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Research Notes

On the Food Front

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The Prime Minister recently mentioned the priorities for the Nation. As reported in the press, these are Food Production, Procurement, Distribution, Science and Technology, etc., in that order. In this context it is of interest to examine the trends in food production and availability during the last 25 years. The trends are given in Fig. 1.

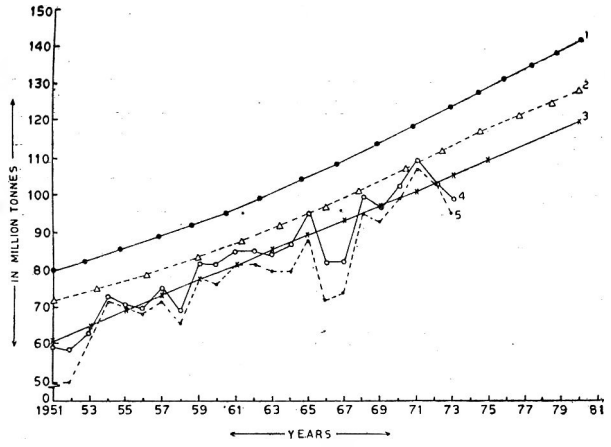

Fig1: AVAILABILITY AND CONSUMPTION LEVELS OF FOODGRAINS IN INDIA

1. NSS level of consumption; 2. current consumption; 3. availability trend; 4. Gross availability and 5. Total production.

Agricultural production estimates are anybody's guess due to so many uncontrollable variables and in-built hidden factors in the whole system. At the time of the formulation of the Fourth Plan an estimated production of 129 million tonnes of food was anticipated for the year 1973–74. This, however, was revised to 122 million tonnes during the mid-term appraisal. As per the latest 5th plan approach paper the estimate for the year 1973–74 is 114 million tonnes. What the actual production during the year 1973–74 would ultimately be, will be known later, but in any case the figure of 114 million tonnes is not likely to be achieved.

The production estimates do take into account the demand of the population and capacity in relation to inputs. Demand is a flexible factor which is dependent broadly on the income-elasticity, prices and availability of substitutes. It would be noted from the production trend in the country that total agricultural production of foodgrains could not exceed 108 million tonnes—the production of the year 1970–71. On the other side the import during that year also was not of large magnitude. Even in the year 1971–72 when food production dropped to 105 million tonnes, the imports decreased to 0.5 million tonnes. During that year, the country also exported about 1 million tonnes to Bangla Desh.

Taking into account the actual production plus imports *minus* exports, the per capita net availability[1] during 1951 was 144.1 kg per annum. In 1961 it increased to 171.1 kg per year. In 1971 this has almost remained the same.

As per the NSS survey (1965–66), the per capita consumption estimated was at 219 kg including feed, seed and wastage, per annum in that year. In reality the availability (production *plus* imports), has not touched the consumption level as envisaged in the survey (Fig. 1). It is also seen that over the years per capita consumption has gone down. If the requirements estimated by the Expert Committee on Storage are assumed to be the minimum necessary (i.e. 196 kg per capita per annum including feed, seed and wastage) the availability has exceeded demand during the years 1965–66 and 1971–72 only. This indicates that the country in the other years has survived at a lower level of consumption.

The current level of per capita net consumption may be around 467 g per day. Fig. 1 also exhibits actual availability curve i.e. production *plus* imports. In case the linear trend (1951–1973) is taken, then it indicates that the availability curve is ($y=84.01+2.04x$) where origin is taken at the year 1962 and x indicates the distance from origin in terms of number of years. According to this trend the per capita net availability is 440 g per day. This shows that the minimum availability should be 106.7 million tonnes during 1973–74 to feed the population of that year and should be 120 million tonnes to feed the estimated 659 million population during the year 1980–81.

A rough estimate[2] indicates that at present there is no equitable distribution of foodgrains all over the country. In Orissa, the per capita consumption per annum including feed, seed and wastage according to the available statistics is 289 kg whereas in the case of Kerala it is as low as 134 kg. Taking the four Zones

of the country, this figure is 205 kg per capita per annum for the Northern Zone; 204 kg for the Eastern and Western Zones and 171 kg for the Southern Zone. In an effort to achieve uniform food availability it is necessary to decide what should be the minimum availability per capita per day.

A problem needing immediate thought is what should be the strategy in case the country does not achieve the desired minimum foodgrains production. Naturally the first attempt should be to maximise utilisation of the available foodgrain so that there is only unavoidable wastages. In this regard the problem known by the term "post-harvest technology" needs to be looked into right from the farm level involving optimum utilisation of seeds, adequate protection against losses due to pests and diseases, optimum utilisation of water, power and fertilisers, harvesting with minimum losses and proper storing, marketing and processing.

Presently, the foodgrain distribution in India is on individual basis which results in sizeable losses mainly due to the individual tending to ignore small losses in his handling and processing. This loss on aggregate basis sums up to a very high figure suggesting the economy that is possible. Secondly, the refractions which are lost in this process could well be utilised elsewhere, indirectly being made to yield human food. The time and money spent on processing of foodgrains by individuals if taken into account, a colossal national waste would be obvious. A deep study on economic viability and technical feasibility in this direction of food distribution is most urgently called for at present.

Whenever a shortage in food availability develops presently, import is the only alternative being considered. This in technical terms, would appear to be a line of least resistance. So far not much difficulty was experienced in arranging imports. Future, particularly with world shortages increasing, may not be that optimistic. The disastrous weather of the year 1972 for the first time during the previous two decades, brought a reduction of 33 million tons of cereals all over the world[3]. So far each year, an additional 25 million tons had been grown to reach a global total of 1200 million tons. As would be noted (Table 1) between 1971 and 1973, the cereal hoard all over the world declined from 112 million tons to about 53 million tons which is estimated to be of just two weeks' supply. The decline in stocks has sky-rocketed the prices of cereals. The U.S. hard winter variety of wheat which sold for $62 a ton in 1971, touched $220 a ton at the beginning of 1974. Similarly, Thai rice rose from $ 129 a ton to $ 525–a 460 per cent increase in three years.

TABLE 1. STATEMENT SHOWING WORLD FOOD STOCK FROM 1971 TO 1973

(in million tons)

Commodity	1971	1972	1973
Wheat	48.8	29.0	20.7
Rice	8.2	4.8	?
Coarse grains	55.6	39.6	31.8

One of the solutions for achieving the food requirement targets lies in utilising chemical fertilisers to enrich soil and, therefore, increase its productivity. Unfortunately, the production of fertilisers also all-over the world is incapable of meeting the demand. According to a study by Professor Alien of the University of Aberdeen, demand of fertilisers will reach 124 million tons by 1977 and production will run 5 million tons behind. As oil prices are also likely to increase, the cost of fertilisers will also go up. This would place the under-developed nations in a tight situation where they would be required to cut back on their imports. There is little evidence to show that possible alternatives are up the sleeves of the Nations in situations where no breakthrough in the farm-technology or water-power-management is achieved. Further, a deficiency in rain-fall and prevalence of adverse weather conditions poses another big constraint which is the most critical problem to be dealt in while food planning for immediate as well as long range planning.

From the food crops grown, utilisation is limited to 40 to 50 per cent of the crop as seed. Almost the entire economy of production is also related to the use of only this much portion of the plant. Further, sizeable portions of the seed are lost for human food in processing. It would be a worthwhile exercise to examine the possibilities of converting all available potential of a food crop to food when needed. It needs to be appreciated in this connection that Nature has created cattle and many other animals to convert agricultural and other wastes into human food. The efficiency of this Nature's Machine, however, is as low as 20–25 per cent. It is not beyond the capacity of man to fabricate machines with much higher efficiency ratio. When production is unable meet the needs, solution lies in achieving this objective.

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Comparative Study on Different Treatments of Detoxification of Guar (*Cyamopsis tetragonoloba*) Meal and their Subsequent Effect on Its Nutritive Value

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The effect of detoxification of guar meal with acid extraction, autoclaving and incubation with *Fusarium oxysporum*, *Aspergillus niger* and *Rhizopus* sp., was studied. Crude protein, ether extract and mineral matter contents of fungi treated meal were higher. With all the treatments, the concentrations of lysine and cystine increased while that of arginine was unaffected. Detoxification of the meal with various fungi or autoclaving did not improve its nutritive value. Only acid treatment of guar meal considerably improved the biological utilization of guar protein by rats.

Guar meal, which is a by-product in the extraction process of gum from guar seed, is available in India in abundance. For its adequate contents of protein (35–50 per cent) and amino acids, except lysine[1], attempts made to feed it to monogastric animals have met with varying degree of success[2-4]. Kawatra *et al.*[5] observed that hot water treatment of guar meal helps to detoxify the meal as judged by the growth performance of rats. Supplementation of this meal with methionine and lysine further improved its nutritional quality. Various other workers[6-7] have also observed beneficial effect of heat on the nutritive value of guar meal. Katoch[8] reported detoxification of dhaincha (*Sesbania aculeata*) seed by *Aspergillus niger*. The present study deals with the effect of detoxification of guar meal by heat, acid treatment and microbial fermentation on its nutritive value.

Materials and Methods

(*A*) *Detoxification:* Guar meal (sieved through 1 mm) was detoxified with the following three treatments:

1. *Acid treatment:* Seventy grams of the guar meal was put in 400 ml of IN HCl and kept in a boiling water bath for 1 hr. Contents were filtered and the residue was washed with distilled water till free of acid. The acid free residue, so obtained was dried in a hot air oven.

2. *Autoclaving:* Raw meal was moistened to 20 per cent moisture level, spread in trays as thin layer ($\frac{3}{4}$") and autoclaved at 15 psi for 15 min. Sample was dried at 70°C in an air oven.

3. *Microbial fermentation: Fusarium oxysporum Aspergillus niger* and *Rhizopus* sp. of fungi were used to detoxify the meal. The meal was uniformly spread in enamelled trays to which 500 ml of Czopek's solution (potassium dihydrogen orthophosphate, 1; potassium chloride, 0.5; magnesium sulphate, 0.5; and ferrous sulphate, 0.01 g/litre) was added. The soaked material was sterilized and incubated with fungal spores at 37°C for 72 hr. The growth of the fungi was arrested before the onset of spore formation. The material was thoroughly mixed, dried at 60°C and finely ground.

Chemical analysis: All the samples were analysed for total nitrogen[9] while ether extract, crude fibre and mineral matter were determined by A.O.A.C.[10] methods. Lysine was determined by 1-flouro 2:4 dinitrobenzene method[11]. Methionine, arginine and cystine were estimated by colorimetric methods[12-14].

Nutritional evaluation: The effect of the differently treated guar meals on growth of rats and protein efficiency ratio (PER) was studied using casein as control. All the diets were prepared to contain 10 per cent protein level with adequate amounts of mineral salt and vitamins. Four weeks old albino rats (averaging 32 g in the body weight) randomly divided into seven groups and the diets were fed *ad-libitum* for 4 weeks on the respective diets. At the end of the experiment, the animals were anesthetized with solvent ether, the liver, kidneys and spleen were removed and weighed. The liver was analysed for total nitrogen[9] and glycogen[15]. The haemoglobin content of the blood was determined by the acid hematin method of Wintrobe[16]. The plasma was also analysed for total nitrogen.

