6.4	9.0	12.8
Prestratification								
Ripening	90	1.0	2.2	2.6	4.0	7.2	10.2	13.8
Lactic acid	85	1.2	2.4	2.6	4.4	7.0	10.0	13.4
Citric acid	85	1.0	2.2	2.6	4.6	7.2	10.2	13.6
Washing+citric acid	78	1.0	2.0	2.6	3.2	4.8	8.0	12.0

*Copper contents of uncontaminated ghee samples were below 0.02 ppm in all cases and peroxide value less than 0.8 after 14 weaks of storage.

Results are averages of 4 samples.

TABLE 3. EFFECT OF THE ADDITION OF 20.0 PPM. Fe^{++} TO CREAM ON THE IRON CONTENT AND OXIDATIVE DETERIORATION OF BUFFALO GHEE*

Treatment	Fe^{++} in ghee (μg/kg)	Peroxide value (m.eq./kg). at indicated storage period (weeks) 2	4	6	8	10	12	14
Direct cream								
Ripening	1780	2.2	4.0	8.2	12.6	16.0	18.8	21.0
Lactic acid	1785	2.0	4.4	8.6	12.2	15.8	18.8	21.4
Citric acid	1750	2.2	4.6	9.0	12.0	16.2	18.4	21.2
Washing+citric acid	1026	1.2	2.4	4.2	6.8	10.0	13.4	16.8
Cream butter								
Ripening	700	1.0	1.6	2.2	3.8	7.0	10.4	13.8
Lactic acid	705	1.2	1.8	2.0	3.8	7.2	10.4	13.8
Citric acid	690	1.0	1.6	2.2	3.8	7.0	10.8	14.2
Washing+citric acid	614	0.8	1.6	2.0	3.6	6.8	10.0	13.2
Prestratification								
Ripening	610	1.2	1.3	2.4	3.8	7.4	10.2	13.4
Lactic acid	600	1.0	1.6	2.2	3.6	7.2	10.0	13.2
Citric acid	614	1.0	1.8	2.4	3.6	7.0	10.0	13.4
Washing+citric acid	560	1.0	1.4	2.2	3.4	7.0	10.0	13.0

*Iron contents of uncontaminated ghee samples were below 0.075 ppm. in all cases and peroxide value less than 0.8 after 14 weeks of storage.

Results are averages of 4 samples.

TABLE 4. EFFECT OF THE ADDITION OF 20.0 PPM. Fe^{++} TO CREAM ON THE IRON CONTENT AND OXIDATIVE DETERIORATION OF COW GHEE*

Treatment	Fe^{++} in ghee (μg/kg)	Peroxide value (m.eq./kg). at indicated storage period (weeks) 2	4	6	8	10	12	14
Direct cream								
Ripening	1820	1.0	3.4	5.6	8.8	12.8	16.4	19.2
Lactic acid	1814	1.2	3.2	6.0	9.0	12.8	16.6	19.2
Citric acid	1820	1.2	3.2	6.6	9.2	12.6	16.2	18.8
Washing + citric acid	1080	1.2	2.2	3.2	5.6	9.0	12.4	15.4
Cream butter								
Ripening	714	1.0	1.6	2.4	3.0	5.2	8.6	11.8
Lactic acid	725	1.0	1.4	2.2	3.2	5.0	8.6	11.8
Citric acid	700	1.0	1.6	2.4	3.2	5.2	8.8	12.0
Washing + citric acid	630	0.8	1.4	2.2	2.8	4.4	8.2	11.2
Prestratification								
Ripening	634	1.0	1.4	2.4	3.2	5.0	8.4	12.0
Lactic acid	632	1.2	1.4	2.0	3.4	4.6	8.6	12.0
Citric acid	638	1.2	1.4	2.4	3.2	4.4	8.8	11.6
Washing + citric acid	600	0.8	1.2	2.0	2.6	4.0	8.0	11.2

*Iron contents of uncontaminated ghee samples were below 0.075 ppm. in all cases and peroxide value less than 0.8 after 14 weeks of storage.

Results are averages of 4 samples.

found in higher quantities in direct cream ghee.[12] Copper is present probably in combination with these compounds; hence the higher copper concentration in direct cream ghee.

Further, it is known that phospholopids occur to a considerably higher extent in cow ghee than in buffalo ghee.[13] Nevertheless, there was no marked difference in the copper contents of buffalo and cow ghee. This, again, suggests that copper transport to ghee is not entirely by copper-phospholipid association. Copper can be present in ghee in the metallic state, dissolved in the fat as fatty acid soaps, or in water phase in contact with the ghee. In this respect, Uri[14] found even methyl linoleate which was twice distilled in a glass fractionating column contained 0.21 ppm of copper.

The case with iron was similar. Iron content of uncontaminated ghee was below 0.075 ppm. When the cream was contaminated, direct cream ghee contained the highest concentrations of iron (Tables 3 and 4). No marked differences were noted between the iron contents of buffalo and cow ghee prepared from cream contaminated to the same extent.

Oxidative effect: Both copper and iron produced oxidative rancidity in ghee. The effect was more pronounced in buffalo ghee. The oxidative deterioration of ghee as measured by peroxide value is given in Tables 1 and 2. In all trials ghee prepared by direct cream method developed peroxides at a faster rate. In ghee prepared by this method from cream containing 2.0 ppm added copper, a peroxide value of above 5.0 was reached which was arbitrarily fixed as an indication of poor quality, in 2-4 weeks of storage in closed glass bottles in diffused day light at room temperature ($\sim$25°C), except in cases when the cream was washed before boiling down to ghee. Even when the cream was washed, the resultant ghee had a lower keeping quality than that prepared by the other two methods. This could be correlated to its higher copper content. Normally, direct cream ghee has a better keeping quality due to the greater production during the prolonged heating of sulphydryl compounds of known anti-oxidant property and perhaps due to the greater content of non fatty solids in such ghee over that boiled down from butter.[12] Novertheless, when cream was contaminated with 2.0 ppm copper, the pro-oxidant effect of the higher amount of copper passed on to ghee prepared by this method was greater than the anti-oxidant effect of these compounds. The faster rate of oxidation in direct cream ghee could also be due to the lower content of phospholipids which have been found to reduce the catalytic effect of copper on milk fat oxidation[15].

Ghee prepared from fresh butter with or without prestratification had similar keeping quality. Washing of the contaminated cream before churning to butter

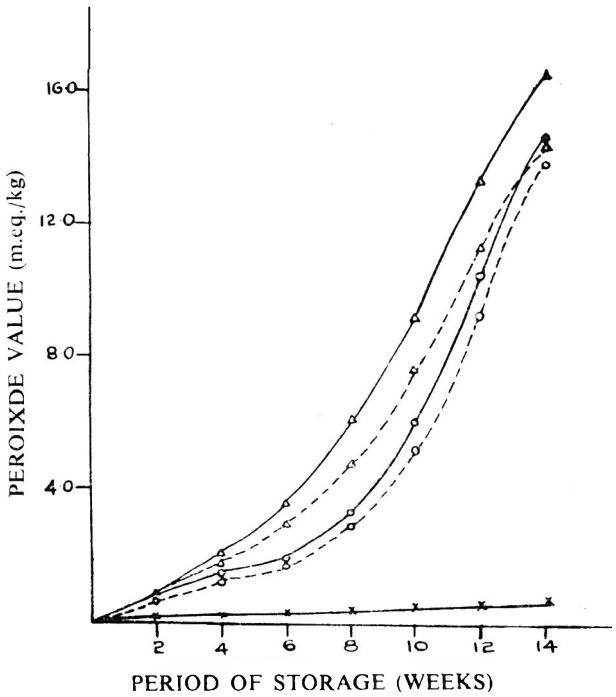

Fig. 2. Effect of 1.0 ppm iron on peroxide value of ghee stored at 25°C

— O — Direct cream buffalo ghee; — △ — Cream butter buffalo ghee; - - O - - Direct cream cow ghee: - - △ - - Cream butter cow ghee; — × — Uncontaminated ghee.

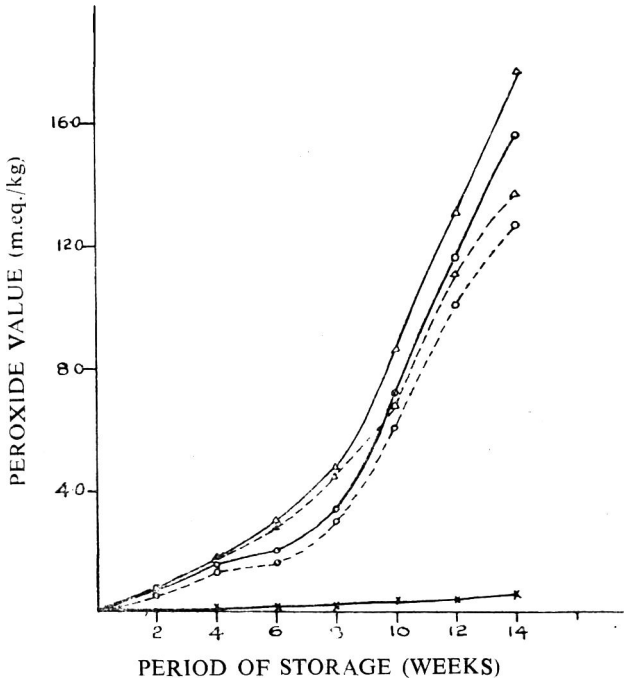

Fig. 1. Effect of 0.1 ppm copper on peroxide value of ghee stored at 25°C

— O — Direct cream buffalo ghee; — △ — Cream butter buffalo ghee; -- O -- Direct cream cow ghee; -- △ -- Cream butter cow ghee; — × — Uncontaminated ghee.

did not improve the keeping quality of the resultant ghee to any great extent. Also, addition of lactic acid or citric acid to cream did not affect the peroxide development in the ghee prepared. This observation is in agreement with the report of Sounderarajan.[16]

Direct cream process was found to yield ghee of poor keeping quality when the cream was contaminated with iron (Tables 3 and 4). As the case with copper, washing of the cream before boiling down which resulted in considerable reduction of iron content improved the storage life of direct cream ghee. The different treatments given to cream and the processes employed for the preparation of ghee had similar effects on copper and iron with respect to their influence on peroxide development in ghee. Iron, however, was less potent than copper. Vachha *et al*[1] had suggested that copper and iron catalysed autoxidation of ghee through different mechanisms; while copper had enhanced water formation during oxidation, iron enhanced carbon dioxide formation.

Keeping quality of ghee prepared by the three processes and contaminated to the same extent with copper or iron after the preparation was also compared. Citric acid (0.1 per cent) was added to fresh uncontaminated cream from which ghee was prepared. Since the temperature of clarification influences the storage stability of ghee prepared in all the three processes the clarification temperature was maintained at 120°C. After filtering off the ghee, samples were contaminated with copper or iron as described earlier. The storage stabilities of the samples as measured by peroxide values are presented in Fig. 1 and 2. The peroxide values of ghee prepared from butter with or without prestratification were identical when contaminated to the same extent with copper or iron. Therefore, in the figures, 'cream butter, ghee' represents ghee prepared by both the processes. Similarly 'uncontaminated ghee' showed identical peroxide values irrespective of the method of preparation.

When contaminated with 0.1 ppm copper, ghee prepared by direct cream process had a slightly better keeping quality. Buffalo ghee prepared by this method developed a peroxide value of 5.0 after 9 weeks of storage at room temperature while ghee prepared by the other methods showed same level of peroxides in about 8 weeks under identical storage conditions. This would mean that the lower keeping quality noted for direct cream ghee in the earlier experiment was due to its higher copper content.

Peroxide value development was at a lower rate in cow ghee. Though in the early stages of storage the peroxide value did not differ markedly, at later stages buffalo ghee showed considerably higher values compared to cow ghee.

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Studies on the Equilibrium Relative Humidity and Seasonal Variation in Moisture Content of Walnuts *(Juglans regia)*

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Studies on moisture relations of shelled and inshell walnuts at tropical temperature (25°C) are described; a simple, easy and rapid method for the determination of moisture in walnut kernels is elaborated. Based on sorption isotherm curves, relating the ambient relative humidities to the corresponding equilibrium moisture content of walnut kernels stored in sealed glass jars, the maximum safe moisture content in equilibrium with 75% R. H. at 25°C is estimated as 4.9 to 5.0%. The average equilibrium relative humidity for the three types of walnut kernels studied was found to be 57.6%. Variations in moisture content in walnuts during the entire crop season from October to April has been studied and the maximum minimum tolerance limits of moisture content for grading and marketing purposes have been suggested.

Jammu & Kashmir is the principal walnut growing State in India. Other walnut growing regions are the hilly areas of Punjab, Himachal Pradesh and Uttar Pradesh, but the quality of produce from these regions is not usually as good as that from Jammu & Kashmir.[1] The most esteemed among the cultivated varieties is *Kaghzi akhrot*, a large nut with easily breakable thin shell and whitish kernel of excellent taste and flavour. During 1974–75 India exported walnuts worth Rs. 1.9 crores.[2]

Shelled walnuts are highly susceptible to darkening and the development of rancidity. Moisture, heat, light and air are primary factors in their deterioration.[3-5] In India, though walnut is produced in temperate regions it has to pass through various temperature and humidity zones before reaching the consumer. In respect of kernels despatched to foreign markets, the spoilage becomes pronounced owing to prevailing high temperature and humidity in the shipholds and the consequential mould infestation. Initial moisture content of walnuts prior to packing is the most improtant factor both from the mould infestation and flavour stability point of view.

At present, in India, walnuts are graded for export on the basis of size and colour only.[6] The present study was undertaken (*a*) to determine the equilibrium relative humidity for walnut kernels; (*b*) to find a suitable rapid method for moisture estimation in walnut kernels; (*c*) to study the variation in moisture content of walnuts during the entire crop season (Oct. to April); and (*d*) to suggest a maximum safe limit for moisture content.

Materials and Methods

(*a*) *Equilibrium relative humidity for walnut kernels:* Samples of three grades of walnut kernels, Indian light halves, Indian light amber halves and Indian brown halves, obtained from Jammu, were used for this study.

Wink's weight equilibrium method[7] was employed for the determination of ERH curve. Ten lots of each grade of these samples (about 5 g each) were accurately weighed in 10 flat-bottomed glass dishes and exposed to ten different percentages of relative humidities ranging from 7.0 to 93.0 per cent at 25°C. The relative humidity conditions were obtained by preparing saturated aqueous solutions of different salts.[8] The gain or loss in weight was determined after every 24 hr till the moisture equilibrium of the product was obtained at each level of R.H. The relationship between the equilibrium moisture content and the number of days the product took to reach equilibrium at a particular relative humidity at 25°C is presented in Table 1.

The initial moisture content of the samples was determined by toluene distillation method.[9]

(*b*) *Suitable rapid method for moisture estimation in walnut kernels:* The methods tried included (*i*) hot air oven method using 130°C for 3 hr; (*ii*) vacuum oven method using 100°C and 100 mm pressure for 3 hr; (*iii*) Dean and Stark's toluene distillation method.

A bulk lot of walnut kernels was powdered in a Monamill and sieved through IS 1.00 mm sieve. Samples of 5 g was used in air oven and vacuum oven methods and 40 g for toluene distillation method.

The moisture content values obtained by air oven at 130°C for 3 hr and vacuum oven at 100°C/100 mm pressure for 3 hr were found to be comparable with those obtained by toluene distillation method. To draw a precise relation between the three methods ((*i*) air oven method at 130°C/3 hr; (*ii*) vacuum oven method at 100°C/100 mm/3 hr and (*iii*) toluene distillation method) 30 samples of different grades were analysed in replicate by the above three methods. The average values by three methods are given in Table 2.

(*c*) *Variation in moisture content of walnut samples during the entire crop season:* Shelled and inshell walnut samples were received from Jammu and Delhi. every fortnightly, during the crop season (Nov. to April). Total of 209 samples (141 shelled and 68 inshell) were analysed for moisture content in duplicate by (*a*) Air oven method at 130°C for 3 hr; and (*b*) vacuum oven method at 100°C and 100 mm pressure for 3 hr.

Frequency distribution of moisture content are given in Table 4.