Results and Discussion

Data on the chemical composition of raw and treated guar meals are given in Table 1. The effect of different diets on body weight gain of rats, PER, weights of organs and their altered qualitative characters are given in Table 2.

Apparently the microbial fermented meal registered an increase in the crude protein, ether extract and mineral matter over the raw meal. With all the treatments given to raw guar meal the concentrations (mg/g protein) of lysine and cystine appeared to have increased compared with the untreated meal. The methionine content increased in T_2 (autoclaved) and T_5 (incubated with *Aspergillus niger*) and declined in T_3 (incubated with *Rhizopus* sp.) and T_4 (incubated with *Fusarium oxysporum*). However, the concentrations of arginine remained more or less the same in all samples.

Data in Table 2 indicate that animals fed on D_2 (raw meal) and D_5 (*Rhizopus* treated meal) diets consumed less food and showed decrease in body weight. The group fed on D_4 (acid treated meal) diet, however, gained 21.7 g body weight and consumed a maximum of 193.7 g of food against 181.4 g in case of D_1 (casein) diet. There was a considerable improvement in PER (1.12) with D_4 diet. The mortality rate was registered 100 per cent in case of groups fed D_3, D_6 and D_7 diets and 80 per cent in groups fed on D_2

TABLE 1. EFFECT OF DIFFERENT TREATMENTS ON THE NUTRIENT COMPOSITION OF GUAR MEAL*

	Treatments	Crude protein (N×6.25) %	Crude fibre %	Ether extract %	Mineral matter %	Lysine mg/g	Methionine mg/g	Cystine mg/g	Arginine mg/g
T_1	Untreated guar meal	49.16	7.50	6.35	5.70	42.2	14.5	25.8	44.6
T_2	Guar meal autoclaved	50.00	7.20	6.20	5.90	48.1	17.2	32.0	45.4
T_3	Guar meal incubated with *Rhizopus* sp.	58.12	6.30	7.60	6.90	45.4	13.2	27.8	44.8
T_4	Guar meal incubated with *Fusarium oxysporum*	52.18	6.60	7.80	7.00	42.0	10.6	28.2	44.1
T_5	Guar meal incubated with *Aspergillus niger*	54.37	6.10	8.10	6.90	46.4	17.7	31.8	44.9
T_6	Acid treated guar meal	46.24	6.00	8.20	6.10	50.2	14.9	30.8	44.5

*Chemical composition on dry matter basis.

TABLE 2. EFFECT OF DIFFERENT DIETS ON BODY WEIGHT GAIN, PER, WEIGHTS OF ORGANS, LIVER NITROGEN, LIVER GLYCOGEN, PLASMA NITROGEN AND BLOOD HAEMOGLOBIN CONTENT OF RATS

Diets*	Weight gain g	Food intake g	PER	Kidney weight		Spleen weight		Liver weight		Liver		Blood analysis	
				Total g	g/100g BW**	Total g	g/100g BW**	Total g	g/100g BW**	Total N mg/g	Glycogen mg/g	Plasma N g/100ml	Haemoglobin content g/100ml
D_1	42.1	181.4	2.32	0.50	0.65	0.14	0.21	2.16	3.10	27.42	51.32	0.76	12.0
D_2	-12.3	39.2	-ve	0.43	1.10	0.05	0.14	1.65	4.34	12.81	40.38	0.58	9.0
D_4	21.7	193.7	1.12	0.46	0.81	0.15	0.27	2.30	4.04	22.81	64.32	0.63	10.5
D_5	-19.8	83.6	-ve	0.31	0.88	0.06	0.17	1.32	3.78	14.33	55.63	0.56	8.5

*D_1—Casein; D_2—Raw guar meal; (D_3—Autoclaved guar meal; D_4—Acid treated guar meal; D_5—*Rhizopus* sp. treated guar meal. D_6—*Fusarium oxysporum* treated guar meal; D_7—*Aspergillus niger* treated guar meal (All the animals in these three groups died) BW**—Body weight.

and D_5 diets respectively. These results indicated that treatment of guar meal with the three fungal species or autoclaving, did not help in detoxification or improvement in the utilization of guar meal protein by rats. Borchers and Ackerson[17] and Tannus and Ullah[18] observed that autoclaving has no effect on the utilization of guar meal and suggested that some other toxic factors besides haemagglutinin and trypsin inhibitors were responsible for growth inhibition. Katoch[8] reported that *dhaincha* seed fed after incubation with *Aspergillus niger* for 72 hr to chicks produced good growth. The present data indicate, on the contrary, that groups fed on D_5, D_6 and D_7 diets containing guar meal incubated with various fungi resulted in loss of body weight in comparasion with even untreated meal (D_2 diet).

The beneficial effect of acid treated meal on growth rate and PER indicates a partial inactivation and destruction of guar meal toxins resulting in a better utilization of its proteins. Feeding of acid treated meal also resulted in an increase in the total weights of liver, spleen and body weight. The concentration of total nitrogen and glycogen in the liver of the rats fed on D_4 diet were 22.81 and 64.32 mg/g of liver respectively against 27.42 and 51.32 mg/g of liver in casein diet. Similarly the blood haemoglobin levels were also comparable. In case of the groups fed on D_2 and D_4 diets the weights of organs and their vital constitutents considerably decreased in comparison to casein and acid treated guar meal. The present study leads to the conclusion that amongst the various treatments of detoxification of guar meal only acid treatment helps in improving the quality of guar protein for growing rats.

Acknowledgement

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Prevention of Pink Discolouration in Canned Litchi (*L. chinensis*)

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Both *China* and *Shahi* varieties of litchi gave positive test for leucoanthocyanins and developed pink discolouration on canning. The discolouration can be prevented by canning in 30° Brix syrup containing 0.1–0.15% added citric acid (depending on the initial acidity of the fruit, so that the final pH is around 4.5), processing for not more than 10 minutes in boiling water (301x411) and immediately cooling thereafter, preferably under chilled water. Sulphur dioxide in the covering syrup (300 ppm) is effective in preventing pink discolouration but the canned product had sulphite taste.

Litchi grown in India turns pink on canning. Pink discolouration in certain fruits and vegetables after canning has been attributed to the presence of leucoanthocyanins[1-7]. Addition of tartaric acid (0.4 per cent) or 0.1 to 0.2 per cent citric acid has also been reported to prevent discolouration although the flavour of the product was not very acceptable[8]. In recent reviews Mathew and Parpia[9], Chandler and Klegg[10] have identified the major pigment in discoloured canned pears as purple-pink insoluble tin-anthocyanin complex. Mahadeviah *et al.*[11], found that pink discolouration in canned cabbage can be inhibited by blanching in 0.1–0.5 per cent potassium metabisulphite solution. Addition of small quantity of ascorbic acid has also been found to be effective to some extent. In canned okra, sulphur dioxide (200 ppm and above) added to the covering brine inhibited the pink discolouration[12]. Similarly addition of 0.125 per cent ascorbic acid and 0.06 per cent citric acid to the covering syrup has been found to inhibit discolouration in canned guava[13].

The present investigation was taken up to standardise a method for canning litchi with a view to prevent pink discolouration.

Materials and Methods

China and *Shahi* varieties of litchi were canned immediately or one day after storage.

Canning: The fruits were washed, peeled, destoned, blanched in hot water (70–75°C) for 30 sec, canned in 30° Brix syrup containing 0.05 per cent citric acid, exhausted to can centre temperature of 82°C, sealed, processed for 10 min in boiling water and immediately cooled under chilled water (8-10°C). Plain (S. R. lacquered for sulphite treated cans. (301 × 411) were used. The various treatments studied are given in Table 2.

Chemical analysis: Fresh litchi after destoning and canned litchi after draining for 2 min, were homogenised separately in a Waring blender and used for chemical analysis. Total and reducing sugars were estimated by Lane and Eynon method[14], ascorbic acid by direct titration with 2:6 dichlorophenol indophenol [15]. Leucoanthocyanins in the flesh of litchi were tested according to the methods of Roux[16] and Dickinson[4].

Cut out examination of the cans, stored at room temperature (25–32°C) were carried out 7 days after canning, and after 3, 6 and 12 months of storage. Data for 6 months storage alone are, however, presented in this paper.

Results and Discussion

Results of chemical analysis are presented in Table 1. There was no appreciable difference seen in the chemical constituents except in their acid content and pH.

The flesh of litchi of both varieties, *China* and *Shahi* showed positive tests for leucoanthocyanins.

The results of the cut out examinations after six months of storage at room temperature are given in Tables 2 and 3.

Effect of processing time: The *Shahi* variety processed for 15 and 25 min showed pink discolouration while those processed for 5 and 10 min were normal in colour. Taste and flavour of the product in the cans processed for longer time were also impaired.

Effect of varying syrup pH: With the variety *China*, at an initial pH of 4.3 in the covering syrup, spoilage was observed within six months of storage

TABLE 1. CHEMICAL ANALYSIS OF LITCHI FRUIT (FLESH) BEFORE CANNING

Variety	Reducing sugar as invert %	Total sugar as invert %	Ascorbic acid mg/100g.	Titrable acidity as anhydrous citric %	Total soluble solids (° Brix)	pH
Shahi	13.5	15.6	18.3	0.24	18.0	4.0
China	14.6	15.9	17.9	0.16	17.0	5.2

TABLE 2. CUT OUT ANALYSIS OF CANNED LITCHI AFTER SIX MONTHS OF STORAGE AT ROOM TEMPERATURE

Treatments	Visual fruit colour	Taste	Flavour	Syrup pH
	Shahi			
Processing time (min)				
5	Normal	7.6	7.0	4.5
10	Normal	7.6	7.5	4.5
15	Fairly pink	6.6	6.6	4.4
25	Mod. pink	5.5	5.3	4.4
Syrup strength (° Brix)				
25°	Normal	7.6	7.6	4.5
30°	Normal	8.0	8.0	4.5
35°	Sl. pinkish	7.0	7.3	4.6
40°	Fairly pink	6.0	7.0	4.6
Cover syrup with 300 ppm SO_2	Normal	7.0	7.2	4.6
	China			
Acidity of covering syrup				
0. 05% Citric (Syrup pH, 4.3)	Sl. pinkish	—	—	4.1*
0.075% ,, (,, ,, 3.9)	Normal	6.6	6.6	4.6
0. 10% ,, (,, ,, 3.6)	Normal	7.0	6.7	4.5
0. 20% ,, (,, ,, 3.0)	Sl. pinkish	6.5	6.5	4.4
0. 40% ,, (,, ,, 2.5)	Mod. pink	5.5	6.0	4.0
0. 15% Tartaric	Normal	7.0	6.3	4.5
0. 30% ,,	Normal	7.0	6.7	4.4
0. 40% ,,	Sl. pinkish	6.3	6.3	4.0
Cover syrup with .05% citric acid and				
50mg Ascorbic acid/100g. syrup	Sl. pinkish	6.3	6.3	4.5
100mg ,, ,, ,, ,,	Normal	6.8	6.5	4.5
150mg ,, ,, ,, ,,	Normal	6.6	6.3	4.4
KMS blanched fruits				
700 ppm KMS	Fairly pink	5.6	5.3	4.4
,, + covering syrup with ascorbic acid 100mg/100g	Fairly pink	6.0	5.6	4.3
1000 ppm KMS	Sl. pinkish	5.6	5.0	4.3
2000 ppm KMS	Sl. pinkish	5.5	5.0	4.4

Sl:—Slightly Mod:—Moderately KMS:—Potassium meta bisulphite * The product had become sour

The colour of syrup was from pale yellow to light yellow. Scoring for taste and flavour of the fruits are on a 9 point hedonic scale ranging from "like extremely" to "dislike extremely".

Figures are means of scores awarded by 5 judges.

TABLE 3. CUT OUT ANALYSIS OF CANNED LITCHI AFTER SIX MONTHS OF STORAGE AT ROOM TEMPERATURE

Variety	Citric acid in syrup (%)	Fruit colour	Taste	Flavour	Syrup pH
Shahi					
	0.05	Normal	7.8	8.2	4.6
	0.075	Normal	8.0	8.2	4.5
	0.10	Normal	8.0	8.2	4.4
	0.05**	Fairly pink	7.8	7.5	4.4
China					
	.05	Sl. pinkish	—	—	3.9*
	.075	Normal sl. dull	6.0	5.5	4.7
	0.10	Normal	6.0	5.7	4.6
	0.05**	Normal	6.0	6.2	4.6

* The product had become sour.

** Also contained ascorbic acid 100 mg/100g.

The colour of syrup was in general from pale yellow to light yellow. Scoring for taste and flavour was done as described in Table 2.

at room temperature, whereas *Shahi* variety canned at the same syrup pH of 4.3 did not show any spoilage. This was due to the variation in pH of the two varieties, pH of *China* and *Shahi* being 5.2 and 4.0 respectively.

No pink discolouration was noticed in the fruits canned in syrup containing 0.075 and 0.10 per cent added citric acid (around pH 4.5). Tartaric acid replacing conventional citric acid was also effective between pH 4.4 and 4.5 but at pH 4.0 pink discolouration was observed.

It is evident from Table 2 that pink discolouration was enhanced with the increase in added acid in syrup resulting in lowering of pH below 4.4–4.5. The high acidity imparted sour taste to the product.

Effect of syrup strength: Although canning of litchi in 40° Brix syrup has been recommended by Siddappa[17] and Verma and Ahmed[8], high syrup strength (35° and 40° Brix) seemed to enhance discolouration (Table 2) and became very sweet. Pink discolouration was not observed in litchies canned in 25° and 30° Brix syrup, throughout the storage period.

Effect of ascorbic acid: Ascorbic acid at a concentration of 100 mg/100 g in the covering syrup and above, along with 0.05 per cent citric acid was effective in overcoming pink discolouration in the *China* variety but was not effective in the case of *Shahi* variety.

Addition of ascorbic acid did not significantly improve the flavour of the product.

Effect of sulphur dioxide: Addition of sulphur dioxide at a level of 300 ppm in the covering syrup was effective in preventing pink discolouration. The canned litchies retained the original white colour but had slight sulphite after taste. Steeping or blanching in potassium metabisulphite solution before canning as recommended for cabbage[11] was not effective in preventing pink discolouration. These treatments rather impaired the taste and flavour of the product to a considerable extent and enhanced discolouration.

Canning of litchi fresh from the orchard or after a lapse of not more than a day had no significant effect on prevention of pink discolouration.

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Studies on the Physico-chemical Characters of Some Important Commercial Varieties of Mango of North India in Relation to Canning and Freezing of Slices

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Investigation was undertaken to evaluate some important varieties of mango viz., *Bombay Green*, *Dashehari*, *Langra* and *Chousa* of North India and *Baneshan* of South India (known as *Safeda* in North) for canning and freezing of slices. It was observed that the varieties *Baneshan*, *Langra* and *Dashehari* had good pulp and slice yield while *Bombay Green* and *Chousa* produced poor pulp and slice yield. The varieties, *Langra* and *Dashehari* were quite rich in ascorbic acid and total carotenoid pigments respectively. Colour and flavour of variety *Dashehari* were best among the varieties studied during storage. However, texture of the variety *Baneshan* scored highest rating in canned and frozen slices during storage. The overall assessment showed that *Dashehari* was best as canned and frozen slices followed by *Baneshan*, *Langra*, *Bombay Green* and *Chousa* after nine months of storage.

Mango is one of the important commercial fruits of India used for processing. Although more than a thousand varieties of mango are grown in India, all are not suitable for canning and freezing of slices. The ultimate quality of mango products largely depends on the selection of the variety. Among the South Indian varieties *Alphonso*, *Baneshan*, *K.O.*8, *Mulgoa*, *Priyor*, *Neelum*, *Sundri* and *Dashehari* were best for canning[1-5] while *Dashehari* ranked first among all the varieties studied followed by *Bombay Yellow*, *Bride of Russia* and *Neelum* in order of preference[6]. According to Bose and Das[7] the variety *Himsagar* of Eastern India was best followed by *Langra* and *Fazli*. Information available regarding freezing of mango slices is scanty. However, Mathur *et al.*[8] studied the loss of ascorbic acid in *Raspuri*, *Badami* and *Mulgoa* by freezing them at –20°F and storing at 0°F. They did not study the suitability of a particular variety for freezing.

In the absence of detailed information on canning and freezing of mango slices of North India and their subsequent storage, the present study was undertaken to fill this lacuna.

Materials and Methods

Canning and freezing studies were made on four important varieties of mango viz., *Bombay Green*, *Dashehari*, *Langra* and *Chousa* of North India and were compared with *Baneshan* of South India (known as *Safeda* in North India) in the present investigation. North Indian varieties were procured from IARI, New Delhi and South Indian variety was procured from the local market.

The average weight of fruit was determined from ten fruits taken at random. Average length and breadth of the fruits were measured with the help of slide callipers.

Both the surface and flesh colour of the fruits were evaluated visually. Peel and stone percentage was found out from the weight of peel and stone respectively in relation to total weight of fruits. After peeling the fruits, pulp was removed from the stone and passed through 30 mesh sieve. The recovered pulp percentage was determined in relation to the total weight of fruits. Edible portion was found out by deducting the weight of the peel and stone from the total weight of fruits. After peeling the fruits, the side shoulders were cut into slices longitudinally and the slice percentage was determined in relation to the total weight of fruits taken. After slicing the peeled fruits, the pulp adhered to the stones was considered for recovery of pulp in relation to total weight of fruits. Here also, pulp was passed through 30 mesh sieve as followed in pulp percentage.

Canning of slices: Sliced fruits were filled in plain 1 lb Jam (301 × 309) cans and covered with a hot syrup of 40°Brix containing 0.3 per cent citric acid. The cans were exhausted, sealed, processed for 15

minutes at 100°C, cooled and stored at room temperature (32.2–37.8°C) during the period of study.

Freezing of slices: Sliced fruits were filled in plain 1 lb Jam cans and covered with a cool syrup of 50°Brix containing 0.5 per cent citric acid and 0.5 per cent ascorbic acid (Mathur *et al*[8]). The cans were sealed and kept at temperature of 0°C for 48 hr for proper sugar penetration. Then, they were transferred to a deep freeze maintaining –12.2°C and stored at that temperature for further study.

Moisure percentage was determined by drying a known weight of sample at 55 to 60°C according to AOAC[9]. Total soluble solids (w/w) were determined with a hand refractometer and value corrected to 20°C. Reducing sugars were estimated by Lane and Eynon's method[10] and non reducing sugars were similarly estimated after acid inversion. Titratable acidity was determined by titrating the sample against standard NaOH solution. The titratable acidity was calculated and expressed as citric acid. pH was determined by using a Beckman's pH meter at 20°C. Ascorbic acid was determined by the visual titration method as decribed by the Association of Vitamin Chemists[11]. Total carotenoid pigments (expressed as β-carotene) were estimated by method standardized by Roy[12]. Tannins were estimated by the colorimetric method of Folin Denis as given in AOAC[9] and cut out analysis of canned slices was followed as given in FPO[19].

The organoleptic evaluation of the mango products was done by a panel of seven judges. The average score of the seven judges are presented in Fig. 1.

Results and Discussion

It is seen from Table 1 that the edible portion of the fruit is directly proportional to weight and size of fruit and the peel percentage is inversely proportional to the size and weight of fruit. However, in the variety *Langra*, the peel percentage was more than *Dashehari* inspite of having bigger size and higher weight. This could be due to high peel thickness. The stone percentage did not show any such relation with the size and weight of the fruit. The variety *Langra* had minimum stone percentage followed by *Chousa*, *Baneshan*, *Dashehari* and *Bombay Green*. However, pulp percentage was maximum in *Langra* followed by *Baneshan*, *Dashehari*, *Chousa* and *Bombay Green*. The high pulp content in *Langra* was attributed to its low fibre content. On the contrary, low pulp content in *Bombay Green* was owing to its high stone and peel content. It was interesting to note that higher edible portion did not give high pulp percentage. e.g., *Chousa* had high edible portion as compared to *Dashehari* but the pulp percentage was found to be less than *Dashehari*. This could be due to presence of high fibre content in the variety *Chousa*. *Dashehari* produced maximum slice yield among the varieties studied since the fruit of *Dashehari* had uniform width along the length and absence of bulging of stone in the centre as it was noticed in the variety *Bombay Green*. However, pulp yield after slicing was noticed minimum in *Dashehari* due to its high slice percentage.

The chemical composition of the varieties studied (Table 2) shows that the variety *Dashehari* had highest total soluble solids (°Brix) and total sugar where as *Baneshan* was lowest in both. Correspondingly, it was seen that the moisture content of *Dashehari* was minimum and *Baneshan* was maximum. However, the variety *Baneshan* had highest percentage of reducing sugars among the varieties assessed. This could be due to the fact that *Baneshan* had highest percentage of acidity which might have accelerated the hydrolysis. The variety *Langra* had the highest ascorbic acid while *Bombay Green* and *Baneshan* the lowest. As regards total carotenoid pigments, varieties *Dashehari* and *Bombay Green* were found to be fairly rich, followed by *Langra*,

TABLE 1. PHYSICAL CHARACTERS OF DIFFERENT CULTIVARS OF MANGO

Physicial characters	Baneshan	Bombay Green	Dashehari	Langra	Chousa
Av fruit wt (g)	395	138	150	160	273
Av length (cm)	10.92	7.40	8.94	7.60	10.60
Av breadth (cm)	8.27	4.90	4.83	5.10	6.87
Flesh colour	Light yellow	Deep yellow	Deep yellow	Moderate yellow	Light yellow
Peel%	13.7	20.2	15.6	16.9	14.3
Stone%	17.5	26.0	19.3	14.3	16.9
Edible portion%	68.8	53.8	65.1	68.8	68.8
Pulp%	58.5	47.0	57.7	62.0	53.9
Slice%	53.7	34.8	57.7	55.8	49.0
Recovery of pulp%	—	19.0	7.4	13.0	20.7