Results and Discussion

(*A*) *Equilibrium relative humidity for walnutss* It is evident from Table 1 that the time taken to reach equilibrium is not greatly affected by the differences in the initial moisture content. Based on the equilibrium moisture content (EMC) curves, the ERH for the three types of walnut kernels under study is to 57.2, 57.8 and 57.9 per cent respectively or a mean of 57.6 per cent. If the product is stored under 57.6 per cent R.H. there will be neither increase nor decrease in moisture content during any length of storage. It was observed that walnut kernels at R.H. above 75 per cent became mouldy within one week when critical moisture level is 5.5-5.8 per cent. average moisture content of 4.96 per cent at 75 per cent R.H. or below is reasonably safe from mould infestation. It has been suggested[10] that the maximum permissible limit for the safe storage of oilseeds is 14 per cent (moisture) calculated on the non-oleaginous portion of the

TABLE 1. RELATION BETWEEN EQUILIBRIUM MOISTURE CONTENT, RELATIVE HUMIDITY AND TIME TO REACH EQUILIBRIUM FOR WALNUT KERNELS AT 25°C

RH (%)	Indian light halves*		Indian light amber halves*		Indian brown halves**	
	EMC (%)	No. of days to reach equilibrium	EMC (%)	No. of days to reach equilibrium	EMC (%)	No. of days to reach equilbrium
7.0	1.1	11	1.2	11	1.2	11
11.1	1.3	9	1.3	11	1.9	10
22.5	2.2	8	1.9	9	2.4	9
33.0	2.7	7	2.4	8	2.6	6
42.8	3.1	5	2.9	3	3.1	4
52.9	3.4	3	3.4	3	3.7	3
63.0	4.1	4	3.9	6	4.3	6
73.8	4.8	6	4.8	7	5.3	6
81.1	5.6***	6	5.6***	8	5.8***	6
93.0	Mould attack on 5th day at 9.1% moisture		Mould attack on 5th day at 9.5% moisture		Mould attack on 5th day at 9.3% moisture	

*Initial moisture content 3.7%; **Initial moisture content 4.0%; EMC Equilibrium moisture content.

***Simultaneously, as the equilibrium was reached, mould formation was noticed, in these cases.

TABLE 2. COMPARISON OF PROCEDURES FOR ESTIMATION OF MOISTURE

Samples	Moisture (%) by			AOM % deviation from	
	AOM	VOM	TDM	VOM	TDM
ISSLH	3.86	3.89	4.04	0.03	0.18
ILB	3.47	3.52	3.74	0.05	0.27
ILH	3.67	3.73	3.88	0.06	0.21
Mean	—	—	—	0.05	0.22

AOM: Air oven method; VOM: Vacuum oven method; TDM: Toluene distillation method.

Coefficient of correlation between (*i*) AOM *vs* TDM and (*ii*) VOM *vs* TDM was found to be same as 0.94.

ISSLH—Indian special small light halves; ILB—Indian light brokens; ILH—Indian light halves.

seed. Indian walnut kernels on an average contain 64.5 per cent of fat. Therefore, the total non-oil portion in walnut kernel would be approximately 35 per cent, and the calculated maximum permissible moisture content would be 4.9 per cent on the basis of 14 per cent of non-oil portion. Hence the calculated limit of the maximum 'safe' moisture content for walnut kernels agrees very closely with the limit established in the present study.

(*B*) *Method for moisture determination:* It is seen from the Table 2 that values of moisture, obtained by vacuum oven method are higher than the values obtained by air oven method. The average difference in values is 0.05 per cent. Similar observations were recorded in case of toluene distillation method when compared with the air oven and vacuum oven methods. The average differences in values obtained by toluene distillation method and air oven method; and toluene distillation method and vacuum oven method are 0.22 and 0.18 per cent respectively. The co-efficients of correlation between the three methods are highly significant. In view of this, either the results of air oven method or vacuum oven method could be profitably used for the moisture determination. From the criterion of least variability in results, the toluene distillation method is to be preferred. The relative precision for both the oven methods was found to be the same i.e. 0.94 per cent. The estimated moisture percentage by the toluene distillation method on the basis of moisture determined by the air oven method using the regression equation $Yc=0.88+0.82\times$ for moisture content ranging from 3.05 to 4.25 per cent can be estimated (Table 3). As the relative precision for both the oven methods is the same, from economy point of view air oven method at 130°C for 3 hr may be preferred.

(*C*) *Variation in moisture content during the crop season;* From November to February out of the total 108 samples (Shelled) 99 or 91.6 per cent fell within the range of 4.5 per cent moisture. From March to April, as many as 97 per cent of samples fell within 2.01 to 3.5 per cent moisture. This indicates that as the season advances and the summer season sets in, the moisture content starts decreasing.

For the entire season 93.6 per cent of the samples fell within the range of 2.01 to 4.5 per cent i.e. the number of samples having moisture content more than 4.5 per cent are only 6.4 per cent of the total.

In case of inshell walnuts (Table 4), during Nov.-Feb. as many as 81.2 per cent of samples fell within the range of 4.5 per cent moisture and in the months of March-April, 95 per cent fell within the limits of 2.01 to 3.5 per cent. This again indicates that moisture gets

TABLE 3. COMPUTED VALUES OF MOISTURE CONTENT IN WALNUT KERNELS IN TERMS OF TOLUENE DISTILLATION METHOD FOR ACTUAL MOISTURE DETERMINED BY AIR OVEN METHOD AT 130°C

Moisture (%) by AOM (×)	Moisture (%) by TDM $Y=0.88+0.82\times$	Moisture (%) by AOM (×)	Moisture (%) by TDM $Y=0.88+0.82\times$	Moisture (%) by AOM (×)	Moisture (%) by TDM $Y=0.88+0.82\times$
3.05	3.38	3.55	3.79	4.05	4.20
3.10	3.42	3.60	3.83	4.10	4.24
3.15	3.46	3.65	3.87	4.15	4.28
3.20	3.51	3.70	3.91	4.20	4.32
3.25	3.55	3.75	3.96	4.25	4.37
3.30	3.58	3.80	4.00		
3.35	3.63	3.85	4.04		
3.40	3.67	3.90	4.08		
3.45	3.71	3.95	4.12		
3.50	3.75	4.00	4.16		

AOM: Air oven method; TDM: Toluene distillation method

TABLE 4. FREQUENCY DISTRIBUTION OF MOISTURE CONTENT IN WALNUTS DURING THE CROP SEASON (NOVEMBER-APRIL)

Moisture range (%) by wt.	November - February		March - April		November - April	
	No. of samples	% in total	No. of samples	% in total	No. of samples	% in total
Shelled Walnuts						
2.01 - 2.50	—	—	17	51.5	17	12.0
2.51 - 3.00	2	1.9	6	18.2	8	5.7
3.01 - 3.50	11	10.2	9	27.3	20	14.2
3.51 - 4.00	51	47.1	—	—	51	36.2
4.01 - 4.50	35	32.4	1	3.0	36	25.5
4.51 - 5.00	7	6.5	—	—	7	5.0
5.01 - 5.50	2	1.9	—	—	2	1.4
5.51 - 6.00	—	—	—	—	—	—
Total	108	100.0	33	100.0	141	100.0
Inshell Walnuts						
2.01 - 2.50	—	—	2	10.0	2	2.9
2.51 - 3.00	—	—	10	50.0	10	14 7
3.01 - 3.50	6	12.5	7	35.0	13	19.1
3.51 - 4.00	17	35.4	1	5.0	18	26.5
4.01 - 4.50	16	33.3	—	—	16	23.6
4.51 - 5.00	6	12.5	—	—	6	8.8
5.01 - 5.50	2	4.2	—	—	2	2.9
5.51 - 6.00	1	3.1	—	—	1	1.5
Total	48	100.0	20	100.0	68	100.0

reduced as the season advances. For the entire season as many as 86.8 per cent of samples were within the range of 2.01 to 4.5 per cent. Rockland *et al*[11]. have studied the stability of walnut kernels from flavour point of view; and they found that the samples containing moisture from 3 to 4 per cent remained acceptable for at least 6 months, whereas the samples having 2.8 per cent moisture became unacceptable sooner. After 6 months, only insignificant organoleptic changes were observed among the kernels containing 3.1-4.0 per cent moisture. The data show that the moisture content starts decreasing from 3 per cent from the second fortnight of March onward. The moisture content in the second fortnight of April varied from 1.9 to 2.7 per cent. It can, thus, be summarised that walnut kernels packed after the middle of March under Indian conditions may not keep proper flavour as the moisture will be below 3 per cent.

Conclusion: Equilibrium relative humidity and moisture content in walnut kernels (shelled and inshell) play an important part in safe storage and maintaining flavour. Though the maximum safe moisture content for walnut kernels was found to be 4.9 per cent, the maximm acceptable misture content for safeguarding walnut kernels against fungus attack may be taken as 4.5 per cent so as to avoid any chances of fungus damage. Again, as the organoleptic qualities of walnut kernels deteriorate during shelf-life period in a packed condition if the moisture content is less than 3.0 per cent, for grading and marketing purpose walnuts below 3.0 per cent moisture level should be rejected. Thus, for grading and packaging, walnuts having moisture 3.0 to 4.5 per cent be selected and the humidity in packaging room and store house be kept at about 55-60 per cent.

During the entire crop season, maximum number of samples had moisture content within 4.5 per cent. For the determination of moisture content, air oven methed at 130°C for 3 hrs. can be used for routine analysis.

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Polyphenoloxidase from the Peel of the Mango Fruit *(Mangifera indica)*

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Polyphenoloxidase (O-diphenol: O oxidoreductase EC:1:10.3.1) was purified fifty-fold from the peel of the mango fruit (*Mangifera indica*, *Badami* variety). The enzyme showed maximum activity towards catechol and 4-methyl catechol. There was no change in the substrate specificity of the enzyme both in the preclimacteric and climacteric stage. Copper requirement for the enzyme activity was demonstrated by dialysis experiments and inhibition studies. The pH optimum of the enzyme was around 5. 4.

Polyphenoloxidase, the enzyme responsible for the discolouration in many fruits and vegetables has been isolated or partially purified from a wide variety of sources.[1-5] In many cases this enzyme exists in multiple forms.[6,7] Kertesz and Zito[8] have shown that copper is a part of polyphenoloxidase isolated from mushroom. In the present investigation polyphenoloxidase from mango (*Mangifera indica*) peel has been partially purified and some of its properties studied.

Materials and Methods

Fully mature mango fruits were harvested from the local gardens and stored at room temperature (28°C). After 9 days of storage at this temperature these fruits had reached their climacteric maximum. Peel portion of the fruit was collected for enzyme isolation. Acetone dried powder was prepared from the peel and stored at 0°C. The powder retained polyphenoloxidase activity for a period of 6 months.

Enzyme purification

Acetone dried powder: Peel of the fruit (50 g) was homogenized in a Waring blender with 400 ml chilled acetone. The suspension was immediately filtered through a Buchner funnel. The powder was washed further with 200 ml of acetone, air dried and stored at 0°.

Extraction of the enzyme: The powder (4 g) was extracted with 32 ml of 0.1 M phosphate buffer (PH 7.2) by constant stirring for 30 min. The extract was filtered through cheese cloth, centrifuged at 4000 × g for 10 min. in refrigerated centrifuge and the clear supernatant decanted.

Calcium acetate treatment: To 30 ml of the clear supernatant 150 mg of calcium acetate was added to remove the polyphenols that were left in the powder after acetone treatment. After stirring for 15 min the clear supernatant on centrifugation was collected and the precipitate discarded. The supernatant solution was dialysed against 0.001 M phosphate buffer (pH 7.2) for 3 hr to remove calcium acetate.

Alcohol fractionation: From the dialysed solution, the enzyme was precipitated between 30 and 70 per cent alcohol concentration. The temperature during the

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operation was maintained around 0°. The precipitated protein was collected by centrifugation, dissolved in 0.001 M phosphate buffer (pH 7.2) and dialysed against 0.001 M phosphate buffer for four hours.

DEAE cellulose column chromatography: The above enzyme was placed on a DEAE cellulose column (1.5×7 cm). After stepwise gradient elution with phosphate buffer pH 7.2 (0.01 M-0.025 M-0.05 M-0.1 M), cluote the enzyme fraction was detected in 0.05 M phosphate.

The enzyme at this stage of purity was used in all the studies described.

Protein nitrogen of acetonedried powder was estimated by Kjeldahl method and on subsequent fractions by absorption reading at 260 m μ and 280 m μ in Beckman recording spectro photometer model DK-2A.

Enzyme assay: Method of Mayer, Harel and Benshaul[9] was followed for assay of the enzyme. The reaction mixture contained 0.01 M citrate-0.025 M phosphate buffer pH 5.5, 3.3-m catechol and 0.5 ml enzyme (protein range 10 μg to 2250 μg) depending on the fraction used). The final volume was 3ml. The reaction was started by the addition of the substrate. The enzyme blank cuvette contained all reagents except substrate.

Results and Discussion

Table 1 gives the results of purification of the enzyme polyphenoloxidase. Attempts to fractionate by ammonium sulphate precipitation of the original extract were not successful as the precipitate so obtained had a tendency to float, get dispersed and did not settle. It was not possible to get a compact pallet by calcium acetate treatment as it led to considerable loss of enzyme activity and no increase in specific activity. However, this step was necessary to remove a large amount of colouring material including the polyphenolics. Alcohol precipitation and the use of DEAE cellulose column gave to about 50-fold purification.

TABLE 1. PURIFICATION OF POLYPHENOLOXIDASE FROM MANGO FRUIT PEEL

Fraction	Total vol.	Protein mg/ml.	Specific activity units	Total units	% recovery
Acetone powder extract	33	4.5	0.09	13.36	100
Calcium acetate treated extracted	30	1.5	0.08	3.6	27
30-70% alcohol pre-cipitole	4.5	0.9	0.15	0.6	5
DEAE cellulose column	5.0	0.02	4.6	0.46	4

The enzyme assay was carried out with Beckman recording spectrophotometer model DK-2A at 395 mμ. Specific activity unit is equal to 0.001 OD at 395 m/u per min per mg. protein.

TABLE 2. SUBSTRATE SPECIFICITY OF POLYPHENOLOXIDASE

Substrate	Preclimateric	Climateric
Catechol*	100	100
Chlorogenic acid	62	55
Caffeic acid	52	40
3-4 dihydroxybenzoic acid	42	38
Gallic acid	52	45
3:4 Dihydroxy phenylalanine	8	11

*Value of catechol— 100

All the substrates were added at a concentration of 3.3 mM.

The substrate specificity of purified enzyme is shown in Table 2. For this experiment the enzyme was prepared from fruits both in the climacteric and the pre-climacteric stage. Maximum activity was demonstrated with catechol and 4-methyl catechol among the various substrates studied.

The metal requirement of the polyphenoloxidase is shown in Table 3. On dialysis for four hours against 1 mM sodium cyanide the enzyme lost most of its activity which was restored by the addition of copper but not ferrous iron.

The effect of copper chelating agents on the enzyme activity is shown in table 4. Both sodium azide 0.3 mM and sodium diethyl dithiocarbamate at 3 mM considerably inhibited the polyphenoloxidase activity.

The pH optimum for the purified enzyme was found to be around 5.4. 0.01M citrate-phosphate buffer was used in the range 4-6.5.

The enzyme polyphenoloxidase from the peel of the mango fruit has been purified about 50 fold by conventional purification methods. This enzyme was very

TABLE 3. METAL REQUIREMENT OF POLYPHENOLOXIDASE

Enzyme	Specific activity
Undialysed	3.2
Dialysed	0.4
Dialysed +1 μ mole Cu^{2+} (preincubation for 4 hr. at 0°)*	3.0
Dialysed +1 μ mole Cu^{2+} (without preincubation)	0.4
Dialysed +1 μ mole of Fe^{2+}	

DEAE cellulose eluate was dialysed against 0.01 M phosphate buffer pH 7.4 containing 1 mM sodium cyanide for 4 hrs.

*Aliquot of the dialysed enzyme containing about 20 μg protein was incubated with 1 μ mole of Cu^{++} at 0° for 4 hrs. and then used for assay.