TABLE 2. CHEMICAL COMPOSITION OF DIFFERENT CULTIVARS OF MANGO

Constituents	Baneshan	Bombay Green	Dashehari	Langra	Chousa
°Brix (20°C)	18.0	18.5	21.5	20.50	20.0
Moisture %	81.4	81.07	78.89	78.93	79.60
Reducing sugar %	6.0	5.04	3.01	2.77	4.21
Non-reducing %	6.8	9.36	13.79	12.43	11.34
Total sugar %	12.8	14.40	16.80	15.20	15.55
Acidity as % citric (w/w)	0.46	0.31	0.17	0.23	0.14
pH(20°C)	3.9	4.4	4.9	4.9	4.9
Ascorbic acid (mg/100g)	5.0	5.00	17.70	124.70	18.6
Total carotenoid pigments as β-carotene (μg/100g)	2370	8685	9065	6895	3095
Tannins (mg/100g)	83.0	67.0	27.0	45.0	98.0

TABLE 3. CUT OUT ANALYSIS OF CANNED SLICES

Variety	Storage period* months	Vacuum (in)	Head space (cm)	Drained wt (%)	Internal condition
Baneshan	0	14	0.4	66.2	Normal
	3	12	0.4	66.3	Light feathering, faint staining.
	6	11	0.4	70.2	,, ,,
	9	10	0.5	70.5	Light feathering, moderate staining.
Bombay Green	0	18	0.5	67.8	Normal
	3	16	0.5	71.7	Light feathering,
	6	15	0.6	76.5	,, ,, with faint staining.
	9	13	0.6	76.0	,, ,,
Dashehari	0	16	0.5	62.3	Normal
	3	14	0.6	62.9	Light feathering, Faint staining.
	6	—	0.6	63.8	,, ,,
	9	12	0.7	63.9	,, ,,
Langra	0	16	0.4	58.6	Normal
	3	14	0.4	60.6	Light feathering, faint staining.
	6	12	0.5	63.8	,, ,,
	9	12	0.5	63.9	,, ,, with moderate staining.
Chousa	0	16	0.4	62.3	Normal
	3	16	0.4	62.5	Light feathering, faint staining.
	6	12	0.5	63.8	,, ,,
	9	10	0.6	64.0	,, ,, with moderate faint staining.

* Room temperature

The appearance of the syrup at 0, 3, 6, and 9 months of storage was fairly clear, yellow, turbid yellow and turbid yellow with sediment respectively, except in *Baneshan* at 6 months storage where it was yellow.

Chousa and *Baneshan*. The tannin content of the mango varieties varied from 27 *Dashehari)* to 98 (*Chousa*) mg/100g.

The cut out analysis of canned slices and changes in chemical composition during storage of canned and frozen slices are given in Tables 3 and 4. It was observed that vacuum decreased with increase in storage period of canned slices. Similarly, clarity of syrup was also reduced in all the cases. This could be due to slight disintegration of slices during storage. Similar results were reported by Satyavati *et al*[1]. The drained weight percentage of slices also increased upto six months and thereafter remained constant. This is attributed to sugar pick up by slices during storage. The total sugar content and total soluble solids of the slices also increased up to six months in the same manner during storage (Table 4). This is in conformity with the findings of Satyavati *et al.*[1] and Andrabi *et al*[13]. It was observed that unlike canned slices the total soluble solids and total sugar of frozen slices and syrup remained almost unchanged during storage. This could be due to complete absence of osmotic diffusion at low temperature (–12.2°C). The acidity (as citric acid) in both canned and frozen slices and syrup did not show much variation. Ascorbic acid content decreased in canned and frozen slices (Table 4) during storage due to presence of of residual oxygen (Andrabi *et al.*[13]). The loss of ascorbic acid during subsequent storage could be due to decomposition of ascorbic acid by fructose or sucrose yielding fructose on hydrolysis, confirms the results of Huelin[4]. Ascorbic acid retention in canned slices was better as compared to frozen slices and this may be due to inactivation of enzymes in canned slices during heat processing. Among the varieties, *Langra* was found to have high retention of ascorbic acid since it had originally high content. This is in conformity with the results of Jain and Subbaiah[15]. The retention of carotenoid pigments in these products was found to be greater than that of ascorbic acid. However, slow and steady decline of carotenoid pigments was noticed in canned and frozen slices (Table 4) during storage. This was mainly due to the presence of residual oxygen in both the products as reported by Dhopeshwarkar and Magar [16, 17], Siddappa and Bhatia[18] and Andrabi *et al.*[13].

Colour of the frozen slices of all the varieties scored more as compared to canned slices up to six months

TABLE 4. CHANGES IN CHEMICAL COMPOSITION OF CANNED AND FROZEN SLICES DURING STORAGE

Variety	Storage period* (months)	Sugar %				Ascorbic acid retention %		Carotenoid retention %	
		Canned		Frozen					
		Reducing	Non-reducing	Reducing	Non-reducing	Canned	Frozen	Canned	Frozen
Baneshan	0	13.6	9.3	6.8	14.3	—	—	—	—
	3	13.9	9.4	5.4	15.7	77.51	96.66	93.60	94.80
	6	14.6	10.4	5.2	15.6	66.66	66.15	93.60	94.80
	9	15.1	8.7	4.3	15.2	51.16	17.05	87.40	89.90
Bombay Green	0	6.6	13.2	6.2	17.3	—	—	—	—
	3	8.7	13.6	4.0	19.5	84.00	91.96	94.70	—
	6	9.5	13.7	3.4	19.4	56.80	44.40	89.40	91.96
	9	10.3	11.0	3.4	19.2	40.00	19.91	89.40	88.71
Dashehari	0	9.2	10.2	3.1	21.2	—	—	—	—
	3	11.7	12.0	2.9	21.9	80.43	86.86	95.10	98.70
	6	12.1	11.9	1.9	22.1	68.28	70.48	93.50	96.30
	9	13.0	9.4	1.4	22.7	51.38	31.64	91.70	91.50
Langra	0	12.7	7.7	2.6	21.7	—	—	—	—
	3	13.5	11.9	2.1	21.2	91.75	87.44	94.90	97.98
	6	14.2	11.3	2.0	22.2	83.70	80.42	90.80	94.90
	9	15.0	10.0	1.7	20.6	71.73	63.48	90.80	91.25
Chousa	0	12.5	11.2	3.0	20.2	—	—	—	—
	3	13.3	11.5	3.9	19.2	81.48	85.62	96.50	93.54
	6	14.3	15.6	3.3	18.9	68.87	65.74	93.00	90.40
	9	15.4	8.1	2.8	19.9	46.91	33.66	90.70	97.89

* Storage temperature is 32.2–37.8°C for canned slices and –12.2°C for frozen slices.

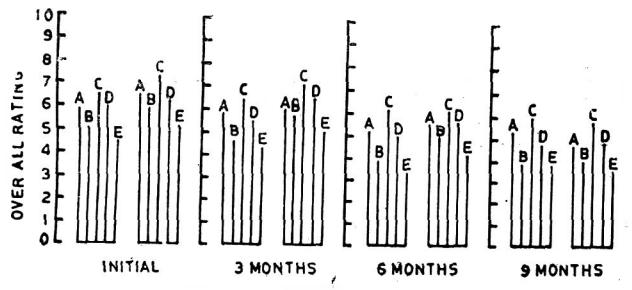

Fig. 1. Organoleptic evaluation of canned and frozen mango slices. A, *Safeda;* B, *Bombay Green;* C, *Dushehari;* D, *Chousa.*

and thereafter remained constant. Similarly, flavour of the frozen slices of all the varieties was adjudged better than the canned slices. The variety *Dashehari* was found to have maintained colour and flavour better in canned and frozen slices as compared to other varieties. However, the texture of canned slices scored higher rating as compared to frozen slices due to slow freezing. Among the varieties, *Baneshan* was found to have better texture in canned and frozen slices. The assessment of overall rating did not produce any significant difference between canned and frozen slices (Fig. 1). However, the differences were noticed among the varieties. *Dashehari* was found to be better both as canned and frozen slices followed by *Baneshan, Langra, Bombay Green* and *Chousa.*

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Biochemical Activity of *Staphylococci* Isolated from Raw Meats

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Biochemical characters like mannitol fermentation, haemolysin production, gelatinase, lipase and coagulase activities of *Staphylococci* strains isolated from 45 sheep and goat carcasses were studied. Of all the biochemical activities studied, lipolytic activity observed on Egg Yolk-Tellurite-Glycine-Pyruvate Agar (ETGPA) and combination of mannitol fermentation and lipolytic activity exhibited highest association with coagulase production. Irrespective of the various degrees of association observed between gelatinase, lipase, coagulase activity, haemolysin production and mannitol fermentation, the results do indicate the possibility of sheep and goat meat to act as a reservoir of the *Staphylococci* of potential toxigenicity.

Food poisoning outbreaks or epidemics, so often reported in meats or meat products are frequently identified as of *Staphylococcal* origin. Direct methods to identify the *Staphylococci* strains involved or likely to be involved in intoxication is to demonstrate their ability to produce enterotoxins. In the absence of any established, rapid, cheap and reliable method to detect enterotoxins, the coagulase activity is considered to be the most dependable property in the identification of pathogenic *Staphylococci*[1-5]. However, other properties like mannitol fermentation, haemolysin production, gelatinolytic and lipolytic activities and phage type also have been of particular importance in assessment of pathogenicity.

In view of the above reports, in the present study, biochemical characters of *Staphylococci* strains isolated from sheep and goat carcasses were studied in an attempt to evaluate the significance of raw meat as a reservoir of *Staphylococci* of potential importance from public health standpoint.

Materials and Methods

Two hundred and fifty-nine strains of *Staphylococci* were isolated from 45 sheep and goat carcasses kept for sale in Mysore meat market.

Samples were initially enriched in mannitol salt broth for 24 hr at 37°C and then streaked on to *Staphylococci* medium No. 110. Chromogenic colonies from this medium were picked up for colony purification. The pure isolates were then subjected to oxidation-fermentation[6], catalase test[7] and microscopic examination to eliminate *Micrococcus* and *Streptococcus* respectively. All the strains thus isolated and purified were then tested for production of alfa haemolysin, lipase, gelatinase and coagulase activity and mannitol fermentation.

Production of alfa haemolysin was observed on rabbit blood agar, lipolytic activity on Baird-Parker medium[8] and gelatinase in gelatin tube medium (DIFCO[9]). All the reactions were carried out at 37°C for 24 hr except gelatinase which was carried out at room temperature for 14 days. Coagulase production was tested in 24 hr old cultures by slide test[10].

Results and Discussion

A total number of 259 isolates were made from 45 sheep and goat carcasses. All the isolates were gram positive spheres, arranged singly, or in pairs and in clumps, were catalase positive and could ferment glucose in Hugh and Leifson's medium[6].

Summary of the biochemical properties of *Staphylococci* isolates used in the present study are indicated in Table 1, which shows that out of 173 isolates used for the study of coagulase reactions 18 isolates were coagulase positive, and 128 isolates were coagulase negative and 27 isolates indicated doubtful reaction amounting to 10.4, 73.9 and 15.6 per cent respectively.

In Table 2, data are presented relating to biochemical properties such as mannitol fermentation, gelatinase activity, production of lipase and α-haemolysin production by coagulase positive and coagulase negative strains. As seen from Table, out of 18 coagulase positive strains, 14 (77.7 per cent) were found to ferment Mannitol. Similarly in the case of coagulase negative strains, out of 128 isolates, 86 isolates (67.1 per cent) were positive for mannitol fermentation.

TABLE 1. RANGE OF BIOCHEMICAL ACTIVITY OF ISOLATES OF STAPHYLOCOCCI ISOLATED FROM SHEEP AND GOAT CARCASSES

Reaction	Isolates tested No.	+ve reaction total No.	+ve reaction %	-ve reaction total No.	-ve reaction %	Doubtful reaction total No.	Doubtful reaction %
Mannitol fermentation	259	184	71.00	73	28.10	2	0.70
Gelatinase	254	142	55.90	108	42.50	4	1.50
α-Haemolysin	257	177	68.80	63	24.50	17	6.60
Lipase	163	60	36.80	102	62.50	1	0.60
Coagulase	173	18	10.4	128	73.90	27	15.60

Mannitol fermentation used to be one of the criteria for determining the pathogenicity of *Staphylococci*[11]. The ability of a potential food poisoning *Staphylococcus* to ferment mannitol has not been demonstrated conclusively; however Evans, has stated that high correlation could be obtained between mannitol fermentation and enterotoxin production but Clark *et al.*[12], in their limited studies failed to establish such a correlation. In the present study, direct correlation between enterotoxin production and mannitol fermentation has not been carried out, instead, ability to coagulate rabbit plasma was taken as an index of enterotoxigenic potentiality of *Staphylococcus aureus* [1-4]. The results obtained with regard to mannitol fermentation were in agreement with the results obtained by other workers[13], who doubted the value of mannitol fermentation as an index of pathogenicity.

Gelatinase activity of *Staphylococci* in the assessment of pathogenicity has been questioned by several workers [12, 14], even though high percentage of pyogenic strains are known to exhibit gelatinase activity. In the present investigations, 50 per cent of the coagulase positive *Staphylococci* and as high as 56.2 per cent of coagulase negative strains of *Staphylococci* could liquefy gelatin. The data obtained clearly indicate that gelatinase activity as a diagnostic test for the detection of pathogenic *Staphylococci* has limited application.

Production of α-haemolysin as an index of pathogenicity is supported by some workers [12, 15] while it is not acceptable to others[16]. In the present investigations, among the isolates studied 77.7 per cent of the coagulase positive strains could lyse red blood corpuscles of rabbit, while 74.2 per cent of coagulase negative strains also produced α-haemolysin when tested on rabbit blood agar plates. These results indicate the doubtful value of α-haemolysin production in the assessment of pathogenicity of *Staphylococci*.

TABLE 2. BIOCHEMICAL CHARACTERISTICS OF COAGULASE POSITIVE AND COAGULASE NEGATIVE STAPHYLOCOCCI

Property	Coagulase +ve strains† Nos.	%	Coagulase -ve strains+ Nos.	%
Mannitol fermentation	14	77.7	86	67.1
Gelatinase	9	50.0	72	56.2
Lipase	13*	86.6	20	15.6
α-Heamolysin	14	77.7	95	74.2

*Out of 18 coagulase+vestrains, only 15 were tested for lipase production on Baird-Parker medium.
†out of 18.
+out of 128.

Reports on lipolytic activity of pathogenic *Staphylococci* is conflicting. Some workers[17-21], have observed that lipolytic activity is largely associated with the pathogenicity of *Staphylococci*, while others[12-22], do not consider it to be a reliable indicator. These conflicting views may be partly due to differences in the techniques employed or due to differences in the opinions as to what constitutes a positive egg yolk reaction in a given media[11-23]. Recent reports indicate that the lipolytic activity is due to production of lipoprotein lipase[24] of *Staphylococcus aureus* on egg yolk. Baird-Parker has developed a selective and diagnostic medium—egg yolk tellurite glycine pyruvate agar (ETGPA) to read the egg-yolk reaction, and this medium has been reported to give an excellent correlation with coagulase[23, 25-28] and enterotoxin production[23]. In the present study 86.6 per cent of the coagulase positive *Staphylococci* and 15.6 per cent of coagulase negative *Staphylococci* indicated positive reaction on ETGPA. Stewart and Patterson[29] have reported that ETGPA medium has failed to indicate positive reaction for coagulase positive *Staphylococci* and 70 per cent of the colonies giving typical

TABLE 3. ASSOCIATION OF VARIOUS BIOCHEMICAL CHARACTERS WITH COAGULASE ACTIVITY OF STAPHYLOCOCCI

Combination of biochemical reactions	Coagulase+ve strains (18)		Coagulase–ve strains (128)	
	Nos.	%	Nos.	%
Mannitol and haemolysin	12	66.6	63	49.2
Mannitol and gelatin	9	50.0	51	39.8
Mannitol and lipase	12*	80.0	52	40.6
Gelatin and haemolysin	9	50.0	57	44.5
Gelatin and lipase	8*	53.3	39	30.4
Haemolysin and lipase	10*	66.6	50	39.0
Mannitol, haemolysin and lipase	10*	66.6	44	34.3
Mannitol, gelatin and lipase	7*	46.6	33	25.7
Mannitol, gelatin and haemolysin	9	50.0	25	19.5
Lipase, gelatin and haemolysin	8*	53.3	31	24.2
Mannitol, gelatin and lipase	9*	60.0	27	21.0

* Percentage is calculated on the basis of 15 coagulase positive *Staphylococci* instead of 18 as only 15 coagulase positive isolates were tested on Baird—Parker media.

positive reaction on ETGPA on primary isolation turned out to be coagulase negative. Baird-Parker[25] has reported that coagulase positive strains which on primary isolation failed to clear egg yolk, on replating caused well defined clearing. Coagulase negative *Staphylococci* giving positive reaction on ETGPA may be due to *Proteus vulgaris* which can be confused for *Staphylococcus aureus* in the absence of microscopical examination[25-30]. The possibility of isolates being *Proteus vulgaria* in the present investigations was ruled out as the isolates of *Staphylococci* tested on ETGPA were previously purified and confirmed to be *Staphylococci* by both, microscopical and biochemical examinations. The coagulase negative strains showing typical positive reaction on ETGPA for lipase activity may be due to bound coagulase. Presence of bound coagulase was not tested in the case of coagulase negative strains used in the present investigations.

In Table 3 data are presented regarding association of various biochemical characters with coagulase activity of *Staphylococci*. It was of interest to study the association of combination of biochemical properties in the case of coagulase positive and negative isolates of *Staphylococci*. Accordingly, 11 combinations of biochemical characters were studied. As seen from Table 3 combination of mannitol fermentation and lipase, 80 per cent positive association is obtained in the case of coagulase positive isolates. Correspondingly for coagulase negative isolates the positive association is in the order of 40.6 per cent. Next in order are mannitol and haemolysin, haemolysin and lipase and mannitol, haemolysin and lipase combination, where per cent positives in the case of coagulase positive strains is commonly 66.6 per cent. For the same set of combinations of bio-chemical characters for coagulase negative strains the per cent positives are 49.2, 39.0 and 34.3 respectively. The rest of the combinations indicate a range of 46.6 to 60.0 per cent in the case of coagulase positive isolates and 19.5 to 44.5 per cent for coagulase negative isolates.

Of all the biochemical reactions studied lipolytic activity observed on ETGPA, and the combination of mannitol fermentation and lipolytic activity exhibited highest association with coagulase activity—the index reaction of pathogenicity of *Staphylococci*. However, more detailed studies are required to test the validity of egg yolk reaction on ETGPA in the assessment of pathogenicity of *Staphylococci* which are encountered in meat and meat products, because many coagulase negative *Staphylococci* such as *Staphylococcus saprophyticus*, *Staphylococcus epidermidis* are commonly encountered in meat and meat products. These two species are shown to give typical positive reactions similar to coagulase positive *Staphylococcus aureus*[8, 31] Irrespective of various degrees of association observed between gelatinase, lipase, coagulase activity, haemolysin production and mannitol fermentation, the results indicate the possibility of sheep and goat meat to act as a reservoir of *Staphylococci* of potential toxigenicity.

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Effects of Starter Cultures and Incubation Period and Temperature on the Acidity of *Dahi* (Curd). Part I

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Investigations were carried out in order to study the effect of cultures, quantity of starter cultures and time of incubation on the acidity of *Dahi* (curd) using both buffalo and cow milks.
Curd from buffalo milk produced slightly more acidity than that from cow milk at a particular time of incubation and with a particular quantity of starter culture. Optimum titratable acidities of curds made from buffalo and cow milks ranged from 0.76 to 0.87% respectively. *S. lactis* produced maximum acidity among all the *Streptococci* studied; *S. thermophilus* produced moderate acidity. *S. diacetilactis* distinguished itself from other cultures by its ability to produce appreciable amounts of lactic acid as well as desirable flavour. Acidity increased rapidly upto 16 hr of incubation, after which the rise in acidity was not very significant.

Curd, popularly known as *Dahi* in India, is one of the most important milk products used by the majority of population, as an article of diet, refreshing beverage, and as an intermediate in the manufacture of country butter. As much as 7.8 per cent of the milk produced in this country is converted into curd for direct consumption[1].

Dahi or its western counterpart, yogurt is a product of milk fermented by *Streptococci* and *Lactobacilli*. Certain lactic acid bacteria utilise the lactose of milk and produce lactic acid and also acetic acid and CO_2 whereas *Streptococcus diacetilactis*, *Leuconostoc dextranicum* and *L.citrovorum* use the citric acid of the milk to produce certain volatile organic compounds that are responsible for flavour in curd.

Nicholls[2] observed that buffalo milk gives better curd than cow milk. Kielling *et al.*[3] attributed the syneresis of milk curd to the presence of *S. thermophilus* and recommended the heating of milk upto not less than 80°C and holding it for 15 min to give firm curd free from separated serum. While Talce[4] suggested the use of 2.0 per cent inoculum of starter culture, Beutler *et al.*[5] recommended 0.83 to 0.88 per cent of titratable acidity. For getting a firm coagulum in curd Laxminarayana and Iya[6] recommended heating of milk at 70 to 90°C for 5 to 10 min and then boiling,cooling to 35 to 40°C and incubating at 30 to 37°C for 16 hr. Omurtag[7] suggested the optimum incubation time for yogurt as 10 to 12 hr at 37°C whereas Galesloot and Hasing[8] suggested 32°C

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as the optimum temperature for the production of yogurt. Krishnaswamy *et al.*[9] compared the curd from Miltone (vegetable toned milk) with that of milk. No systematic work on the effect of culture, quantity of starter culture and time of incubation on the quality of curd, using both cow and buffalo milks has been reported so far and therefore, the present study was necessitated.