TABLE 4. INHIBITION OF POLYPHENOLOXIDASE BY COPPER CHELATING COMPOUNDS

Addition	Specific activity
Nil	5
Sodium azide (0.3 mM)	Nil
Sodium d ethyldithiocarbamate 3mM	0.25
Sodium d.ethyldithiocarbamate 0-3 mM	2.50

active towards catechol, d-catechin and 4-methyl catechol[5]. Thomase and Nair[10] reported maximum activity towards DOPA amine as the substrate for partially purified banana polyphenoloxidase while activity towards catechol was extremely low. In the present experimen:s substrate specificity was studied for the enzyme isolated both in the pre-climacteric and climacteric stage. The substrate specificity did not appear to change during the ripening process. Involvement of copper in the polyphenooxidase was demonsotrated by dialysis experiments and inhibition by copper chealating agents. Similar requirements for prolonged pre-incubation for restoration of the activity has been demonstrated for the mushroom polyphenoloxidase.[8]

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RESEARCH NOTES

DETECTION OF CAPSAICIN IN ADULTERATED GINGER OLEORESIN

A TLC procedure for the detection of capsaicin adulteration in ginger extracts is outlined. This method is more specific than the currently available official method or the method based on colour of the capsicum.

Capsicum extract is used for increasing the pungency of ginger extracts, especially for ginger ale manufacture. If this is not declared specifically this becomes adulteration. AOAC[1] provides a method for detecting the presence of capsicum extract in ginger extracts based on the fact that pungent principles of ginger, gingerols are decomposed readily by alkali while capsaicins from capsicum retains its pungency. However since shogaol, the dehydration product from gingerol generally found in commercial oleoresins is not easily transformed and the degradation product zingerone has also some pungency and the subjective testing has not been standardized, results could be highly variable. A TLC procedure based on separating the colouring matters of capscium, curcuma and ginger has recently been suggested by Osisiogu[2] to detect clearly these adulterants. However, if the ginger extract is mixed with *the colourless pungent* capsaicin, or extracts of capsicum after decolorization, the above procedure will not be useful to detect the additions. In our work[3] on correlation of pungency with the estimated pungent gingerol and shogaol we came across a sample which showed very high pungency not correlated to the gingerol and shogaol contents. By using the TLC procedure of Osisiogu no colour was observed at R_f 0.12 or 0.70 or 0.97 indicating the addition of capsicum extract. This was then examined by TLC, with a view to identify capsaicin in the ginger oleoresin samples. Standard TLC plates and procedure have been used to separate capsaicin, gingerol and shogaol. Based on our experience on the TLC behaviour of pungent principles of spices, benzene/methanol, 80:5 (v/v) and Hexane/Ether 1:1.5 (v/v) was

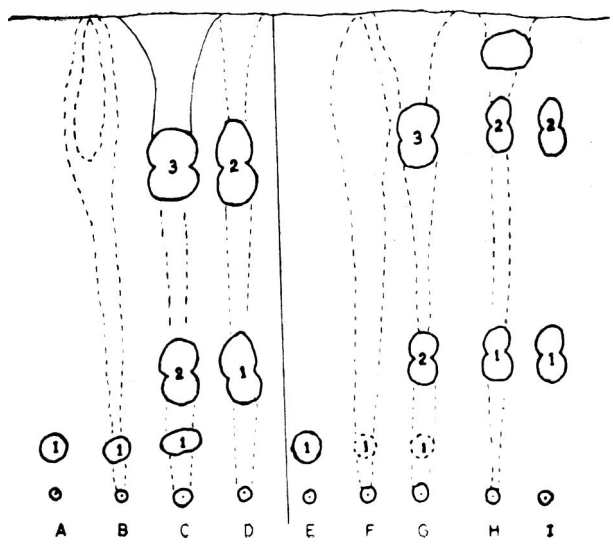

Fig. 1. Tracing of TLC separation of pungent components of capsicum and ginger Oleoresins

Developing solvent.: Hexane: Ether 1:1.5 (v/v)

Spraying reagent: Sample Nos. A-D, Gibbs reagent + Buffer; Sample Nos. E-H, 2, 4 Dinitrophenyl hydrazine

See Table for identity of sample and separated components. Dotted lines indicate the faint background colour.

TABLE 1. R_f, CHARACTERISTIC COLOUR AND IDENTITY OF TLC SEPARATED COMPONENTS

Figure Sample No.	Sample	Spot No.	Benzene Methanol 80:5	Hexane Ether 1:1.5	Gibbs reagent (samples A to D)	2, 4-DNP Hydrazine (samples E to I)	Vanillin sulphuric acid	Identity of spot
A & E	Capsaicin	1	0.32	0.10	Blue	Reddish	No colour	Capsaicin
B & F	Capsicum Oleoresin	1	0.32	0.10	Blue	Reddish	No colour	Capsaicin
C & G	Ginger Oleoresin (suspected)	1	0.32	0.10	Blue	Reddish	No colour	Capsaicin
		2	0.53	0.26	Yellow	Yellow	Copper sulphate blue	Gingerols
		3	0.88	0.70	Yellow	Yellow	Copper sulphate blue	Shogaols
D & H	Ginger oleoresin (commercial)	1	0.53	0.26	Yellow	Yellow	Copper sulphate blue	Gingerols
		2	0.88	0.70	Yellow	Yellow	Copper sulphate blue	Shogaols
I	Gingerol (isolate)	1	0.53	0.26	Yellow	Yellow	Copper sulphate blue	Gingerols
	Shogaol (isolate)	2	0.88	0.70	Yellow	Yellow	Copper sulphate blue	Shogaols

chosen for the TLC separation. Pure capsaicin (K & K laboratory, USA), TLC purified isolates of gingerols and shogaols[4] along with the samples of the suspected commercial and pure ginger oleoresins were used to determine the R_f values. Fig. 1 gives the pattern for one of the solvent systems and Table 1 the R_f values and colour with three chromogenic reagents in both the solvent systems. Identification of capsaicin was confirmed by the highly sensitive blue colour reaction with Gibb's reagent (0.1 per cent solution of 2, 6-dichloroquinone chlorimine in acetone followed by buffer, pH 9.6)[5] that of gingerol and shogaol by the characteristic yellow 2, 4-DNP hydrozones and the copper-sulphate blue colour on spraying with vanillin-sulphuric acid reagent. The three pungent components are very clearly separated with R_f 0.32, 0.53, and 0.88 in the benzene; methanol solvent and with R_f 0.1, 0.26 and 0.7 in hexane; ether solvent (Fig. 1 A, E & I); the colour reactions are also distinct. It is clearly shown that the highly pungent commercial ginger extract had been mixed with capsaicin (Fig. 1 C & G), though *any colour of the Capxanthins* could not be found by the Osisiogu method.[2]

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VARIETAL DIFFERENCES IN THE CHEMICAL COMPOSITION OF SOYBEAN (*GLYCINE MAX* L.)

Variability for chemical composition, energy value and crushing hardness was studied in fifty five varieties of soybean, Variety PK 71-5 under late sown trial gave the highest protein content (53.35%) and the average protein content was found to be 43.27 per cent. The maximum fat content of 25.13 per cent was observed in Harsoy deciduous in spring trial and 20.21 per cent by PK 73-97 in late sown trial. The mean energy value did not show any remarkable variation under both the trials. The mean value for crushing hardness under late sown trial was greater than spring trial, which also showed higher values for protein content.

Soybean is now well recognised for its high protein and oil contents. Its chemical composition is controlled by an interplay of genotype, agroclimatic and environmental factors. Chapman *et al*[1]. have observed that oil and protein contents in soybeans are affected by the environment, whereas the level of lipoxygenase activity appear to be genetically controlled. Nitrogenous fertilizers result in high protein and seed yield, while phosphatic fertilizers lead to high oil content[2]. In this communication we report the chemical composition and hardness of seeds of fifty five varieties of soybean raised in spring and late-sown trials.

Soybean samples of fifty five varieties raised in two replicated trials viz. spring trial and late sown trial at the Research Farm of Haryana Agricultural University, Hissar, were procured from the Department of Plant Breeding. The samples were dried in an hot air oven at 60°C and were ground to pass through 40 mesh sieve and stored in air tight containers. Moisture content of samples was determined by drying at 105°C for 8 hr to a constant weight. Protein content was estimated by the method of McKenzie and Wallace[3] and the values for fat relate to the total lipid extractives determined by cold percolation method.[4] The mineral matter was estimated by the AOAC methods[5] and the carbohydrate content was obtained by difference between 100 and the sum of moisture, protein, fat and mineral matter contents. The food energy value was calculated from the content of proximate principles assuming that proteins and carbohydrates yield 4 K cal/g and fats yield 9 K cal/g. The crushing hardness (Kg/seed) was judged in whole seed with the help of Hardness Tester (Ogawa Seiki, Ltd. Tokyo, Japan).

Chemical composition of fifty-five soybean varieties have been grouped and averaged with standard deviation and coefficient of variation between the two major groups of spring varieties and late sown varieties in Table 1. There are differences in the spring and late sown trials, however, no special varietal differences were observed. The mean moisture content in late sown trial and the overall mean observed was 6.08 per cent. Gopalan *et al*[6]. reported that soybean on an average contained 8.1 per cent of moisture.

Protein content ranged from 36.90 to 53.35 per cent and only 10 varieties contained less than 40 per cent protein. The average content of protein in late sown trial was 44.85 whereas in spring trial it was 4.34 per cent less than in late varieties. The results reported in the present findings are in conformity with the findings of

TABLE 1. ANALYSIS OF QUALITY COMPONENTS IN SOYBEAN

Constituent	Mean±S.D.	C. V.
Spring varieties		
Moisture (%)	5.59± 0.76	13.69
Protein (%)	40.51± 1.13	2.78
Mineral matter (%)	7.00± 0.61	8.64
Carbohydrates (%)	27.41± 4.03	14.72
Energy value (K cal)	445.95±19.41	4.35
Fat (%)	19.49±10.02	51.40
Crushing hardness (kg/seed)	15.98± 4.38	27.43
Late sown varieties		
Moisture (%)	6.36± 1.44	22.62
Protein (%)	44.85± 3.40	7.85
Mineral matter (%)	6.18± 0.25	4.45
Carbohydrates (%)	25.40± 1.54	6.06
Energy value (K) cal)	435.20±10.18	2.30
Fat (%)	17.22± 1.56	9.06
Crushing hardness (kg/seed)	16.23± 2.85	17.56
Spring + Late sown		
Moisture (%)	6.08± 1.29	21.21
Protein (%)	43.27± 3.53	8.16
Mineral matter (%)	6.47± 0.64	9.89
Carbohydrates (%)	26.16± 8.21	31.38
Energy value (K cal)	439.11±15.13	34.46
Fat (%)	18.05± 7.36	40.77
Crushing hardness (kg/seed)	16.10± 6.20	38.50

Bailey *et al.*[7] and Cartler and Hopper.[8] Several investigators have estimated the protein content in different varieties of soybean under different agro-climatic conditions. According to Kale,[9] the crude protein averaged 38.3 per cent. However, Kuzayali *et al.*[10] reported a lower range of 30.3 per cent. Saxena and Pandey[11] reported a narrow range between 39.5 and 43.2 per cent.

The average fat content of spring varieties is more than in the varieties of lates own trial. This shows a negative correlation between oil and protein contents. The range observed for different varieties was from 13.43 (UPSM 953) to 25.13 (Harsoy deciduous) per cent. Similar results have been reported by Cartler and Hopper,[8] Pant and Kapur[12] and Vakil.[13]

The mineral matter content in spring soybeans showed a wide variation and varied from 4.83 (UPSM 2226) to 7.80 (UPSM 366) per cent and the mean observed was 7.00 per cent. In late sown varieties the maximum ash content of 7.09 per cent was found in variety UPSM 214 and minimum of 5.49 per cent in PK 73-49. The overall mean observed was 6.47 per cent. Thirteen varieties showed more than 7 per cent mineral matter. However, the present findings are not in agreement with those of Banwar[14] and Cartler and Hopper.[8] This may be due to differences in variety, soil condition and fertilizer treatment and climatic conditions.

The data calculated for energy value revealed that in spring grown varieties the range is wider as compared to the late varieties and it varied from 414.06 (PK 73-55) to 455.05 (PK 73-97) Kcal. The spring soybeans were found to contain 6.84 Kcal more energy than late varieties on an average (Table 1). Similar results were also reported by Gopalan *et al.*[6]

Average carbohydrate content of soybean was found to be 26.16 per cent. The spring soybeans were found to contain comparatively less carbohydrate than late soybeans. Thirteen varieties contained more than 30 per cent of carbohydrates. The results reported in the present findings are in agreement with those of Gopalan *et al.*[6] Carbohydrate content has also been reported to vary 17 to 36.0 per cent.[15,16]

Crushing hardness (Kg/seed) ranged from 11.10 (PS 73-9) to 19.90 (UPSM 375). Twelve varieties were having less than 15.0 Kg/seed crushing hardness, whereas the mean observed was 16.10 Kg/seed. Seed hardness is dependent upon protein content and is important from crushing and milling point of view i.e. recovery of the flour. Seed hardness is also related to germination. Late varieties of soybean showed higher average crushing hardness concomitant with higher proportion of protein as compared to the spring soybeans. Similar results were obtained by Cutler and Worzella[17] in wheat seeds.

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EXTRACTABILITY OF LEAF PROTEIN FROM THE GREEN TOPS OF GROUNDNUT (*ARACHIS HYPOGAEA* L.)

Defoliation at 80 or 90 days after sowing adversely affected the grain yields of groundnut. The extractability of protein N from green tops was very poor when they were removed 20 to 30 days before the harvest of nuts. The study shows that if the byproduct groundnut greens are to be used for the extraction of leaf protein they should be taken only at the time of the harvest of main produce.

Groundnut (*Arachis hypogaea* L.) is the main oil yielding crop of this region and large quantities of green tops are available after the nuts are harvested. With a view to suggesting an economic use of this green by-product vegetation, studies have been carried out to determine the extractability of protein from green tops in this laboratory[1,2] and elsewhere[3] and to assess the nutritive quality of the extracted protein.[4] It has been observed that the extractability of protein nitrogen from green tops taken after the main produce is harvested ranges from 10 to 42 per cent.[1-3] The nutritive value of this leaf protein was found inferior in rat growth test to lucerne leaf protein.[3] Singh[4] suggests that the harvest of tops at a physiologically active stage of the plant might increase the capacity of the green haulms and vines to yield nutritious product without seriously affecting the yield of nuts. In order to test this hypothesis experiments were conducted with SB 11 variety of groundnut in the summer and monsoon seasons of 1975 and the results obtained are reported in this note.

The seeds were sown by hand on 19 February for the summer trial and on 5 July for the monsoon trial. The recommended cultural practices for groundnut were followed.[5] There were six replications of three treatments in a randomised design and the net area harvested was 16.7 m^2. In two treatments the first cuts were taken at 80 and 90 days after sowing and regrowths harvested after 30 and 20 days respectively making a total number of two harvests each in 110 days. In the third treatment the tops were removed only once at the time of the harvest of the nuts[1-3]. The underground part and the by-product vegetation were cleaned and separated in all the three treatments and their fresh weight yields recorded. Samples of nuts were dried to constant weight for the determination of dry matter. The N determination was made by the micro-Kjeldahl procedure and the protein in seeds was calculated as N×6.25. The methods adopted for the determination of dry matter, crude protein and extracted protein, analyses and calculations of results from by-product vegetation were the same as described in an earlier paper.[6]

The results obtained in the summer trial are given in Table 1. More or less similar results were recorded during the monsoon trial. The data in Table 1 show that

TABLE 1. YIELDS OF DRY MATTER AND PROTEIN FROM EDIBLE PART AND BY-PRODUCT VEGETATION OF GROUNDNUT DURING SUMMER (1975)

Type of cut	Age at cutting (days)	By-product vegetation				Edible part	
		Dry matter Yield (kg/ha)	Crude protein Yield (N×6) (kg/ha)	% extractability of protein N	Extractable Yield (kg/ha)	Dry matter Yield (kg/ha)	Protein Yield (N×6.25)
1st harvest	80	2004	286	7.8	23		
Regrowth	30	1919	181	12.7	23		
Total	110	3923	467		46	807	219
2nd harvest	90	1915	293	4.0	12		
Regrowth	20	2300	212	13.0	28		
Total	110	4215	505		40	905	240
3rd harvest	110	5223	464	19.1	89	1379	382
L.S.D. (P = 0.05)		945	121		17	243	70

defoliation of groundnut at 80 or 90 days after sowing had adverse effect on grain yield. The regrowth ability of the plant was apparently good. But the vegetation yields of total dry matter, crude protein and extracted protein as also the extractability of protein N at the first cuts and regrowth cuts in both treatments was very poor relative to the single harvest of vegetation. The N content of the foliage ranged from 1.40 to 2.40 per cent (on dry matter). The fibre remained after leaf protein extraction contained from 1.21 to 2.22 per cent of N on dry weight basis.