Materials and Methods

Pure cultures of *S. lactis*, *S. thermophilus* and *S. diacetilactis* used in the study were obtained in chalk-milk medium from the National Dairy Research Institute, Karnal (Haryana). For preparing mother and bulk cultures skim milk of cow or buffalo was used. The incubation temperatures adopted were 30°C for cultures of *S. lactis* and *S. diacetilactis* and 37°C for culture of *S. thermophilus*. Composite buffalo and cow milk procured from the College Dairy Farm, (avoiding abnormal milks) were tested for fat, solids-not-fat, and acidity (expressed as per cent lactic acid) as per ISI procedures[10]. The curd was prepared from cow milk (fat, 4.8 to 5.1 per cent and SNF, 8.8 to 9.0 per cent) and buffalo milk (fat, 6.5 to 7.0 per cent and SNF, 9.25 to 9.50 per cent) separately, taking all necessary precautions. The starter culture was added at the rate of 1.0, 1.5, 2.0 and 2.5 per cent and samples were incubated at 30 and 37°C for periods of 8, 10, 12, 14, 16 and 24 hr respectively. At a time one culture for one type of milk (cow or buffalo) was used with four starter culture concentrations and with six different times of incubation. There were two replications. Curd formed was evaluated for its qualities on the basis of the following tests.

Total titratable acidity was determined as per ISI procedure[10].

Bacteriological tests: In order to confirm the absence of any contamination, the samples were tested for the (i) presence of yeast and mold[11] and (ii) presumptive coliform test[12].

Results and Discussion

Titratable acidities of the curd as determined at each successive time interval and with each concentration of starter cultures are shown in Table, 1, 2 and 3. In case of buffalo milk, *S. diacetilactis* produced maximum acidity of 1.04 per cent in 24 hr. When 1.0 per cent starter culture was used, the acidity was 0.62 per cent after 8 hr of incubation. With the increase in the time of incubation the acidity also increased. The increase in acidity during intervals of 8 to 16 hr and 16 to 24 hr of incubation was found to be from 0.62 to 0.95 per cent and from 0.95 to 1.04 per cent respectively. The acidity increased rapidly upto 16 hr, afterwards the increase in acidity was very small up to 24 hr. In case of cow milk curd, the same culture produced minimum acidity of 0.61 per cent in 8 hr and maximum acidity of 1.0 per cent in 24 hr of incubation. The increase in acidity was rapid up to 16 hr and then upto 24 hr of incubation. The increaes in acidity was very slow, as observed with buffalo milk. *S. diacetilactis* differed from other cultures by its ability to produce good amount of lactic acid and desirable flavour. The results in Table 1 are in agreement with the findings of Karnad[13] who also reported that *S. diacetilactis* has the ability to produce 1.0 per cent lactic acid together with high amount of acetoin and diacetyl.

TABLE 1. EFFECT OF *S. diacetilactis*, QUANTITY OF STARTER CULTURE AND TIME OF INCUBATION ON THE ACIDITY OF CURDS USING BUFFALO MILK AND COW MILK

Incubation time hr	Acidity produced at indicated concentrations of starter culture							
	1.0%		1.5%		2.0%		2.5%	
	B	C	B	C	B	C	B	C
8	0.62	0.61	0.65	0.64	0.67	0.66	0.68	0.68
10	0.73	0.72	0.77	0.76	0.79	0.78	0.80	0.81
12	0.84	0.83	0.86	0.87	0.86	0.87	0.87	0.88
14	0.86	0.86	0.87	0.88	0.88	0.89	0.91	0.90
16	0.89	0.88	0.93	0.91	0.95	0.94	0.95	0.95
24	0.98	0.96	0.02	0.97	1.04	0.99	1.04	1.01

B = Buffalo milk curd; C = Cow milk curd; Acidity is expressed as per cent lactic acid.

TABLE 2. EFFECT OF *S. thermophilus*, QUANTITY OF STARTER CULTURE AND TIME OF INCUBATION ON THE ACIDITY OF CURDS USING BUFFALO MILK AND COW MILK

Incubation time hr.	Acidity produced at indicated concentrations (%) of starter culture							
	1.0%		1.5%		2.0%		2.5%	
	B	C	B	C	B	C	B	C
8	0.52	0.51	0.55	0.54	0.58	0.57	0.59	0.59
10	0.62	0.61	0.68	0.69	0.69	0.68	0.71	0.71
12	0.68	0.67	0.69	0.69	0.73	0.72	0.75	0.74
14	0.73	0.71	0.75	0.73	0.77	0.75	0.78	0.77
16	0.76	0.75	0.77	0.76	0.78	0.77	0.79	0.78
24	0.80	0.79	0.81	0.80	0.82	0.81	0.84	0.83

B = Buffalo milk curd; C = Cow milk curd; Acidity is expressed as per cent lactic acid.

Maximum acidity produced by the culture *S. thermophilus* in 24 hr of incubation was 0.84 per cent and minimum acidity in 8 hr was 0.52 per cent, in case of buffalo milk curd, as shown in Table 2. The acidity increased sharply upto 14 hr of incubation as compared to that exhibited by *S. diacetilactis* in which acidity increased rapidly upto 16 hr. In case of *S. thermophilus* acidity increased from 0.52 to 0.79 per cent during 8 to 14 hr of incubation. Similarly the acidity also increased from 0.79 to 0.84 per cent during 14 to 24 hr, but in the latter case the increase in acidity was found to be less. With different concentrations of starter culture used, the increase in acidity was not found significant. In case of cow milk, *S. thermophilus* produced a minimum acidity of 0.51 per cent in 8 hr and maximum of 0.83 per cent in 24 hr of incubation. The results of acidities produced by cow milk curds showed the same trend in rise as in the case of buffalo milk. The acidity increased sharply from 0 to 14 hr and afterwards the increase was comparatively less than that observed in early incubation periods. Also this culture produced less acidity as compared with other two cultures in this study. These results are in full agreement with the findings of Pette[14] who also established that *S. thermophilus* is less tolerant of high acidities. It produces less acidity, using the same quantity of starter cultures ranging from 1.0 to 2.5 per cent in case of cow milk.

TABLE 3. EFFECT OF *S. lactis*, QUANTITY OF STARTER CULTURE AND TIME OF INCUBATION ON THE ACIDITY OF CURDS USING BUFFALO MILK AND COW MILK

Incubation time hr.	Acidity produced at indicated concentrations (%) of starter culture							
	1.0%		1.5%		2.0%		2.5%	
	B	C	B	C	B	C	B	C
8	0.64	0.63	0.66	0.65	0.68	0.67	0.69	0.69
10	0.72	0.72	0.75	0.74	0.77	0.77	0.78	0.77
12	0.77	0.77	0.79	0.78	0.81	0.81	0.83	0.82
14	0.81	0.79	0.82	0.81	0.84	0.85	0.88	0.87
16	0.88	0.86	0.90	0.88	0.93	0.92	0.95	0.94
24	0.99	0.95	0.04	0.96	1.08	1.00	1.11	1.05

B = Buffalo milk curd; C = Cow milk curd; Acidity is expressed as per cent lactic acid.

The starter culture of *S. lactis* produced a maximum acidity of 1.1 per cent in case of buffalo milk and 1.05 per cent in case of cow milk in 24 hr and a minimum of 0.64 per cent in case of buffalo milk and 0.63 per cent in case of cow milk in 8 hr of incubation as shown in Table 3. In this particular culture the increase in acidity at regular incubation intervals showed a significant variation. From 8 to 24 hr, 8 to 16 hr, and 16 to 24 hr of incubation, the acidity, in case of buffalo milk, increased from 0.64 to 1.11, 0.64 to 0.95 and 0.95 to 1.11 per cent respectively and in case of cow milk, it increased from 0.63 to 1.05, 0.63 to 0.94 and 0.94 to 1.05 per cent respectively. This showed that increase in acidity from 8 to 16 hr (0.64 to 0.95 per cent) was 0.31 per cent in case of buffalo milk and the same 0.31 per cent (0.63 to 0.94 per cent) in case of cow milk. The increase in acidity from 16 to 24 hr of incubation was found to be 0.16 per cent (0.95 to 1.11 per cent) and 0.11 per cent (0.94 to 1.05 per cent) in case of buffalo and cow milk curds respectively. The results of this trial using *S. lactis* revealed that this culture produced the highest acidity amongst other cultures of *Streptococcus* species, supporting the findings of Laximnarayana[15]. These results have also been found similar to the observations of Nicholls[2] who reported that *S. lactis* produces 1 per cent acidity within 24 hr of incubation, using 1 per cent inoculum.

The results of Tables 1 to 3 showed that the curd from buffalo milk produced higher acidity at a particular time of incubation, and at a particular concentration of starter culture than that prepared from cow milk under identical conditions, which have been found in agreement with the findings of Iyengar[16] who reported that acid production was faster for buffalo milk than cow milk.

These results revealed that the curds of both buffalo and cow milks under study were in general free from coliforms and yeasts and molds. Out of 72 samples of buffalo milk curd, five were found positive in presumptive coliform test and four showed the presence of yeasts and molds. Out of 72 samples of cow milk curd, only two gave positive presumptive coliform test and three showed the presence of yeasts and molds.

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Effect of Additives on Cooking-release-volume and Tenderness of Pre-cooked, Freeze Dried Mutton

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Effect of additives on cooking release volume (CRV) of meat has been studied in order to minimise the cooking losses either by restricting the excess gravy release or by promoting the reabsorption of the gravy so released to improve the quality of pre-cooked freeze dried mutton chunks. Pretreatment with agar-agar, native potato-starch and a mixture of wheat gluten and autolysed yeast improved the quality of freeze dried mutton chunks both organoleptically and also as judged by objective measurement of cohesiveness and hardness.

Pre-cooked freeze dried mutton has been reported to lack juiciness, aroma and texture and is often characterized as dry and woody[1-4]. This has been attributed to many factors (such as postmortem-pH, fat content, species, age, sex and muscle function of the animal) but the major reason appears to be the release of gravy during cooking and melted fat which account for aroma [5-7], juiciness, tenderness and texture of meat[8,9]. The water holding capacity (WHC) of the cooked meat has been found to be directly correlated with tenderness and texture. The gravy, released on cooking of mutton chunks at 85°C for 4 to 5 hr contains approximately 9 per cent solids. Additives (binders) are known to have been used in commited meat products to reduce shrinkage and increase the WHC for improvement of the quality but their use for 'meat chunks' has not been investigated. A mixture of wheat gluten and autolysed yeast has been used at 2.0 per cent level to reduce cooking losses and to prevent shrinkage and improve flavour in meat pie fillings[10]. Amylopectin, a chelating agent and a protease have been found to improve the texture of ground meat, reduce shrinkage and promote moisture retention[11]. Native (natural, uncooked) starch injected into raw meat has also been reported to bind meat fluids produced during cooking[12]. Injection of EDTA and pyrophosphate at 10 μM per kg improved the rehydration capacity and texture of freeze dried pork-loin[13]. Reduced loss of extractives during pickling and improved quality are produced by adding agar-agar at 1.0 per cent concentration[14].

With a view to improve the quality of precooked freeze dried mutton chunks, effects of some additives on CRV, degree of reabsorption of gravy, organoleptic and objective measurement of the quality of the freeze dried additive treated mutton chunks have been investigated.

Materials and Methods

(*a*) *Mutton:* Only hind legs of the male goats (Bannur variety) one and a half to two years were used in these studies. Mutton was deboned, defatted and cut into pieces (2 to 2.5 cm in size).