Adverse effects of defoliation on grain yield and growth of some other crops have been shown by various workers.[7-10] Enyi[10] observed that in groundnut complete or half defoliation significantly reduced grain weight and pod number, the greatest reduction occurring when defoliation was done 1 week after early podding stage (12 week after sowing). The pod number and grain weight were positively correlated with stem weight and Enyi[10] feels that defoliation reduces pod number by depressing the growth of stems and this in turn reduces the number of flowering nodes. The results obtained in the present investigation suggest that, under the specified treatments maximum yields were obtained only when harvests were made at the normal time. However, further studies may aim at determining the most productive shoots on individual plants for the nut yields, and also the stage when the connection between the shoot and the pegged pod-bud can be broken without adverse effects on the nut-yields.

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CERTAIN BIOCHEMICAL REACTIONS OF *KLEBSIELLA AEROGENES* ISOLATED FROM RAT INTESTINE

Klebsiella spp inhabiting the rat intestine were known to fix nitrogen. In the present study rats fed with low protein diet (sweet potato diet) showed very high (55-87 × 10^4/g) number of _Klebsiella_ like colonies as compared to the rats fed protein diet. The organism isolated was characterised as _Klebsiella aerogenes_ by biochemical reaction. None of the strains isolated were capable of fixing nitrogen.

A diet very low in protein is well recognised to affect the development of body and functional performance of humans and other experimental animals. However, OOmen[1] observed extraordinarily good physique in the poor potato eating Highlanders of New Guinea where the diet contains essentially carbohydrates with protein averaging only to 1.2-2 g/day. He put forward the hypothesis that nitrogen is being fixed in the intestine by some members of the intestinal flora to provide the necessary proteins required by these individuals. This opened up a new line of thinking of a highly specialised adaptation to a particular way of life and added to the importance of the intestinal flora in human nutrition. We also were interested, as in India, we have certain regions where the diet contains mostly starch with very little protein e.g., the tapioca eating people of Kerala and sweet potato eating people of Bengal. The present work was undertaken with a view to study the possibility of the existence of this type of adaptation. Some members of *Klebsiella* especially *K. pneumoniae* and *K. aerogenes* are known to be very good nitrogen fixers and hence our first step was to find out the presence of these bacteria in the intestine of albino rats. The present communication reports the isolation, characterisation and biochemical reactions of a few strains of *Klebsiella* isolated from intestine of rat maintained on sweet potato diet.

Tweleve adult, male, albino rats weighing around 180 g were divided into two groups, one group being fed control diet and the other experimental low protein sweet potato diet. Control diet had the composition o, protein, 10 (milk powder); fat (refined groundnut oil), 10; shark liver oil, 1; salt mixture, 2; vitaminised starchf 1; and corn starch 76 per cent. Experimental diet had the composition of fat (groundnut oil); 10, vitaminised starch, 1; shark liver oil, 1; salt mixture, 2; and sweet potato mash, 86 per cent, the protein content being about 0.72 per cent. Experimental diet was prepared as follows: Sweet potato was cooked at 15 psi for 30 min, deskinned, mashed and stored in deep freeze at -20°C. Both the groups were fed the diet '*ad libitum*'. There was a constant loss of weight of the rats maintained on the experimental diet, and by 7th week one of them died.

The protein content of the sweet potato group was therefore increased from 0.72 to 1.91 per cent by the addition of 10 g of control diet. The animals were then allowed to adapt to the diet for a period of 45 days. With this additional protein, initially there was an increase in weight and after some days it became constant. The rats were sacrificed at the end of the experimental period and their caeca taken out and weighed under aseptic conditions. Caecal matter was squeezed out with a sterile forceps and 1 g of it was mixed thoroughly with 99 ml sterilized Ringer's solution.[2] Serial dilutions were made and they were plated out on Eosine Methylene blue agar and Mackonkey agar.[2] Morphologically different looking individual colonies numbering 44 were isolated, purified and studied further.

There was heavy loss of weight from an average of 180 to 139 g when the rats were on purely sweet potato diet. With the addition of 10 per cent stock diet there was increase in weight upto 2 weeks and then remained more or less constant at 153 g. The weight of those on control diet remained more or less same throughout the experimental period. The caecum of the experimental diet animals weighed 1-3.24 g as compared to 0.6-1 g of those on the control diet. This increased bulk may possibly be due to the undigested fibre in the sweet potato diet (2 per cent) as compared to the control diet (negligible) and also the larger quantity of food intake in the case of sweet potato diet. In the case of humans, MeCance *et al*[3]. have shown that the contents of the small intestine are more bulky and dilute after wholemeal bread than after refined bread and they attribute it to the fibre content and increased digestive secretions.

The total number of *Klebsiella* like colonies in the caecum of sweet potato diet animals were very high ($55\text{-}87 \times 10^4$/g) compared to those on control diet ($42\text{-}81 \times 10^2$/g). Cultures (44) isolated from these were tested for gram stain, sporulation, indole formation, methyl red, voges-proskauer, citrate utilisation and lactose fermentation as per the methods of Cowan *et al.*[4] Out of these, 24 isolates which were gram negative, non spore forming rods which fermented lactose with gas production were selected and subjected to further morphological and biochemical reactions. They were further identified according to Carpenter, Lapage and Steel[5] and Bascomb *et al.*[6] Examination for motility was performed microscopically by the hanging drop technique using 18 hr old broth cultures. Gelatin liquefaction was observed after incubating at 37°C for 7 days. These reactions together with those of a few standard strains obtained from elsewhere are given in the table.

Cultures that were non motile, urease positive, MR negative, VP positive, indole negative, gelatin not liquefied and fermented glucose, salicin, xylose, mannitol, inositol together with few other biochemical reactions as given in (table 1) were identified as *Klebsiella aerogenes*. Acetylene reduction test however, indicated that none of the strains isolated are capable of fixing nitrogen. Amongst the other microorganisms present, the prominent ones were *Escherichia coli*, *E. freundii*, *Enterobacter*, *Citrobacter* and *Serratia*.

TABLE 1. BIOCHEMICAL REACTIONS OF VARIOUS STRAINS OF *Klebsiella* STUDIED

Biochemical reactions	K_1 & K_3	K_2	K_4	KP_1	KP_2	KP_3	AA
MR	—	—	—	+	—	—	—
VP	+	+	+	—	+	—	—
Indole	—	—	—	+	—	—	—
Citrate	+	+	+	+	+	+	+
Motility	—	—	—	—	—	—	—
Urease	+	+	+	+	+	+	+
Gelatin	—	—	—	—	—	—	—
Fermentation							
Glucose	AG	AG	AG	AG	AG	AG	A
Lactose	AG	AG	AG	A	AG	AG	AG
Raffinose	AG	AG	AG	A	AG	AG	AG
Dulcitol	A	A	A	A	AG	AG	AG
Inositol	AG	AG	AG	A	AG	AG	AG
Sucrose	AG	AG	AG	AG	AG	AG	AG
Arabinose	,,	,,	d	A	,,	,,	,,
Sorbitol	,,	SA	AG	AG	A	,,	,,
Adonitol	,,	AG	,,	A	AG	,,	,,
Rhamnose	,,	,,	,,	A	AG	A	,,
Xylose	,,	,,	,,	AG	,,	AG	,,
Mannitol	,,	,,	,,	A	,,	AG	,,

K_1 & K_2—Sweet potato diet rats; A—Acid
K_3 & K_4—Control diet rats; AG—Acid & Gas
KP_1—*Klebsiella* sp from Dr Mahl; d—delayed + ve
KP_2— –"– Prof. Postagte; SA—Slight acid; no gas
KP_3— –"– Australia
AA—*Aerobacter aerogenes* from Australia.

The study thus indicates that *Klebsiella aerogenes* is a normal inhabitant of the rat intestine. However, though the presence of *Klebsiella* in the intestine of man[1,7,8], pigs[9] and some other mammals[9] have been reported earlier, there has been no reference of its occurrence in the intestine of rats. The significance of their presence in higher numbers in the protein deficient diet and whether this plays any role in adaptation on a protein deficient diet remains to be explored further.

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EFFECT OF CARBOHYDRATES AND PHOSPHATES ON ACID PRODUCTION BY LACTIC ACID BACTERIA IN SOY MILK

Enrichment of soy milk with carbohydrates-glucose, sucrose and lactose and phosphates enhanced acid production by 3 species of lactic acid bacteria and a heme catalase-negative *Streptococcus* isolated from soy milk. However, the carbohydrates differed in their ability to increase acid production, Acid production at 1% level of carbohydrate enrichment was found to be greater than at 0.5% level but more or less similar to 2% level. Addition of phosphates (0.25% w/v KH_2PO_4 and KH_2PO_4 each) did not result in enhanced acid production by all the cultures. A maximum of 1.20% developed acidity was exhibited by the mixed culture of heme catalase negative *Streptococcus* isolated from soy milk and *L. acidophilus* in soy milk enriched with 1% sucrose and phosphates.

Mital and Steinkraus[1] reported that fermented milk-like products with an acceptable flavour and yogurt-like texture could be prepared from soybeans. However, they found that acid production in such products was less as compared to fermented cow's milk which was a drawback in their wider acceptability.

Soy milk contains approximately 1 per cent fermentable carbohydrates[2]. In addition, all the carbohydrates in soy milk are not fermented by the lactic acid bacteria[3]. Lack of buffering capacity in soy milk may also be a limiting factor for greater acid production. Therefore, the present investigation was undertaken to study the effect of different carbohydrates and phosphates on acid production in soy milk.

Lactobacillus acidophilus (NRRL-B-629) and *Lactobacillus plantarum* (NRRL-B-531) obtained from Northern Regional Research laboratory, Peoria, Illinois (U.S.A.) and *Streptococcus thermophilus* obtained from National Dairy Research Institute, Karnal, were used in this study *Sy*-1, a heme catalase negative *Streptococcus* isolated from soy milk was also included in this investigation.

Soy beans (variety Bragg) were used for preparation of soy milk. The beans were soaked in water for 16-18 hr at room temperature, washed and ground for 3 min with boiling water (1:9 dry beans: water 85-95 C w/v). The resulting suspension was filtered twice through two layers of Cheese cloth and autoclaved for 15 min at 121°C. Filter sterilized solution of glucose, lactose or sucrose was added to soy milk to give a final concentrations of 0.5, 1 and 2 per cent. Acid production at 1 per cent level of carbohydrate enrichment was found to be greater than at 0.5 per cent level but more or less similar to 2 per cent level. Therefore, data at 1 per cent level of carbohydrate enrichment have been presented. Final concentration of 0.25 per cent (w/v) each of K_2HPO_4 and KH_2PO_4 was added to soymilk before sterilization to study the effect of phosphates on acid production and pH changes.

Sterile soymilk was used as the medium to prepare inoculum. One per cent of the 16-18 hr old actively growing culture (cell density 2.7×10^8/ml to 6.2×10^8/ml) of the organism under study was used as the inoculum. A 0.5 per cent inoculum of each culture was used when acid production and changes in pH brought about by mixed cultures were studied. The inoculated medium was incubated at 37°C for 16 hr for *S. thermophilus* and *Sy*-1 and for 24 hr for *Lactobacilli* and mixed cultures. Titratable acidity was estimated by titrating 10 g of sample with 0.1 N NaOH using phenolphthalein as the indicator. Developed acidity (per cent DA) values reported represent the titratable acidity of an inoculated sample minus that of an identically treated uninoculated sample (control).

Table 1 shows that addition of 1 per cent glucose, lactose or sucrose to soy milk significantly enhanced acid production and lowered the pH as a result of fermentation by different lactic cultures. However, different carbohydrates differed in their ability to increase acid production. *S. thermophilus* produced more than twice the amount of acid in soy milk enriched with glucose or lactose as compared to control. This organism produced less amount of acid in soy milk enriched with sucrose than in soy milk enriched with glucose or lactose but significantly greater than the control. In contrast, *Sy*-1 produced greater amount of acid in soymilk enriched with lactose than in soy milk enriched with sucrose or glucose. *L. acidophilus* showed maximum acid production in glucose enriched soy milk, Acid production in soy milk enriched with lactose or sucrose was significantly greater than in the control but less than in glucose enriched soymilk. Yamanaka and Furukawa[4]

TABLE 1. EFFECT OF DIFFERENT CARBOHYDRATES ON ACIDITY AND pH IN SOY MILK FERMENTED WITH VARIOUS LACTIC CULTURES*

Carbohydrates	*S. thermophilus*		Sy-1		*L. acidophilus*		*L. plantarum*		Sy-1 *L. acidophilus*		Sy-1 *L. plantarum*	
	pH	%DA	pH	%DA	pH	%DA	pH	%DA	pH	pH	pH	%DA
Control	5.30	0.20	5.05	0.32	4.95	0.29	4.95	0.31	5.00	0.32	4.95	0.28
Glucose	4.40	0.51	4.45	0.57	4.10	0.87	4.00	0.96	3.85	1.10	3.85	0.96
Lactose	4.45	0.47	4.45	0.62	4.20	0.50	3.75	0.96	3.95	0.86	3.85	0.96
Sucrose	4.53	0.35	4.35	0.54	4.15	0.73	4.20	0.63	3.80	1.16	4.00	0.78

*Mean of duplicate experiments.

DA = Developed acidity; Unfermented soy milk pH 6.35-6.45; % TA 0.08-0.12

Each carbohydrate added to give 1 % (w/v) final concentration.

found that addition of glucose to soy milk enchanced acid production by *S. thermophilus* and *L. acidophilus*, whereas addition of sucrose enhanced acid production by *L. acidophilus* only. In contrast to this, Angeles and Marth[5] reported that addition of sucrose, lactose or glucose to soy milk had no effect on acid production by *S. thermophilus*. However, results obtained in this investigation showed that sucrose, lactose or glucose considerably enhanced acid production by all the cultures tested.

L. plantarum produced same amount of acid in soy milk enriched with glucose or lactose. The acid production in sucrose enriched soy milk was less than other carbohydrate enriched soy milk but significantly greater than in the control.

The mixed culture of *Sy*-1 and *L. acidophilus* showed greater acid production in all the soy milk carbohydrate combinations than either of the organism when used alone. Glucose or sucrose enrichment of soy milk exhibited 3-4 fold increase in acid production by this mixed culture. Lactose enrichment showed less acid production than in other enrichments but greater than in the control. When mixed culture of *Sy*-1 and *L. plantarum* was used, the acid production in glucose or lactose enriched soy milk was more or less the same as observed for *L. plantarum* alone. However, in sucrose enriched soy milk Sy-1 and *L. plantarum* combination showed greater acid production than either of the organism when used alone.

S. thermophilus, *L. acidophilus* and mixed culture of *Sy*-1 and *L. acidophilus* showed greater acid production in phosphate-carbohydrate enriched soy milk as compared to only carbohydrate enriched soy milk. However, it was not observed for *Sy*-1 in phosphate-sucrose-soy milk, *L. plantarum* in phosphate-lactose/glucose-soymilk and *Sy*-1 and *L. plantarum* mixed culture in phosphate-lactose-soymilk combination (Table 2).

The enrichment of soymilk with different carbohydrates significantly lowered the pH when fermented with various cultures as compared to the control. A rather close and consistent relationship between pH and acid development was observed as expected. However,

TABLE 2. EFFECT OF DIFFERENT CARBOHYDRATES AND PHOSPHATES ON ACIDITY AND pH IN SOY MILK FERMENTED WITH DIFFERENT LACTIC CULTURES*

Carbohydrates	*S. thermophilus*		Sy-1		*L. acidophilus*		*L. plantarum*		Sy-1 *L. acidophilus*		Sy-1 *L. plantarum*	
	pH	%DA	pH	%DA	pH	%DA	pH	%DA	pH	%DA	pH	%DA
Control	5.30	0.20	5.05	0.32	4.95	0.29	4.95	0.31	5.00	0.32	4.95	0.28
Glucose	4.50	0.62	4.58	0.59	4.15	0.90	4.15	0.86	3.90	1.13	3.95	1.03
Lactose	4.58	0.55	4.60	0.65	4.00	0.87	4.00	0.79	3.95	0.96	4.00	0.90
Sucrose	4.72	0.47	4.55	0.48	4.25	0.81	4.20	0.68	3.90	1.20	3.95	0.98

*Average of duplicate experiments.