(*b*) *Additives used:* Optimum concentration of the additives was selected on the basis of gravy release/reabsorption and organoleptic assessment of the treated product. Simultaneous control was run with each additive.

	Additives	Level used % (w/w)
1.	Wheat-gluten (BDH and lab prepared)	2.0
2.	1:1 mixture of wheat-gluten and autolysed yeast (DIFCO, USA).	2.0
3.	3:1 mixture of wheat-gluten and autolysed yeast.	2.0
4.	Native potato-starch (Patel Chest Inst., Delhi and prepared in lab.)	2.0; 1.0; 0.5
5.	Agar-agar powder, USP. (Cellulose Products, Ahmedabad)	1.0; 0.5; 0.1.
6.	EDTA (disodium salt, BDH)	0.1; 10 μM/kg; 50 μM/kg.
7.	Pectin (Swiss make)	1.0; 0.5; 0.1.
8.	Tannic acid (BP Bush, London)	0.1; 0.01.
9.	Amylopectin (Koch Light, England)	1.0; 0.5; 0.1.

Three additives chosen from the preliminary trials were evaluated further in triplicate using a composited lot of mutton.

(*c*) *Method of treatment:* The finely powdered additives were sprinkled over the mutton chunks and thoroughly hand mixed.

(*d*) *Cooking:* The mutton chunks in 5-kg lots were cooked in covered containers in a horizontal autoclave at 5 psi for 75 min.

(*e*) *Evaluation:* After cooking and cooling to 40±2°C, the volume of gravy was measured. The cooked mutton was then left dipped in the respective gravy overnight at 5°C. The volume of unabsorbed gravy was measured after warming in hot water till the superficial fat melted (15 min, 40±2°C). The unabsorbed gravy was concentrated into a thick paste in open pans over flame and mixed with respective mutton and freeze dried.

The quality of the freeze dried samples was evaluated organoleptically in the form of curry using a trained panel of judges on a hedonic scale of nine points. Objective evaluation on the reconstituted samples was carried out by Zenken Texturometer[15].

Results and Discussion

During the preliminary trials, pectin, amylopectin, tannic acid and EDTA did not show any advantage over the control. Treatment with these four additives had some drawbacks. The results with others are presented in Table 1. Wheat-gluten at 2.0 per cent level caused slight hardness and whiteness with 7.0 per cent less gravy release and 5.5 per cent enhanced reabsorption. Mixture of wheat-gluten and autolysed yeast (3:1) at 2.0 per cent level improved the overall quality of the product. Treatment with a mixture containing a higher proportion of autolysed yeast imparted yeasty taste. Native potato starch (0.5 to 1.0 per cent) also showed considerable benefit in gravy retention and enhanced reabsorption. Treatment at 1 per cent was chosen for further evaluation because higher concentration gave slightly starchy taste. Agar-agar treatment at 0.1 to 1.0 per cent was advantageous. Treatment at 1 per cent level was chosen for further evaluation because it caused maximum check in gravy release and maximum reabsorption of the gravy. Gluten prepared from wheat flour in the laboratory[16] and obtained from BDH gave the same effect. Similarly native potato starch prepared in the laboratory[17] had the same effect as that of the one obtained from the trade.

The results of triplicate evaluation of the chosen additives are presented in Table 2. It was observed that (1 per cent) agar-agar treatment was most beneficial. It caused 7.7 per cent reduction in gravy release and 32.1 per cent enhanced reabsorption as compared to control. This treatment gave a product which was graded first in the order of acceptance both by sensory and objective methods of texture evaluation. Possibly the improvement of quality is due to high "gel-strength" and high "gel-melting" temperature of agar-agar gel formed during cooking of meat, which is highly effective in holding of meat juices[18]. All the three chosen additives produced binding of the muscle

TABLE 1. EFFECT OF ADDITIVES PRETREATMENT ON COOKING-RELEASE-VOLUME AND OTHER CHARACTERISTICS OF MUTTON

Treatment	Cooking release volume %	Gravy reabsorbed %	Organoleptic grading	Remarks
Wheat-gluten 2%	28.6	17.5	III	Slightly hard and whitish product
Control	35.6	12.0		
3:1, wheat gluten & autolysed yeast 2%	31.3	14.8	I	Normal meat colour, no unwanted smell
Control	36.4	10.0	II	
Native potato starch 0.5%	38.1	16.6	II	
,, 1.0%	32.7	12.5	I	
,, 2.0%	18.6	18.6	III	Gives slightly starchy taste
Control	44.1	24.4	IV	
Agar-agar 0.1%	37.8	21.4	III	No fragmentation observed; pieces retain better shape
,, 0.5%	36.0	55.0	II	
,, 1.0%	27.0	66.6	I	
Control	39.6	11.3	IV	

TABLE 2. EFFECT OF OF ADDITIVES ON COOKING RELEASE VOLUME AND GRAVY RELEASE/REABSORPTION

Treatment	Cooking release vol. %	Gravy reabsorbed %
Wheat gluten + autolysed yeast (3:1)	40.0	24.6
Native potato starch	37.0	20.2
Agar-agar	35.4	47.5
Control	43.1	15.4

Results are average of 3 replicates.

TABLE 3. EFFECT OF ADDITIVES ON ORGANOLEPTIC EVALUATION OF FREEZE DRIED MUTTON

Quality attribute	Control	Wheat gluten and autolysed yeast treated	Native potato starch treated	Agar-agar treated
Colour	5.3	5.0	5.0	6.6
Flavour	5.0	4.5	4.5	5.0
Juiciness	4.0	5.2	5.2	6.0
Chewiness	4.6	4.6	5.0	6.3
Total score	18.9	19.3	19.7	23.9
Grading	IV	III	II	I

fibres bringing closer due to their gelling property thus preventing shredding or disintegration of freeze dried meat chunks upon reconstitution. The chunks retained the shape well. No selective absorption of gravy solids is observed.

Rehydration ratio of treated and control samples ranged from 2.1 to 2.3. The chosen treatments improved the water holding capacity of cooked meat and thus restricted the gravy release. Cohesiveness and hardness were observed to be directly related to the volume of gravy released. Also, since meat juice and melted fat account for aroma[5-7], juiciness and tenderness and texture of the meat, higher gravy release adversely affects upon quality evaluation. Thus retention of maximum gravy is highly desirable. A restricted release of gravy and enhanced reabsorption because of treatment with the additives results in corresponding decrease in cohesiveness and hardness and the low values are maintained unlike in control samples even after freeze drying. A higher value of hardness observed in gluten-autolysed yeast treated and freeze dried samples is possibly due to the highly proteinous nature of the additive. The objective grading correlates well with subjective grading (Table 3 and 4). It was particularly noted that the treated products had better juiciness, chewiness, and mouth-feel and hence

TABLE 4. EFFECT OF ADDITIVES ON OBJECTIVE EVALUATION OF PRE-COOKED FREEZE DRIED MUTTON

Sample	Before drying Cohesiveness	Before drying Hardness	Dried & reconstituted Cohesiveness	Dried & reconstituted Hardness	Grading
Control	0.73	5.64	0.78	7.85	IV
Wheat gluten autolysed yeast (3:1) treated mutton	0.72	3.99	0.72	6.60	III
Native potato starch treated mutton	0.71	4.43	0.71	4.76	II
Agar-agar treated mutton	0.70	4.30	0.60	4.39	I

comparatively higher total score.

The results of this study show that pretreatment with agar-agar, native potato starch and a mixture of wheat gluten-yeast resulted in improving the quality of freeze dried mutton. However, the adoption of this technique of pretreatment for large scale production of freeze dried mutton chunks has not been tested.

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Studies on Curry Leaf (*Murraya koenigii* L)

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Curry leaf (*Murraya koenigii* L.) is being used extensively in Indian cookery and forms one of the major leafy spices. The present study comprises of the chemical composition of tender, medium and mature leaves; the volatile oil and its chromatographic behaviour, both by TLC and GLC. Dehydration of the leaves is studied using different type of driers.

The leaves of *Murraya koenigii* L have been widely used in Indian cookery for centuries. Earlier also work on chemical composition of leaf and volatile oil has been done[1-11]. There has not been any detailed study on the chemical composition of leaves of different maturity and their dehydration. The present study covers the work on the chemical composition of leaves, dehydration and preliminary work on volatile oil.

Materials and Methods

The leaves were selected from a single tree and collected during the months of March to May. Immediately after picking, the infested, stunted leaves and the stalk were removed and then graded into tender, medium and mature, based on the colour and appearance.

The proximate compositions of the different grades of leaves were determined using standard AOAC methods. The extractives were determined using the Soxhlet extraction apparatus and extracting for about 18-20 hr with different solvents.

The colour of the leaf was determined using a Lumetron photoelectric reflection meter with a tristimulus green filter and search unit 610. The percentage reflectance is reported as Y-value.

The cold water extract was determined by stirring the leaves (chopped) with cold water at room temperature for 1 hr and filtrate evaporated to dryness. For the hot water extract, the leaves (chopped) were boiled in water for 1 hr and the filtrate evaporated to dryness to give the extractive.

Dehydration: The sorted leaves were dried in the sun and also by using cross-flow drier, through flow-drier and vacuum-shelf drier. In all the four types of drying, the tray load was kept at about 50 g/9.3 sq. cm. The temperature of cross-flow drying and through-flow drying was 55-58°C and that of vacuum-shelf drying, 50°C. The maximum temperature in sun-drying was 33°C. The air-velocity in cross-flow drier was 1.5–2.0 m./sec, whereas in through-flow drier, it was 3.5–4.5 m./sec. A mini-model tea drier as through-flow drier was used on these trials.

In the cross-flow and through-flow drier, the leaves dried in 7 hr to a moisture of 4.5–7.0 per cent. Sun-drying was fairly fast, (the material dried up in 3 hr) but the final material was found to be blackish in colour as compared to other types of drying where the colour of the dried sample was light to medium green. The changes in moisture, volatile oil and colour were determined in all the methods of drying.

TABLE 1. COMPOSITION OF THE LEAF (*Murraya koenigii* L.)

Component	Content % Tender	Medium	Mature
Moisture	70.1	65.1	63.2
Total nitrogen	0.87	1.03	1.15
Crude protein (N×6.25)	5.48	6.43	6.92
Fat	3.30	4.74	6.15
Total sugars	14.86	17.95	18.92
Starch	11.4	14.2	14.6
Crude fibre	5.8	6.2	6.8
Ash	12.54	12.68	13.06
Acid insoluble ash	1.20	1.3	1.35
Extractives			
Alcohol	2.00	1.90	1.82
Acetone	1.58	1.36	1.29
Dichloroethane	1.24	2.31	1.91
Petroleum ether	3.28	4.74	6.15
Cold water (20°C)	30.28	28.80	27.33
Hot water (95°C)	35.84	33.90	33.45
Volatile oil	0.82	0.55	0.48
Colour (Y-value)	22.50	21.50	21.00
Appearance	Light green, and shining	Greenish and dark	Dark green

Moisture free basis

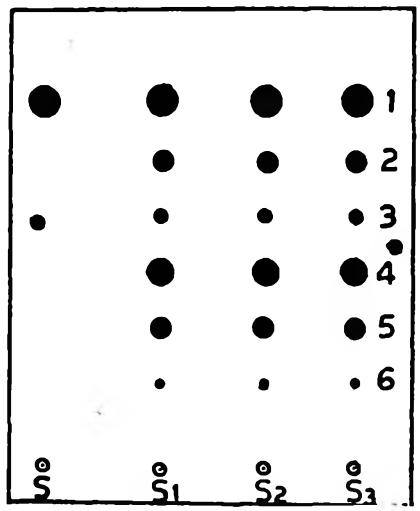

FIG. 1: TLC PATTERN OF CURRY LEAF OIL

S —STANDARD CARYO PHYLLENE
S1—TENDER LEAVES
S2—MEDIUM LEAVES
S3—MATURE LEAVES

Volatile oil: The volatile oil was obtained by steam distillation and the preliminary chromatographic studies were done using thin layer chromatography (TLC) by different solvent systems. The TLC was done using silica gel G (Merck) plates with 250 micron thickness. Samples were spotted at 1μl level and plates developed by spraying with 2 per cent vanillin in alcohol and 0.2 per cent sulphuric acid. Among the various solvent systems used dichloroethane benzene (100:0.5) gave the best resolution. The TLC pattern is shown in Fig. 1.