DA = Developed acidity; Unfermented soy milk pH 6.35-6.45; %TA 0.08-0.12; Unfermented soy milk + phosphates pH 6.45-6.55; %TA 0.27-0.29.

Each carbohydrate added to give 1.0 %(w/v) and phosphates 0.5 % (w/v) final concentration.

slight variations found in the data may be because of proportion of weakly dissociated acids[6].

Wang *et al*[7] reported that *L. acidophilus* singnificantly lowered the pH of soy milk enriched with glucose or lactose but not of sucrose enriched soy milk. However, using the same strain of *L. acidophilus* (NRRL-B-629), we observed significant lowering of pH in soy milk enriched with sucrose as well.

The results show that enrichment of soymilk with sucrose, lactose or glucose significantly enhances acid production by lactic cultures. Incorporation of phosphates in carbohydrates enriched soy milk did not increase acid production by all the cultures in all the combinations. Further investigations to determine the effect of additives such as yeast extract and peptone on acid production are in progress.

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INHIBITION OF THE MULTIPLICATION OF *CALLOSOBRUCHUS CHINENSIS* BY VEGETABLE OILS

Greengram mixed with 0.05 to 0.5% vegetable oils were experimentally infested with *C. chinensis*. Castor, mustard and gingelly oils inhibited the multiplication of *C. chinensis* at 0.3% level while coconut and groundnut oils at 0.5% level. Sunflower oil was not effective even at 0.5% level. The germination of greengram was not affected by all the oils tested.

Vegetable oil treatment of the grain to prevent the breeding of stored product insects has been in practice in India for a long time[1]. There are reports of using castor oil on pulses to prevent the breeding of pulse beetles. However, there appears to be no systematic study undertaken to find out the mode of action as well as the effect of different vegetable oils on the breeding of pulse beetles. Hence in the present investigation six vegetable oils were chosen to study their effect on *Callosobruchus chinensis* (Coleoptera: Bruchidae) breeding on greengram (*Phaseolus aureus* Roxb.)

Mustard oil, coconut oil, gingelly oil, groundnut oil, sunflower oil and castor oil each at concentrations of 0.05, 0.1, 0.3 and 0.5 per cent (v/wt) were used in this experiment. Four replications were maintained for each concentration of the oil. For each replicate 20 gm of greengram was used. The oil was mixed with greengram by kneading with hand and held in a four inch petridish. By this method of mixing it is possible that the oil might not have been smeared uniformly over each grain, especially at lower concentrations. One day old adult *C. chinensis* numbering hundred were released on to each petridish. There was a control having four replicatios with released insects and another one sample with grains incubated as such to record the pre-infestation. While computing the data the number of insects emerged if any, due to pre-infestation was deducted from the experimental control and the percentage inhibition of breeding was arrived as per Abbotts[2] formula.

After two weeks, the released insects were sieved out and the sample was incubated at room temperature (25 ± 2°C). Observations for the emergence of insects were made from third to fifth week after the incubation. The results are given in Table 1. The eggs laid on the oil treated and control seeds were observed at various stages under a binocular stereo microscope to note the activity of the embryo. To determine the viability fifty seeds were transfered on to a moist filter paper in a petridish and the germination percentage was counted after four days of incubation at room temperature.

It can be seen from the table that mustard, castor and gingelly oils at 0.3 per cent level; groundnut and coconut oils at 0.5 per cent level when treated on greengram could prevent the multiplication of *C. chinensis*. However, sunflower oil was not effective even at 0.5 per cent level. It has been reported from Nigeria[3] that groundnut oil at 0.5 to 1.0 per cent level treated on cowpea seed prevented the multiplication of *C. maculatus* and protected the seeds for a period of over six months. Further it has been stated that the cowpea treated with groundnut oil germinated normally and the taste was unaffected when they were cooked after storage.

In the present experiment direct observation of the eggs laid on oil treated seeds revealed that this treatment affected the embryonic development. This observation was further confirmed by the absence of larval entrance hole on seeds treated with adequate oil. The movement of embryo in the egg shell after two to three days of

TABLE 1. EMERGENCE OF *C. Chinensis* ADULTS IN GREENGRAM TREATED WITH VEGETABLE OILS

Vegetable oil	Concn. of oil								Untreated green gram	
	0.05%		0.1%		0.3%		0.5%		Insects released	(Control) No insects released
	A	B	A	B	A	B	A	B	A	A
Mustard oil	105	68.1	29	91.2	1	99.7	1	99.7	337	8
Coconut oil	132	34.6	117	42.1	17	91.6	9	95.5	234	32
Gingelly oil	142	48.9	35	87.4	12	95.7	6	97.8	279	1
Groundnut oil	133	35.4	152	26.2	22	89.3	5	97.5	206	0
Sunflower oil	238	30.4	216	36.8	164	52.0	117	65.8	348	6
Castor oil	153	45.4	53	81.1	3	98.9	2	99.2	280	0

Figures in column A indicate the number of adult *C. chinensis* emerged.

Figures in column B indicate percentage inhibition of adult emergence corrected over control, calculated as per Abbott's formula.

oviposition in untreated seeds can be observed under a stereo microscope by slightly disturbing the egg shell with a blunt needle. The embryo inside has made contractile movements due to the mechanical shock and soon returned to its normal form. This type of movement was not observed in eggs laid on oil treated seed at 0.3 to 0.5 per cent level. It is possible that the oil is ovicidal in the early stages of growth. The eggs which are affected by oil treatment remained transluscent without hatching. Emergence of few insects at 0.5 per cent level of oil treatment in mustard, castor, gingelly, groundnut and coconut oils could be probably due to inadequate or improper coating of oil over the seed.

It is confirmed from another experiment that the oil treatment to greengram does not affect its germination. The average percentage of germination recorded for greengram treated at 0.5 per cent level of vegetable oils are mustard oil, 93; coconut oil, 90; gingelly oil, 91; groundnut oil, 91; sunflower oil, 90, castor oil 95 and control 91. Thus in rural areas the method of oil treatment could be gainfully used for pulses meant for seed or food purpose because of its easy availability, simple application and lack of insecticide residue.

The authors are thankful to Mr. S. K. Majumder, Project Co-ordinator, Infestation Control and Pesticides Discipline; and Dr. B. L. Amla, Director, C.F.T.R.I., for providing necessary facilities to carry out this investigation. They are also thankful to Mr. M. Muthu, Scientist, I.C.P. discipline for critically going through the manuscript.

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BOOK REVIEWS

Convenience Foods-Recent Technology: by Philip M. Robbins. Food Technology Review No. 37. Noyes Data Corporation, Park Ridge, New Jersey, U.S.A. 1976. Price:

The author Mr. Philip M. Robbins has compiled from the U.S. Patent Office Literature recent innovations in the technology of convenience foods. With increasing sophistication and urbanization, the consumption of convenience foods that save the time and labour has become a way of life. Their need is being felt even in the developing countries. In this context the classification of all recent patented information on this subject is of great convenience to the food technologist, food manufacturer and even to the general public consuming these products.

Snack foods, breakfast foods, sweetened cereal and nutritionally fortified cereal and protein foods are first discussed. Use of texture improvers, mechanical improvements in extrusion, coating and special shape reduction, precooked cereal products for immediate reconstitution and ready-to-eat products are also described. The section on high protein and vitamin coated products should be of interest to nutritionists, medical practitioners and also to convalescent patients.

The next two sections relate to production of snack foods based on potatoes or a mixture of potatoes and cereal flours. Potato chips and French fried potatoes, being the most widely used potato products, have received greater attention. The art of preparing chips from potatoes with required colour, shape, appearance, crispness and with minimum absorption of oil and use of low grade potatoes for saving on cost have been described. The use of amylose for reducing oil absorption during frying or partial solvent extraction after deep frying of the fried potato and use of EDTA for reducing the darkening in colour of the oil being heated are of interest to those developing countries where there is shortage of edible oil. The section on convenience rice products as also snacks based on rice flour provide valuable information to scientists and food manufacturers in the rice eating countries.

The Chapter entitled "Synthetic Food Process" mainly relates to preparation of imitation meat or fish from vegetable protein materials. Although use of such textured vegetable protein products has become common in western countries their use has not started in the developing countries as legumes and oilseed meals are used in their normal or slightly modified forms in these countries. It is hoped that the information contained in this section may be availed of to reduce the cost of the textured vegetable proteins. In the context of increasing price of meat products, the use of waste protein sources such as fish meat wastes or vegetable proteins is useful for extending available meat and fish supplies.

Surface coating of prepared foods or food constituents for improving texture, flavour, shelf life or appearance should be of interest to those who would like to promote the marketing of the speciality products. Also food bars represent a convenient method of giving the desired food in a compact and concentrated form. Convenience foods of this category would be useful for school feeding programmes and in distress rations for the armed forces.

Speciality food items like *Tofu*, *Tortillas* and peanut products would be of interest to connoisseurs of these products in their respective countries.

As to how much of the documented information presented in an easily readable form contained in this book would be readily utilized depends upon the cost and consumer acceptability of the products and the sophisticated consumer habits in the developed countries. But the information would be useful in production of required food at less cost and presenting the same to the consumer in different appetising and attractive forms. This should be availed of by those interested in market expansion promotion.

H. S. R. DESIKACHAR
C F T R I, MYSORE

Refrigeration Techniques in Developing Countries: Institut International Du Froid International Institute of Refrigeration, 177, Boulevard Malesherbes-75017. Paris, 1976, 168 pp.

Information on Refrigeration and Air-conditioning pertaining to foodstuffs is scattered in the literature. Also stress is made on the necessity of this field in the developing countries taking into consideration the concept of a plan for refrigerating equipment, programme, draft project and final plan.

The Book contains altogether seven Chapters giving the necessary information on the role of refrigeration with foodstuffs. First Chapter provides information on the methods used to produce cold, compression refrigerating machines, refrigerant fluids, and liquefiable fluid refrigerating machines which require heat energy. Also information is given on production of cold using solar

and earth radiation. The next Chapter deals with design considerations for heat transfer elements and insulated walls, giving details of various insulations used in the construction of the cold chambers.

The Third Chapter contains the technological aspects of refrigerating machinery with a special reference to the utilisation of cold in different ways, their implications and manoeuvres. Similarly, the following two Chapters are devoted for refrigeration of foodstuffs. Here it is made clear, the reasons for using refrigeration, its applications for preservation of perishables viz., cooling chilling, freezing, storage and transportation of foodstuffs. Information is also provided on manufacture of ice and special features of frozen stores in warm countries.

The air-conditioning for industries, human comfort, animal and plant production spaces, is a must for a developing nation. Noteworthy feature of the Chapter is presentation of climatic distribution in warm countries throughout the world. The specific problems of developing countries in air-conditioning are given in brief with the advices on construction of buildings in tropical countries and selection of equipment.

The last Chapter—"Plans for refrigerating equipment in developing countries" contains notes on study of a plan, conception of a paln, realisation of a plan for refrigerating equipment, with a model inventory of the principal equipment.

The get-up of the Book is good providing at the end the Bibliography and other books and booklets referred. The book, being latest in the field, is highly useful for students, research workers and industrialists concerned. I strongly recommend this book for all Libraries as a good addition.

M. M. KRISHNAIAH
CFTRI, MYSORE

Guide to Refrigerated Storage: Institut International du Froid International Institute of Refrigeration 177, boulevard Malesherbes, 75017 Paris: 1976, pp. 190.

This book is an up-to-date and enlarged version of the publication—"Practical Guide to Refrigerated Storage" which appeared in 1965. This bilingual document (French and English) has been prepared by an international team of qualified experts on refrigerated storage.

There are Six Chapters wherein the literature has been spread in systematic lay out and illustrated photos of the construction patterns of cold stores with metal frame works. Initially, under the design and construction of cold stores, it has been very clearly made out about the general conception of a cold store, planning of the cold store, constructional methods, and refrigeration equipment. It is very helpful in checking a cold store when the appendix:check list is followed, which contains the objective items under—(*a*) basic cold store requirements; (*b*) technical design information; (*c*) facilities additional to the cold store; (*d*) overall building project considerations; and (*e*) insurance considerations.

This literature is followed by handling of merchandise, with special features of handling operations in cold stores. The design aspects on lay-out, traffic areas and loading banks are provided which would definitely be much useful while designing a cold store, along with their economic aspects. In the third Chapter, essential conditions for good refrigerated storage have been stressed. The importance of temperature, humidity, and air circulation is made clear with the factors affecting them. For best performance of the cold store the minimum standards of lighting, stacking etc., are provided, followed by the storage disorders and manocurring methods.

Apart from the basic essential services, the store may also offer other services to its customers, viz., product packaging distribution, etc. Links between the customer and the store can therefore be created and these have both legal and commercial aspects which have been successfully examined. The Chapter essentially consists of legal analysis of the refrigeration contract, storage, insurance of the goods and securing goods by warrant.

The last two divisions, viz., "safety precautions" and "personnel working in cold stores" examines with the questions concerning safety precautions, to be adhered to while establishing the cold stores. Critical examination was made on the hazards created by fire, its remedies, safety precautions against the risk of being locked in a low temperature room, and against water. The book concludes with the protective clothing for personnel working in cold store, their minimum standards and welfare facilities to be provided for the personnel.

The get-up of the book is good. This is essentially required by the people working and connected to cold storages, students, researchers, scientists and technologists engaged in the field. I strongly recommend this book as a good necessary addition for all the libraries.

M. M. KRISHNAIAH
CFTRI, MYSORE

Food Processing Hygiene: by Donald J. Cook and Raymond Binsted Food Trade Press, London, 1975 pp. 71; Price: £ 4.00.

To the food processor plant sanitation and hygiene are of as vital interest as processing technologies and marketing strategies, particularly in view of the stringent food legislations operating in many countries. What does the food processor need to know about hygiene? This neat and slim book seeks to answer the question in simple terms without delving into a lot of complex scientific matters.

The book is divided into three sections. Section I explains the meaning of disease, how disease enters the body, how the environment affects the disease causing organisms and the role of food materials as media for transfer of diseases. The second section explains the mechanism by which disease spreads. It discusses the significance of the enteric and respiratory routes, wound infections, toxin ingestion, milk-borne and animal-bite infections in terms intelligible to the food plant operator. Section III is devoted to an exposition of the way disease can be controlled and traces man's defences against disease (natural and acquired immunity), aids against infectious disease (chemotherapy, disinfection and antisepsis) and focusses attention on how efficient cleaning is a critical operation in any food plant sanitation programme. This section also contains a list of disinfectant and antiseptic substances, their properties and uses. A brief note on the evaluation of strength of disinfectants could have been appropriately included in this section.

In addition the book carries half a dozen appendices which summarize information on microbial pathogens, basic sources of microbial contamination of foods and food-borne infection and intoxication. A brief note on food-poisoning is included which is repetitive of the earlier text.

The publication will be of value to the food plant operators, supervisors and chemists who desire to know why and how certain operations create hazards while others minimize them so that they can have more effective control over food plant sanitation and hygiene. In a condensed form it presents the wealth of information that is already known to the food microbiologist.

The book is neatly printed and carries an index. The printer's devil does crop up here and there. The price, however, is too stiff for a book of this size.

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MILTONE PROJECT, BANGALORE DAIRY, BANGALORE

Gas Chromatography in Food Analysis; by G. J. Dickes and P. V. Nicholas; Butterworths, 1976, p. 393; £ 16.

This is an excellent review of literature on the application and techniques of gas chromatography (GC) in food analysis. The book is divided into 5 parts—part 1 dealing with the practical aspects of gas chromatography dealing with details of columns, detectors, sampling and sample derivatisation, identification and interpretation of results; part 2 gives a general update of recommended methods and stationary phases for major foods such as dairy products, fats and oils, meat, fish and eggs, essential oils, fruits and vegetables, alcoholic and non-alcoholic beverages, sugar products, cereals and various intentional and unintentional food additives such as preservatives, antioxidants, emulsifiers and stabilisers, flavourings, pesticides and solvents; part 3 gives details of analysis of various food products; part 4 puts particular emphasis on food additives, a particularly important field in view of low concentrations and extraction procedures involved and part 5 deals with food contaminant analysis.

The book assumes a working knowledge of GC by the reader and even the first part of chapters 1-7 on practical aspects of gas chromatography does not deal with any theoretical aspects of separation. Also a moderate discussion of identification based on the retention characteristics would have been useful in such an excellent publication.

There is also confusion likely to be created in the selection of a particular method as a number of methods are cited in the text, e.g., for the analysis of methyl esters of fatty acids on page 138, a number of columns and operating conditions are given without a critical view for the recommended use of a particular method for a particupar purpose based on the advantages and disadvantages for a specific application. The usefulness of the book would have been enhanced if sufficient details of extraction methods, of additives and contaminants from food material were given in the text instead of expecting the reader to refer back to the original papers.

Indubitably, this book will remain a standard reference for many food analysis and will be a good addition to the library for the use of laboratories doing research and analytical work in foods.

K. K. G. MENON
HINDUSTAN LEVER LTD., BOMBAY

Food microbiology—Public Health and Spoilage Aspects; by Mario P. Defiguerredo and Don F. Splittstoesser The Avi Publishing Co. 1976. pp. 492

The book gives a detailed account of the various microorganisms that are important from the point of view of public health hazard and food spoilage. The arrangement of the book differs from that of usual food

microbiology texts in that the chapters are organised around individual species or groups of microorganisms rather than according to the type of food or method of preservation.

There are 16 chapters written by scientists of eminence in the field, each with its own bibliography and a final subject index. Chapters are well organised. Chapter 1 deals with the use of statistics in microbiological analysis of foods and stresses the fact that statistical approach should not be ignored. Chapter 2 is on *Staphylococcus aureus* and gives the nomenclature, classification, and laboratory methods in enumerating and identifying this organism in foods. The various media employed by different authors with their incubation temperatures, reactions and colony characteristics given in a tabular form is highly useful. Cases of food poisoning reported in US from 1961–74 is also tabulated. Preventive measures that should be adopted in order to avoid staphylococcal food poisoning in food processing and food service establishments is stressed.

Chapter 3 on *Salmonella* and *Shigella* gives the various detection and isolation techniques employed and describes the latest rapid method of detection by the fluorescent antibody technique in the case of *Salmonella*. The common sources of contamination and methods of prevention are also given.

Chapters 4, 5 & 6 on *Clostridium botulinum*, *Clostridium perfringens* and *Vibrio parahaemolyticus* gives their isolation and identification methods on similar times. The next chapter on toxigenic fungi briefly gives the important toxigenic moulds encountered in foods with their mycotoxins and the toxic effects produced. Factors affecting their incidence, growth and toxin production and methods of detection, estimation and biological assay are also given. Finally the various detoxification methods are also briefly dealt with.

The next chapters on viruses, coliforms, enterococci and other microbial indicators are quite brief. Chapter 10 on gram positive non spore forming rods deals with the group coryneforms. Chapter 11 on gram negative nonsspore—forming rods deals with *Pseudomonas*, *Flavobacterium* and *Achromobacter* in detail and describes the Enterobacteriaceae briefly. Chapter 12 is on the various species of the two spore forming genera *Bacillus* and *Clostridium* that are important in canned and processed foods. The next chapter on micrococci gives the general characteristics of the group and its role in specific foods. In chapter 14, the lactic acid bacteria are dealt with and the distinguishing characteristics of the different genera and their undesirable effects in various foods are given in two tables. Chapter 15 on yeasts lists the important genera in food microbiology, their role in food spoilage, detection procedures and methods of control.

The last chapter deals with moulds that are involved in spoilage, their isolation and identification methods. Keys to classes and genera with their brief description given at the end is extremely useful.

However, it may be mentioned here that *Bacillus cereus* deserved to be dealt separately as a full chapter in view of the frequent reports of its involvements in food poisoning. There are plenty of spelling mistakes *Eg.* at page 23 'enterotixin' for 'enterotoxin', 'liquify' for 'liquefy', heat-stabile for 'heat-stable' to name only a few. These I hope the editors will take care of in the next edition.

The book is very useful and is a must for institutions and laboratories dealing with microbiological analysis of food.

RUGMINI SANKARAN
D F R L, MYSORE

Laboratory Methods in Food and Dairy Microbiology: by W. F. Harrigan and Margaret E. Macance, published by Academic Press, 1976.

This is the revised edition of "Laboratory Methods in Microbiology". It is primarily helpful in food and dairy microbiology laboratories as a bench top reference book. Several additions and modifications are apparent. It is divided mainly into three parts; Part I covering basic methods, Part II dealing with applied techniques and part III giving schemes for the identification of gram negative and gram positive bacteria and yeasts and moulds. Under basic methodology, growth rate determinations, selection and examination of colonies and growth factor bio-assay have been included. Also welcome additions are the lucid explanation of D and Z values, their determination and application in process calculations.

Techniques part covers a good range of topics such as from sampling and investigation, dilutions and viable counts and enumeration of indicator bacteria to microbial examination of specific foods. Under pathogenic and toxigenic organisms, sufficient details on *Salmonella* and *Shigella* isolation and identification methods are given to make a firm laboratory identification. *Bacillus cereus* and *Vibrio parahaemolyticus* have been allotted proper coverage emphasising their increasing importance in food poisoning. The identification chart for *Bacillus* species commonly encountered in foods is a helpful addition.

The general schemes for identification though not extensive are adequate.

Warnings of chemical hazards (Appendix I) and guide to manufacturers and suppliers of common and special equipments (Appendix 3) frequently omitted in such books is a real convenience. So also are the general notes stressing the importance of Quality control, vigorous Online control, hygienic precautions, enlightening training courses to the production staff of a food manufacturing unit.

Except for the very brief coverage on staphylococcal enterotoxins by current standards and total exclusion of *Brucella* group of organisms, this book contains the essential methodology and as such is a must in a micrological laboratory.

D. VIJAYA RAO
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Tropical Oil Seeds Abstracts; *Sorghum and Millets Abstracts*; *Cotton and Tropical Fibres Abstracts:* published by Commonwealth Agricultural Bureaux, Farnham, Royal, Slough, U.K., in collaboration with International Food Information Service, Reading, U.K., Royal Tropical Institute, Amsterdam and the Netherlands Tropical Products Institute, London, U.K.

Periodicals of this type publishing abstracts of developments in specialised subjects will no doubt be of value to researchers, particularly where time is the primary consideration. The abstracts on specific subjects in the above journals are reproduced from the regular periodic collection of abstracts from the whole CAB data base. The subscription for each of these journals, issued every month, is 20 £ a year. It would be helpful to have, to the maximum extent possible, informative abstracts of the original documents. These three publications can serve a useful purpose in research organisations, and universities.

J. V. SHANKAR
C F T R I, MYSORE

Food Engineering Systems Vol. 1 Operations: Edited by: Arthur W. Farral, Avi Publishing Co., 1976; pp. 615; $ 21.

The title of the book raises different expectations perhaps, from different people. Apart from saying that "Food Engineering Systems" is designed for the student. plant operator and manager, the preface to the book does not give any indication of what level of engineering the book will take you to. If references to "Systems approach" give an impression of a mathematical and rational approach, then the contents of the book will be disappointing. Apart from some titles here and there I do not see any systems approach in treating the subject material.

Some chapters deal with unit operations, e.g. cooling & refrigeration, evaporation and drying, homogenization etc. Others are based on material processed e.g. potatoes, fruits & vegetable Processing Systems, Candy and Confectionery manufacturing systems, Egg processing etc. In the preface, the author refers to the need for a combination of unit operations and systems approach. Does he have in mind the complete processing line for say eggs, when he refers to "systems approach"? This in my view, is nothing more than just an industry-wise description. From a study of different industries came the concept of "Unit Operations", which would be studied and perfected individually in isolation and applied in any industry. Systems approach, I would have thought, would show how the total system is not optimized, even if the individual components are.

The book appears to be a descriptive treatment of engineering topics in part and a description of some specific industries in other parts. The questions at the end of the chapters clearly indicate the engineering level expected of the reader. Most of them required descriptive answers and a few that require calculations are mostly based on very simple concepts like energy and mass balances. If this is the expectation of the "target" reader, the Chapter 1, which starts abruptly with a lot. of physical data on food products, seems out of place. While individually the tables in this chapter are all of use to the Food Engineer, in the way they have come in this book, they warrant the description "hotch-potch". The same confusion in approach extends to diagrams throughout the book. While the text is a qualitative description, some diagrams are simple line diagrams that explain the concept. Others are hardly relevant to the kind of reader who could benefit, from the text (viz: Fig. 23.5; 23.15 or 23.17 or 15.15 or 12.62.

This book apparently is volume 1 on operations. The preface does not indicate what the next volume will deal with.

Overall the book deals with some engineering topics related to food industries in a simple descriptive qualitative way and may, therefore, be useful to those who have a weak non-mathematical background and who only want a casual acquaintance with the engineering aspexts. It will disappoint those who are based in engineering but want to adapt their engineering to the needs of the food industry. The title of the book, some diagrams and tables dispersed through the volume give a wrong impression about the "engineering level" of the book.

S. S. KALBAG
HINDUSTAN LEVER RESEARCH CENTRE, BOMBAY

NOTES AND NEWS

Symposium on "Ion-Exchange"

The Central Salt & Marine Chemicals Research Institute has proposed to arrange the above symposium during February 1978. The following topics will be discussed:

1. Synthetic and natural organic ion-exchange
2. Synthetic and natural inorganic ion-exchangers
3. Ion-exchange technology in separation, purification and preparation of chemicals
4. Ion-exchange technology in desalination and purification of water
5. Ion-exchange technique in atmospheric and hydrospheric pollution control, industrial effluent treatment, removal of poisoning elements, recovery of precious chemicals from industrial waste, etc.
6. Ion-exchange membrane technology
7. Ion-exchange in analytical chemistry e.g. pharmaceuticals and pathological applications: ion selective electrodes etc.
8. Unconventional use of ion-exchange e.g. materials as catalysts in gas storing, catalyst carrier as molecular sieve etc.

The authors and participants are requested to communicate their interest in presentation of papers and registration before the following dates:

(1) Abstract (300 words)	July 30, 1977
(2) Full paper	Oct. 31, 1977
(3) Registration	Jan. 15, 1978

All correspondance to be addressed to: Dr. D. R. Baxi/Dr. G. T. Gadre, Secretaries, Symposium on Ion-exchange, Central Salt & Marine Chemicals Research Institute, Bhavnagar 364 002 Gujarat (India).

ASSOCIATION NEWS

Bangalore Chapter:

Mr. Gulhati, gave an interesting talk on marketing of Chewing Gum on 19th April, 1977.

Talk given by Mr. K. S. Kannan, Standards Manager, Britannic Biscuits, Madras, on Quality Aspects in Bakery Industry on 24th May 1977:

Bakery Industry has made vast strides in the recent years. In the manufacture of biscuit and bread, the quality aspects of the input raw materials is important to ensure high standards of the finished products. Vanaspathi, sugar, milk powder etc. among ingredients and packing materials like aliminium foil, grease proof paper, tin are some of the important items.

The quality of Maida depends largely on the type of wheat and the milling technique.

It may be thought that flour quality can be determined simply analysing it into its component parts and measuring the quantity of each. It is however more complicated than this and some very special tests are applied to assess the suitability of flour for different varieties of biscuits.

The various factors which affect the Biscuit/Bread making quality of flour can be considered under the following headings: colour, strength, moisture; extraneous contamination, ash, water absorption etc.

Strength is an important property of the flour and this is estimated as the capacity of the flour to produce bold, large, volume loaves in the case of bread. For biscuits, the flour should be capable of proper treatment by the baker so that the characteristics required in the particular variety of biscuit is available. As there is no primary grading of wheat, the quality of flour milled varies from batch to batch. Such variations in flour quality affects the 'flow' of biscuits and give rise to problems like "Spready/shrinky" or Flat/Blowy biscuits. The dimensions of the biscuits are highly critical from the point of packaging.

Acidity in flour is an important factor and depends upon the initial condition of the wheat, its storage subsequently after milling.

Insect infestation is a serious problem in flour. This can be controlled only by careful disinfestation measures at the mill itself.

Fat has a vital role to play in the development of the physical structure of biscuits and other bakery products, apart from its importance in the contribution to nourish-

ment and taste. Properties such as tenderness, appearance, volume and texture of baked goods are greatly influenced by the type of fat used. Fat acts as a shortening agent due to its ability to lubricate and tenderize the structure of baked products. Shortenings when incorporated into dough render the cooked products easier to break, crush and masticate.

Hydrogenated fat intended for bakery use must possess the following characteristics. Be free from granularity to have a smooth texture and no oil separation. Should have bland taste and smell. Should contain low free fatty acids, having satisfactory keeping qualities.

Melting point and dilatation values should be suitable for bakery use, otherwise "Fat bloom" results in the product.

Packing materials: A wide variety of packaging material is available for the packing of biscuits like tinplate, cellophane foil, paper, etc. Tin occupies a unique place as it provides good protection from moisture, weather, light, transit hazard and rodent/insect attack. As modern biscuit packaging is done on high speed sophisticated machines, the quality of the packaging material is of great significance not only to achieve maximum efficiency and avoidance of waste but also to give requisite protection to the biscuits. Quality control in any modern food industry is not just a matter of chance. Quality should be implanted in the product by appropriate standard procedures at every stage of production.

A.F.S.T.-Lore: It is gratifying to note that the Bangalore Chapter of the Association has taken a lead in publishing 'A.F.S.T.-LORE'—a house Bulletin meant for the benefit of their members. Written in a lucid style it covers the multifarious activities of the Chapter. Hope this will serve as a lead to other zones and chapters to start their house bulletins to keep their members informed about the activities and future programmes.

Annual General Body Meeting

Proceedings of the Annual General Body Meeting of the Association, held at New Woodlands Hotel, Madras-4, on 24th April 1977.

Shri M. R. Chandrasekhara, President of the Association presided over the meeting and welcomed the members. He gave the salient points regarding the growth of the Association and stressed the role the Association should play in training the persons engaged in food and allied products.

The minutes of the last Annual General Body Meeting was presented by the Hon. Exec. Secretary and they were proposed for adoption by Shri Bhavani Shankar Rao and seconded by Shri K. L. Radhakrishnan.

The Hon. Exec. Secretary presented his report for the year 1976. This was followed by the Treasurer's report, audited statement of accounts and budget estimate for the year 1977. These reports were taken up for discussion.

Shri K. L. Radhakrishnan, suggested that copies of proceedings of the Symposia held at the Headquarters and at the various Zones and Chapters be sent to all the Zonal Headquarters and Chapters for the information of the members. The President agreed to this idea. To a suggestion to increase the contribution towards the Zone/Chapter, it was pointed out that due to the prohibitive cost of publishing the Journal it will not be possible to increase the contribution to the Zones/Chapters. It was also pointed out that, if the Zones & Chapters can secure advertisements to the Journal the possibility of giving 50 per cent of the money to the Zones/Chapters may be considered. Another suggestion was regarding the creation of a building fund. Dr. Datta was also of the opinion that there should be a provision for Zonal buildings.

All the above reports were approved, duly proposed by Shri Bhavani Shankar Rao and seconded by Shri K. S. Krishna Murthy.

The activities of the Zones/Chapters were presented by the representatives of respective Zones/Chapters as follows:

(*i*) Western Zone	:	Dr. S. R. Padwal Desai
(*ii*) Southern Zone	:	Shri A. Govindan
(*iii*) Bangalore Chapter	:	Miss M. C. Madhura.

It was agreed to continue Shri A. Krishnamurthy, as Auditor for the year 1977.

Prof. V. Subrahmanian Industrial Achievement Award: The ward for the year 1976 was presented to Prof. A. N. Bose, Vice-Chancellor, Jadavpur University, Calcutta. The Award which consisted of a citation and a cash amount of Rs. 1,000/- was presented. Since Prof. Bose could not be present at the meeting, the Hon. Exec. Secretary received the award and the citation on behalf of Prof. A. N. Bose.

Gardners Award: The Gardners Award, for the best research paper published in the Journal of Food Science and Technology during the year 1975, was shared between Shri A. K. Banik, Jadavpur University, Calcutta, Dr. V. Sreenivasamurthy and Smt. T. Shantha of CFTRI Mysore. Smt. T. Shantha received the Award. The Hon. Exec. Secretary received the award on behalf of Shri A. K. Banik.

Suman Food Consultants Travel Award: This Award for the year 1976 was presented to Shri Ashok Kumar Jain, M.Sc., Student, G. B. Pant University of Agri-

culture & Technology, Pantnagar, who received the Award in person.

The announcement of the elected office-bearers of the Association for the year 1977 was made by the President.

President	Shri C. P. Natarajan
President-Elect	Dr. B. P. Baliga
Vice-Presidents	Dr. D. P. Sen (Headquarters)
	Shri I. J. Puri (Southern Zone)
	Shri Y. K. Kapoor (Northern Zone)
	Dr. B. Panda (Central Zone)
	Shri S.N. Mitra (Eastern Zone)
Hon. Exec. Secretary	Shri A. M. Nanjundaswamy
Hon. Joint Secretary	Shri J. V. Prabhakar
Hon. Treasurer	Dr. Richard Joseph
Councillors	Maj. G. S. Bali (Headquarters)
	Dr. R. N. Datta (Southern Zone)
	Shri Laljeet Singh (Northern Zone)
	Dr. Nagendra Sharma (Central Zone)
	Dr. D. K. Chattoraj (Eastern Zone)

There was no proposal for Vice-President and Councillor for the Western Zone. The names of Dr. D. V. Tamhane as Vice-President and Dr. S. R. Padwal Desai as Councillor, were suggested by the Zonal representatives present. These were approved.

Induction of New Office Bearers: Shri C. P. Natarajan (President-Elect for the year 1976) and Shri A. M. Nanjundaswamy, (Hon. Joint Secretary for the year 1976) were then inducted as President and the Secretary respectively for the year 1977. The President, while thanking the members for electing him spelt out the programme for the year 1977 and requested utmost cooperation from all the members. Shri A. M. Nanjundaswamy, thanked the members for giving him an opportunity to serve the organization and requested for active support from the members. The Hon. Exec. Secretary proposed a vote of thanks, to all the members present and specially to the Executive Committee members of the Madras Zone for the efforts they had taken to organize the Annual General Body Meeting and the Symposium at Madras. Miss M. C. Madhura thanked the outgoing office bearers for the excellent work done during the year.

The meeting ended with thanks to the Chair.

Southern Zone

"*Export of processed Foods, Problems and Prospects*", talk delivered by Shri R. N. Ramani, Partner Shri Ganesh Ram & Co., 48 Thambu Chetty St., Madras-600 001, on 2nd July 1977.

The speaker at the outset definied the processed and processed foods.

Now we are exporting food products to U.S.A., Canada, U.K., Middle East, Far East, Australia as they are our main markets for the processed foods.

The fruit products exported include fruit juices and vegetable juices, frozen vegetables, dehydrated vegetables, pickles, vegetables preserved or prepared in air tight containers, jams, marmalades and fruits pastes, meat of bovine animals, sheep and goat (fresh chilled or frozen), biscuits, fresh banana, fresh apples, fresh grapes, fresh potatoes, fresh lemon, oranges, tangerine, clementes, other fresh fruits and citrus fruits, musk melons, water melons, onions, garlic, fresh beans, cauliflower, fresh cucumber, other fresh vegetables, tomatoes, honey, tomato puree, prepared chick peas, broad beans, in air tight containers; butter, eggs, lentils, chickpeas, and various whole spices and powdered spices individually and mixes like curry powder, etc. Dehydrated vegetables and products prepared from Tapioca, Sago also find a good market. Instant ready mixes and Papads too find a good market in these places.

The idea of exporting processed foods in cans, or bottles is to help the consumer to prepare a food of their choice. The consumers expect us to prepare a food which is easy for them to reconstitute or prepare. Similarly they relish a can containing fresh fruit immersed in sugar solution.

Apart from these they evince more interest in the import of Instant Products. These are, dehydrated peas, dehydrated vegetables, jamoon mix, iddli, dosai, vadai, bonda, pakoda mixes. These products can be prepared instantaneously. Within about half an hour you may prepare a sumptuous lunch or dinner with these instant foods. They require only water for their preparation.

Papads are another item of interest to the foreign buyers. They use these papads either by frying them in fat or just roasting them. They choose these papads for a cocktail party along with their hot drinks. Wafers of sago, tapioca, banana chips, potato chips go a long way with their cocktail party.

The speaker pointed out that the products after packaging should be clearly labelled as regards the name of the product, net contents, country of origin, name and address of the manufacturer etc.

The products should conform to all the standards laid down by the importing country. These may include, fungus, colour, artifical sweetners, the quality of oil, poisonous metals. Care should be taken to check specifically for dead insects, insect residues, rodent hair, human hair filth etc.

The Processed Foods Export Promotion Council is doing a herculian task of selecting processed food exporters and sending them periodically to various places each year. It is needless to mention, that I am glad to inform you that I was one of the participants to a sales-cum-study tour to U.S.A. and Canada during 1973. I feel it would be appropriate to furnish the views of the study team in a nutshell to the distinguished audience.

Different sales-cum-study team visited U.S.A., Canada East European Countries, Middle East, Australia etc.

In United States there are not much exchange control restriction and the import of most of the Indian processed food into U.S.A. is freely allowed. However, the clearance of all the processed foods is permitted only after the approval of the goods by the Food and Drug Administration (FDA) of U.S. Department of Health Education and Welfare, at any port of entry in U.S.A. There are also labelling regulations.

U.S.A. Accounts for less than 20 per cent of the total exports of Indian Processed Foods but it is be noted that a vast potential exists for our processed foods in this country. Many of the processed foods are sold in many chain stores and stores run by American Government, apart from the stores manned by Indians. Export of fresh fruits and vegetables to U.S.A. could be permitted only if the botanical names of the fruit or vegetable are submitted to them and the products are free from germ or weevils. If cobalt treatment are given to these fresh fruits and vegetables prior to exportation, then they will be easily permitted entry to U.S.A. Mango stone has a good market. But they area fraid that they may contain germs. If we are able to convince them that they are free from these germs then a good market exists for this products.

For exports into Canada, import licenses are not required except for a few items. Importations of certain goods from Rhodesia are prohibited. Exporters from India are required to fill in M.B. form for entry under British Preferential Tariff for goods sold by the exporter prior to shipment. Commercial invoices, combined with certificate of value and origin are required in the prescribed forms.

Mainly our foods find a good market in Toronto, Ottawa, Montreal, Vancouver. A lot of chain store and small stores manned by our people are available for their distribution. Almost all the products sent to U.S.A. are also exported to Canada.

East European Countries: While fruit products especially, Mango juice, Pineapple juice or slices are currently being exported to U.S.S.R., Poland has emerged as a major buyer of our fruit products. The following are the main markets for our products in East European Countries, Czechoslovakia, Poland, East Germany, Hungary, Rumania, Yugoslavia, Bulgaria. There has been a qualitative change in regard to the products or the import. A number of countries have started bestowing their attention for meeting the needs of consumer goods. Admittedly, this trend towards the consumer goods is not manifast to the same extent in all these markets. It varies from market to market. This again perhaps, would serve to focus our attention in the markets which offer maximum potential. Under this category we may list Poland, G.D.R., Czechoslavakia, Yugoslavia, and Hungary. As Bulgaria is a major producer of fruit and vegetables there is very limited scope for our products, while in the case of Rumania, they have the problem of exchange. It is mainly due to the rupee payment agreement and the bilateral trade agreements. It has been possible for India to develop trade with the East European countries to a significant extent. Nevertheless this cannot be taken for granted as has been the case hitherto untill now, for obvious reasons, western Europe did not bother much about developing trade with the Eastern Europe. In a sense, this provided really access to our products. Of late, west European countries have started taking interest in Eastern Europe. Inevitably this would throw up a challenge to countries like, India, in that, our products have to compete with sophisticated products of the West. Additionally western Europe has the advantage in that they need not carry much inventory and can also move the goods at short notice and at lower cost—Moreover the psychological feeling that the goods of the western Europe origin are qualitatively superior cannot be ignored.

In all these markets pineapple, particularly pineapple slice, pulp and to a lesser extent juice have excellent scope. Though mango has an exotic appeal it needs to be popularised and calls for a great deal of promotional efforts if it has to give a foot hold in these markets. Next in importance is the banana pulp for which, given the necessary efforts it should be possible to develop a market especially in East Germany, Hungary and Czechoslovakia, since this can be used as a baby food. Tomato paste is yet another item for which there is good potential for development in the Polish market.

In Czechoslavakia markets the following items have a good potential. French beans, tomato ketchup, pineapple products, orange marmalade. They are not accustomed to mango products like mango slices, mango

juice, mango pulp, okra, guava, tomato ketchup, orange marmalade etc. The reason being they are scared of lead content in mango juice. They are not interested in okra and guava. In the case of tomato ketchup they require them without colour. Czechoslavakia is importing about 500 tons per annum orange concentrate from Greece and Austria.

They showed much interest in our papads but they prefer plain papads to spiced ones. In Czechoslavakia there is scope for the introduction of biscuits, curry powder, fresh fruits and vegetables. Our products can be popularised provided they participate in trade fairs for which Government should aid through the Council. These products can be popularised to the consumers by way of demonstration in hotels and trade fairs.

Apart from these products they are also interested in the import of frozen tuna fish, provided the mercury content is not more than 0.5 ppm.

Poland's interest is in canned foods namely fruit pulps like mango, papaya, banana, guava, and the slices of these fruits. G.D.R. interested in banana pulp with added vitamins, tomato paste, dehydrated onion, canned peaches and items of interest are concentrate of lime, orange and grape. They are conscious about the limit of heavy metals. In Hungary, Rumania and Yugoslavia there was much interest on the products cited above together with instant coffee and tea, chutney, pickles, curry powder, wafer of sago, banana, black pepper, groundnuts etc.

Most of the products that are listed in the processed foods are of interest to Australia, New Zealand and Fiji. It is a pity that we have not fully explored the possibility of processed foods since it was observed that some of the largest importers of walnuts, cashewnut, had a bitter experience with quality, fumigation etc. It is also disheartening to note that the local population have not been properly educated regarding the usage of our products. It is time now that our council takes immediate steps to educate the foreigner to use our products like pickles, chutneys, curries, mango slices, pulp etc.

Another subtle problem regarding the shipment to these places is inadequate shipping space and non frequency of direct sailings without transhipment at Singapore.

New South Wales, Queensland, Western Australia, Southern Australia are the major markets for our processed foods, Export of processed foods to Australia is quite encouraging and there are chances for a vast improvement provided the prices are competetive, deliveries are quick and the specification are complied with. Indian Businessmen are mostly engaged in textiles or retail sales of consumer goods. Shipping is the biggest constraint in our effort, to enter Fiji in a big way. While Fijian businessmen were fully convinced that India can meet their needs, they were rather sceptical about Indian ability to keep up the delivery schedule. They would not mind waiting for three/four/five months for the Indian goods to arrive, provided they are sure that goods are definitely arriving. The Fijian market can be exploited only if our shipping problems is solved, as competition from Australia, New Zealand, U.K. and Japan can be met effectively. There are certain small scale industries engaged in the manufacture of pickles and chutneys. However, there are chances for export of certain varieties of pickles, chuetneys, curry powder, pineapple pulp, mango juice, pulp as well as canned vegetable, walnuts, peanuts and papadams.

It is learnt that starting business is economical in Fiji since there is good scope for setting up canning units and cold storages. Ginger, mango, lime, carrots, okra, tora fruit, sweet potato, tapioca etc. are some of the items that are readily available. Local finances are available without much difficulty. Labour is comparatively cheap.

Middle East:

Middle East consists mainly of Kuwait, Saudi Arabia, United Arab Emirates, Bahrain.

The main products exported are fruit juices, and vegetable products, meat-fresh (chilled and frozen) biscuits, fresh fruits and vegetables, bananas, wheat bran, tomato puree, honey etc.

Bananas have a good market in Kuwait. But Indian Bananas on ripening become yellowish and develop black spots on the skins, which is considered best in quality but causes consumer resistance there. Packaging and handling methods should be improved for having a good export market.

Having touched a few points regarding the export of various products to various countries abroad, we may conclude by saying that Canada and U.S.A. are amongst the most industrialised nations of the world and there are substantial possibilities of increasing our exports.

Another important suggestion to the AFST is to persuade the government to arrange for analysis of the products as per FDA requirements by our chemists working in private laboratories maintained by exporters or in the Govt. laboratory. They may be sent abroad for a short term training course. Similarly the chemist working in the FDA laboratory may be permitted to visit us and explain their techique to us so that rejection of food products can be controlled in our homeland itself. Apart from this atleast the government laboratories should be equipped with the modern sophisticated equipment to detect the causes for rejection in India and avoid them once for all.

The speaker while concluding his speech pleaded for making proper demonstration of the usage of our products to foreigners and also asked the government to take initiative in arranging a number of direct sails from various ports and also to reduce the freight rates.

Hyderabad Chapter:

The following office bearers have been elected by the General Body on Monday the 4th July 1977.

President	Shri B. Thiagarajan
Vice-President	Dr. S. Raghavendra Rao
Secretary	Shri G. V. Krishnamurthy
Joint Secretary	Shri M. Venkateswara Rao
Treasurer	Shri N. Giridhar

Eastern Branch

Lecture delivered by G. B. Debling of Grimsby College of Technology, U.K. "DEVELOPMENT IN THE UTILISATION OF FISH IN THE UNITED KINGDOM" on 20th August 1976.

The annual fish catch of U.K. is about 9 lakh tons, one third of which is trash fish used for fish meal, the remained being whole fish used for human consumption. Eighty per cent of this fish comprises of the white fleshed fish-cod and haddock.

It has become apparent in recent years that supply of cod and haddock would diminish because of overfishing and loss of traditional fishing grounds. The fish species landed for meal production could be used for human consuption, but, in practice, because of low consumer demand, the fish is not carefully handled at sea.

While the growing shortage of cod and haddock has influenced developments, other factors have been of considerable importance. The labour force is highly mobile and so it is difficult or costly to build up practical expertise or craftsmanship in an individual. Job functions have to be reduced to the simplest level and supervised by qualified highly paid staff. The consumer increasingly demands convenience foods with the result that market growth is un (prepared and semi-prepared) frozen foods. The scale of the industry is such that many developments relate to high capacity continuous systems.

In this article developments in objective measurement of fresh fish quality, in freezing, cold storage and distribution of frozen fishery produce and in utilisation of what would otherwise be trash fish are considered.

Fresh fish inspection: Traditionally, fresh fish has been assessed in terms of appearance, smell and feel. Sinking of the eyes, discolouration of the gills, developments of ammonia odours, softening of flesh and surface slime are all indications of deteriorating fish and/or previously mishandling of the catch.

Such subjective assessment had led to frequent disagreement between fishermen and inspectors.

The speaker described about the meter developed by The Torry Research Station, Aberdeen, Scotland, which is based on the dielectric properties of the flesh. The meter is hand held, portable and contains a numbering device so that the average quality of 10 successive samples can be determined. The meter cannot to used for frozen fish wherein, testing after thawing remains the most popular method.

Freezing of fishery product: Freezing of foods should be carried out as rapidly as possible to overcome dehydration of the cell. The rate of freezing is not so important in fishes having small cells. This, however, is not the case with shrimps and prawns. Liquid nitrogen freezing is adopted in case of shell fishes.

To overcome the disintegration of the food mass it is necessary to pre-cool the product. The speaker explained the functioning of the tunnel freezer being used in U.K. by using liquid nitrogen. A fully utilised LN_2 system is generally considered to be slightly more expensive than a fully utilised conventional system. The speaker explained in detail the costing considering the operating cost, depreciation and weight loss in process.

Cold storage and distribution of frozen produce: The speaker discussing about the movement of water depends said that if a positive gradient exists between the surface of the food and the internal surface of the food and the internal surface of the packaging, water may leave the food to form crystals inside the package. Reversal of the gradient so that the packaging is warmer than the food results in the water recrystalling on the food surface and not in the tissues from which it originated. Such temperature fluctation are very difficult to avoid in commercial practice, with the result that much of the frozen food sold in the U.K. exhibits more thaw drip or cooking loss than would reasonably be expected. The temperature fluctuations cause some denaturation of the protein but do not affect the biological value. The drip loss and cook out may contain nutrients, flavours and may lower the eating quality. Therefore, it is not sufficient to freeze foods rapidly to -20°C or -30°C but also to ensure that the whole cold chain is well established and managed to ensure consumer acceptance.

When frozen fish was first introduced to the U.K. market, in the late 1950, there was great consumer rejection due to poor quality. However, the bulk of fish is in fact supplied to the consumer in a pre-formed frozen block, battered and partially fried-generally

knwon as fish fingures. In the production of the fish slurry polyphosphates may be introduced to help bind the water to the flesh minimising the adverse effects of subsequent mishandling.

The fingures which are produced from skinless, boneless fish flesh require only 6-10 min grilling or shallow frying to gaine acceptance by the consumers.

It is important that the consumer acceptance of this product is only been established by using raw material of the highest quality.

Utilisation of what has traditionally been considered trash fish: Of the 6 lakh tons of fish landed for human consumption less than 3 tons are recovered, the rest being primarily head, skeleton and tail with adhering flesh which is used for fish meal manufacture. An efficient filleting operation will recover about 90 per cent of the edible tissue. The minced product can be incorporated in fish fingures or fish cakes made of potato and fish.

With the increased cost of the popular cod and haddock, manufacturers are considering seriously the inclusion of flesh from less popular species of fish in the preformed blocks and fish cakes. This will lower the cost of fish products and is beneficial especially for the poorer section of the community. Thus a fuller utilisation of trash fish is feasible.

This adversley affects the fish meal manufacturers. Reduction in the flesh content of skeletons from the fish (half their raw material) directly influences adversely the protein content of the meal. Further utilization of trash fish will reduce the volume available for meal production.

The alternative is to adopt on fish ensilage operation originally developed for village scale in the tropics. The fish waste/trash fish is minced and allowed to autolyse (the presence of the gut is essential), and concentrated formic or sulphuric acid is added to control microbial spoilage. After a few days the fish has been reduced to a slurry which may be fed direct or blended with a cheaper carbohydrate to poultry etc.

The speaker indicated that, there is little interest in F.P.C. production, it being considered more likely that the consumer could be persuaded in a free choice situation, to try fresh fish or fishery produce imaginatively presented than a colourless, odorless, tasteless powder, whether presented as a powder or incorporated into a staple of the diet at some small extra cost.

Ordinary Members

Mr. Riazuddin Ahmed, Juice International, Mangala Lake House, Thiruvanmiyur, Madras-600 041.

Mr. Susan Samuel, Maharani Food Products, 4000 Annanagar, Madras-600 040.

Dr. Iya Krishnaswami Kilara, 645, West of Chord Road, Stage II, Rajajinagar, Bangalore-560 010.

Mr. V. Stanley Paulus, TC 11/516, Barton Hill Road, Trivandrum.

Mr. P. Kumar, A/8 Anuradha, 36 Moghul Lane, Mahim, Bombay-400 016.

Mr. V. M. K. Swamy, The Scientific Instruments Co. Ltd., 240 D. N. Road Bombay-400 001.

Dr. Shankar Vasudev Amonkar, B & Ag Division, Bhabha Atomic Research Centre, Trombay, Bombay-400 085.

Dr. G. B. Nadkarni, Head—B & FT Division, Bhabha Atomic Research Centre, Trombay, Bombay-400 085.

Dr. V. Venugopalan, B & FT Division, Bhabha Atomic Research Centre, Trombay, Bombay-400 085.

Mrs. L. V. Ganatra, Vasant ISI fr, 148 Road No. 9, Bombay-400 032.

Dr. S. M. Ahmed, ICP Discipline, C.F.T.R.I., Mysore-570 013.

Dr. B. Ravindranath, PP & FT Discipline, CFTRI, Mysore-570 013.

Mr. Maharaj Narain, Associate Professor, Department of Agricultural Engineering, G. B. Pant University of Agriculture & Technology, Pantnagar-263 145.

Mr. Ram Prakash Saxena, Associate Professor, College of Technology, G. B. Pant University of Agriculture & Technology, Pantnagar-263 145.

Dr. (Mrs) T. S. Gouramma, 10 Govindarao Street, Seshadripuram, Bangalore-560 020.

Mr. K. Krishnaswamy, 23 VIth Main Road, Raja Annamalaipuram, Madras-600 028.

Mr. Krishna Sharma, Modern Bakeries (I) Ltd., Adyar, Madras-600 020.

Mrs Rachel John, Department of Home Science, S.I.E.T. Women's College, Madras-600 018.

Kum. S. Maya Devi, 3-4-872/1 Barkatpore, Hyderabad-500 027.

Mrs Vanaja Ramprasad, 268, 5th Main Road, 4th Block, Jayanagar, Bangalore-560 011.

Mr. P. Varkey Jacob, Oleoresins & Chemicals (P.) Ltd., IX/454 Latin Church Road, Trichur-680 001.

Mr. Jagadish Sakhawatrai Davani, Popular Bread Factory, Guroba Maidan, Nagpur.

Mr. Inder Singh, Shathi Enterprises, Laxminagar, Rohtak Road, Jind-126 102 (Haryana).

Mr. Sushil Chander Mehta, 296-297 Satyaniketan, Dhaula Khan, Ring Road, New Delhi-110 021.

Mr. Kuldip Raj Gupta, P.O. Box. No. 13, Iringa, (Tanzania).

Mr. P. C. Agarwal, 35 Housing Board Colony, Sonepet (Haryana).

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ANNOUNCEMENT 1.

ALL INDIA FOOD PRESERVERS ASSOCIATION
take pleasure in announcing "Raylon Award" 1977–'78

for the innovation of a Machine/Equipment for use by the Fruit and Vegetable Processing Industry

Amount of Award	..	Rs. 10,000.00
Last Date of receipt of application	..	31st December 1977
Presentation of Award	..	April/May 1978 At the Annual General Meeting of the All India Food Preservers Association.

Date and Venue will be intimated later

APPLICATION FORM

1. Name and address of the applicant(s)
2. Name of the equipment

2.1 Model No.
Code No.
Purpose/use

2.2 Brief description of the process along with the role played by the equipment
Literature, working pamphlet and photograph of the equipment

2.3 Is it a prototype or working equipment/machinery
2.4 Improvements carried out after first introduction
2.5 Deficiencies of the equipment and how are they overcome in the new design
2.6 Any additional advantages of the new design
2.7 Working principles and operation
2.8 Power requirement and space requirement
2.9 Ex-works price
2.10 Flexibility and Versatility of equipment
2.11 Names and addresses of the Fruit and Vegetables processing units who are using the equipment
2.12 How many machines are in use in the country and abroad
2.13 Have you previously applied for an award for this equipment elsewhere. Give details
2.14 Is it a copy of the existing Indian or Foreign made Machine/Equipment or an original idea
2.15 Capacity, efficiency and cost compared to original equipment
2.16 Advantages of the equipment in reducing processing cost
2.17 National importance of the machine
Import substitution
2.18 Export potential
2.19 Estimated number of machines required to meet national needs
2.20 Any other plus point justifying claim for the award

Please forward the application form completed with full details and enclosures along with registration fee of Rs. 10 per each entry to

V. B. OBEROI
(*Convener*)
"RAYLON AWARD" Sub-committee
All India Food Preservers Association
c/o Kissan Products Limited
Old Madras Road Bangalore-560 016

The information will be kept in confidence.
The deliberation of the judging committee will be held in camera.
The decision of the judging committee will be final.

Association of Food Scientists and Technologists (India)

Indian Convention of Food Scientists and Technologists (ICFoST)

As a new approach to the activities of the Association of Food Scientists and Technologists (India), the Association this year is organising the Convention of Food Scientists and Technologists. The Ist Convention called **Indian Convention of Food Scientists and Technologists (ICFoST)**, will be held in May 1978, in Central Food Technological Research Institute (CFTRI), Mysore. Besides CFTRI, we are hoping to have the participation, assistance of other organisations like, Council of Scientific & Industrial Research, Department of Science & Technology, Department of Food, Government of India, Indian National Science Academy, Defence Science Organisation, etc.

The main object of the Convention is to provide opportunity for all the food scientists & technologists to come to a common forum for discussion, interacts and exchange of ideas. The papers in the technical programme will be helpful to update the knowledge and keep the members abreast of the current trends and technological developments in the country. Knowledge is also exchanged through impromptu gatherings of food professionals face to face in Convention.

This Convention has taken up the general theme "Science & Technology for changing food concepts", and discussions will be carried out simultaneously at parallel sessions covering wide range of topics. Following are the important topics included for discussion in the Convention:

(*a*) Basic Food Chemistry
(*b*) Flavour Chemistry
(*c*) Food Processing
(*d*) Food Safety & Toxicology
(*e*) Refrigerated & Frozen Foods
(*f*) Food Engineering
(*g*) New Food Product Developments
(*h*) Quality Control
(*i*) Microbial Processes for Producing Foods
(*j*) Bye-products from Food Plant Wastes
(*k*) Food Protection
(*l*) Food Additives
(*m*) Food Packaging
(*n*) Education & Training on Food Science & Technology

The Research & Development efforts made, results achieved on the above areas will be discussed and areas where further Research & Development efforts required will be identified.

Papers for presentation at the Convention are invited from all those interested in Food Science & Technology, on the above topics. The abstracts of the paper, typed in the prescribed form should reach the Hon. Exec. Secretary on or before 31st December 1977. The full papers should reach the Hon. Exec. Secretary before 31st January 1978. All the papers submitted will be screened by screening committee and the decision will be intimated to the authors. It is also proposed to bringout a souvenir where lead papers from eminent specialists in different areas of Food Science & Technology and the abstracts of the papers will be published.

For further detailed information, regarding prescribed form for abstracts, registration fee, accommodation, etc., please write to

The Honorary Executive Secretary
Association of Food Scientists and Technologists (India)
Central Food Technological Research Institute
Mysore — 570 013 (India)

ANNOUNCEMENT

FOOD MACHINERY FAIR INDIA '78

from 13th to 23rd January 1978

Organisers: ASSOCIATION OF FOOD SCIENTISTS & TECHNOLOGISTS (India), BANGALORE CHAPTER.

CO-SPONSORS: Central Food Technological Research Institute
Karnataka State Industrial Investment Development Corporation
Karnataka State Financial Corporation
Technical Consultancy Service Organisation of Karnataka.

For the first time in India of Food Machinery Fair-to provide the vital link between the manufacturers and the users and also help h ghlight new trends and developments in the field.

VENUE: BANGALORE-Karnataka State Cricket Stadium in the Heart of City. with plentiful electricity and water.

Spacious stalls 25' × 38' can accommodate complete line of operation at Rs. 5,000/- per stall.

Smaller stalls for processed foods at Rs. 1,500/- per stall

Also available Table Space of 5' × 3' at Rs. 500/- per unit.

A Symposium on 'TRENDS AND SCOPE FOR FOOD MACHINERY MANUFACTURE' is also organised on the 21st and 22nd of January 1978. The four sessions of the Symposium are as follows:

(*a*) Emerging new foods and machines to manufacture them
(*b*) Technical problems facing the food machinery industry
(*c*) Materials and machinery for food packaging
(*d*) Food machinery for rural development.

Registration Fee: Rs. 50/- for non members
Rs. 10/- for members of AFST

Coincident with the Fair many more meetings and conferences are being arranged among them the All India Dairy Industries Conference will be held between 18th and 20th of January 1978 at Bangalore.

For Reservation of the stalls and Registration contact:

Hon. Secretary,
AFST, Bangalore Chapter
No. 8, First Floor, Govindarao Street,
Seshadripuram, Bangalore—560 020.

PHONE: **33655**

SYMPOSIUM

ON

Dehydrated Foods Industry in India

(Integrated Plan for Development and Export)

Association of Food Scientists and Technologists (India), (Northern Zone), in collaboration with Indian Dehydrated Foods Industries Association has organised the above Symposium, on the 10th and 11th December 1977.

The aims of the Symposium are to

(*a*) Apprise the Industry of emerging trends and demands in the international trade;

(*b*) Crystallise inherent problems and difficulties; and

(*c*) Evolve a concrete, coordinated and integrated plan of action for all the interested parties.

The two-day symposium will have the following five sessions:

(*i*) International trade and India's export potential.

(*ii*) Raw materials.

(*iii*) Production Technology.

(*iv*) Product Development.

(*v*) Quality control, packaging and storage.

Venue:

The symposium would be held in the Auditorium located on the 11th floor of Khadya Sadan (Head office of the Food Corporation of India) 16-20 Barakahmba Lane, Connaught Circus, New Delhi-110 001.

For further details all enquiries may be referred to

Mr. Laljeet Singh

Hony Secretary — AFST (NZ)

c/o Food Corporation of India

16-20 Barakhamba Lane New Delhi — 110 001

Telex ND 2418, Phone-45839, Tel. Food Corp., N. Delhi).

ANNOUNCEMENT

OF

Prof. V. Subrahmanyan Industrial Achievement Award for the Year 1977

Nominations for the above award for the year 1977 *are invited.*
The guidelines for the award are as follows:

1. Only Indian Nationals engaged in the field of Food Science and Technology will be considered for the award.

2. The Nominee should have contributed to the field of Food Science and Technology, for the development of Agro-based food and allied industries or to basic food science and technology with immediate prospects and/or future potential for industrial application.

3. The Nominee should be proposed by any member of the Association; the bio-data of the candidate should be given in detail including the work done by him and for which he is to be considered for the award.

4. The Awardee will be selected (from the names sponsored) by an Expert Panel constituted by the Executive Committee for the above purpose.

Nominations along with bio-data and contributions, should be sent by **Registered Post,** *so as to reach Shri A. M. Nanjundaswamy. Honorary Executive Secretary, Association of Food Scientists and Technologists (India), Central Food Technological Research Institute, Mysore-*570 013
latest by 31*st of January* 1978

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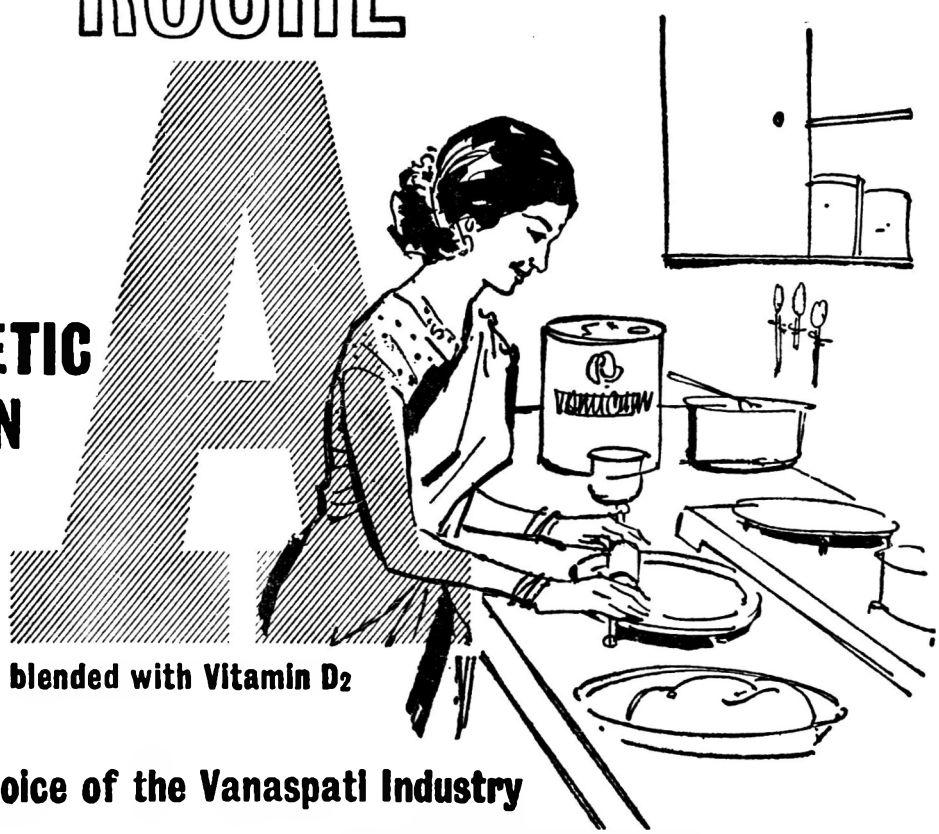

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INSTRUCTIONS TO CONTRIBUTORS

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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Research Papers

Research Notes

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