Using Griffin and George MK 11A Model VPC apparatus the VPC pattern of the oil was obtained. Carbowax (20 per cent) deposited on Celite (90–100) was used as column. Nitrogen was used as a carrier gas at 3 lit/hr. The chromatogram was run at 150°C. The reference standards were caryophyllene, α-pinene and β-pinene and the peaks were identified by comparing their retention time. Oil was injected at 5μl level. The VPC pattern is shown in Fig. 2.

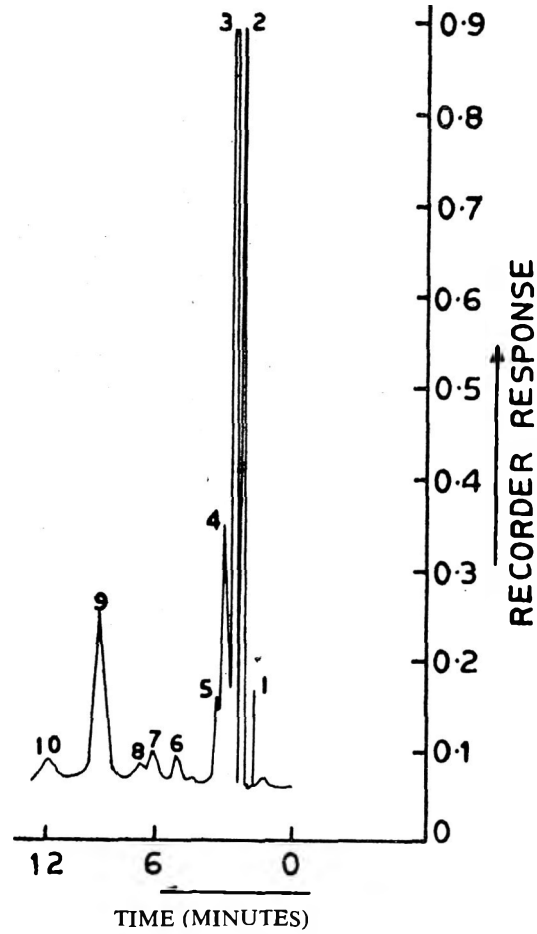

FIG. 2: VPC PATTERN OF CURRY LEAF OIL

TABLE 2. CHANGES IN MOISTURE, VOLATILE OIL AND COLOUR USING DIFFERENT METHODS OF DRYING

Drying	Material	Moisture %		Volatile oil %		Colour	
		Before	After	Before	After	Before	After
Cross-flow drying	Tender	69.0	6.5	0.70	0.79	12.5	18.0
	Mature	64.0	7.0	0.35	0.38	10.0	18.0
Through-flow drying	Tender	70.0	4.5	0.79	0.80	12.5	17.0
	Mature	63.0	5.0	0.65	0.87	10.0	19.0
Sun-drying	Tender	70.0	5.0	0.70	0.80	12.5	20.0
	Mature	65.0	5.0	0.49	0.63	10.0	20.0
Vacuum shelf drying	Tender	69.0	6.0	0.60	0.53	12.5	17.5
	Mature	64.0	5.5	0.42	0.66	10.0	17.0
	Tender+Stalk	64.0	5.0	0.25	0.40	—	14.5
	Mature+Stalk	63.0	6.0	0.25	0.45	—	14.5

Values are on moisture free basis

Results and Discussion

Results of the chemical composition of leaves of different maturities indicate a decrease from tender to mature in alcohol extractives, acetone extractives, cold water extract and volatile oil (Table 1). An increase in the values were noticed in total nitrogen, crude fat, sugars, starch and petroleum ether extractives.

It was found that the yield of volatile oil from the dried leaf was comparatively more than that of the fresh leaf, which indicates that the moisture content plays a role in the release of oil from the leaf. A similar observation has been made on cardamom.

The vacuum-shelf-dried product gave a better green colour and there was complete darkening with other methods of drying (Table 2). Further treatment to preserve the green colour during drying is necessary.

For TLC, dichloroethane–benzene (100;5) gave the best resolution out of all the solvents used. The TLC pattern gave six different spots whereas the VPC pattern indicated nearly ten peaks. Caryophyllene, α-pinene, and β-pinene have been identified in the oil. The presence of β-pinene has not been reported in the literature earlier.

Further detailed studies on characterisation of the oil are in progress.

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Economics of Pressure Parboiling of Paddy

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The economics of pressure parboiling of paddy as worked out at modern rice mill, Tiruvarur is nearly fifty per cent of the expenditure involved when compared to hot soaking and steaming of paddy, besides realizing higher head rice yield with reduced brokens and higher fat content in bran. The difficulties noticed are the development of deeper yellowish brown colour in the pressure parboiled rice and clogging of the polisher sieves by the oil rich bran; these are to be remedied by further research.

Parboiling of paddy has been traditionally practised in India from centuries. Nearly 60 per cent of total rice consumption is after parboiling and the demand for domestic utilization has been steadily increasing. A hot soaking method for parboiling of paddy was developed and has been used in a large number of mills in India[1]. More recently a method of "Pressure Parboiling" has been developed for the paddy[2]. The principle of this method is essentially to wash the paddy in water in a pressure vessel, keep the contents under saturated steam to effect a quick penetration of water into the kernel followed by steaming of the paddy at high steam pressure to effect full gelatinization of the starch. The relative economics of this new method of pressure parboiling as compared with the hot soaking method[3] adopted at the same centre is described in the present study.

The pressure vessel used had a capacity 2.5 tonnes and the vapour phase soaking and pressure steaming were done in the same vessel and were batch operations. The hot soaking method involved 6 parboiling tanks of 5 tonnes capacity each and 4 mechanical driers. The relative costing data on the two processes are summarised in Table 1.

It can be seen from Table 1 that both capital and recurring costs are considerably less in the pressure parboiling process than in the hot soaking method. The capital costs are about 30 percent less. Both labour costs as also the processing costs are also considerably lower. The total parboiling and drying costs worked out to Rs. 13 per tonne in the pressure parboiling process while it was Rs. 25 per tonne in the hot soaking method.

TABLE 1. COMPARATIVE COST ESTIMATES OF PARBOILING UNDER PRESSURE AND HOT SOAKING AND STEAMING

Sl. No.	Particulars	Parboiling	
		Under pressure	Hot soaking and steaming
		Rupees	
A.	*Non-recurring expenditure*		
	Parboiling tanks, raw paddy elevator, belt conveyor, mechanical dryers with one elevator for two dryers and boiler (2.0 tonnes/hr capacity).	3,25,000	4,70,000
B.	*Recurring expenditure per month*		
	Supervisory staff, spares, repairs, etc.	5,300	8,650
C.	*Processing expenditure (Parboiling and mechanical drying) per tonne of paddy*		
	Electricity	1.30	2.95
	Fuel charges (furnace oil)	8.40	16.80
	Total expenditure on the process	9.70	19.75
	Recurring expenditure per tonne of paddy	2.20	3.70
	Non-recurring expenditure per tonne of paddy (depreciation on machinery @10%)	1.15	1.60
	Total cost of parboiling and mechanical drying per tonne of paddy	13.05	25.05

Note: Steam is obtained by using husk as fuel to the boiler. The above figures are subject to variation with fluctuation in cost of material and units.

Other additional advantages of the process are (*i*) the grain becomes quite hard due to pressure steaming resulting in reduced breakage during milling; (*ii*) total processing time is reduced by about 50 per cent and therefore production capacity can be very much increased; and (*iii*) it has also been found that the oil content in the bran obtained in the pressure parboiling system is much higher than that from the hot soaking method.

It has however been found that the rice obtained by the pressure parboiling process has a deeper yellowish brown colour which may be desirable in certain markets, but may be objected to in certain other centres. In view of higher oil content in the bran certain problems of clogging of the polisher sieves have also been noticed. It is however hoped that these difficulties will be remedied by further research work.

Acknowledgement

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RESEARCH NOTES

STUDIES ON HIGH YIELDING INDIAN WHEAT VARIETIES. PART III. FLOUR BLENDING AS A MEANS OF IMPROVING THE BAKING QUALITY

Flour of *Sonalika* and *K*-68 and their blends (containing 10 to 90% *Sonalika* in combination with *K*-68 were studied for farinograph characteristics and baking. The *K*-68 and *Sonalika* varieties showed strong and weak gluten characteristics respectively and produced bread of poor loaf volume. Blends containing upto 40 per cent *Sonalika* showed balanced dough characteristics and bread of good volume could be obtained from them even the blend of 50% *Sonalika* with 40% *K*-68 is just satisfactory though not as good as other blends.

High yielding varieties of wheat are the recent introduction to the Indian agriculture. The varieties differ in their physical dough characteristics and baking quality with soft to strong gluten characteristics. Bakers demand flour of specific strength and baking quality. By blending strong wheat with soft wheat in different proportions flour of desired strength can be obtained. Recently Austin and Singh[1] studied the alveograph characteristics of different blends of *K*-68 and *Pusa Lerma* wheat varieties. Our earlier investigations indicated that *K*-68 has a very strong gluten characteristic while *Sonalika* has weak gluten characteristic. Therefore an attempt has been made to develop suitable blends of *K*-68 with *Sonalika* for the production of bread and the results obtained are reported in this communication.

The straight grade flour used in this study was obtained by milling the *K*-68 and *Sonalika* wheat varieties in a Brabender quadrumat junior experimental mill. The wheat varieties were obtained from the All India Wheat Coordination Programme, IARI, New Delhi and they were grown at Kanpur and Karnal respectively.

For the physical dough characteristic studies, Brabender farinograph employing 50 of flour at 14 per cent moisture basis was used. For baking test straight dough method described in the Cereal Laboratory Methods[2] was used.

Physical dough characteristics: The farinograms of pure wheat varieties and their blends are shown in Fig. 1 and the results are summarised in Table 1. Farinograms show that the *K*-68 wheat variety has strong gluten characteristics and *Sonalika* wheat variety has on the other hand very weak gluten characteristics. Both these varieties are not suitable for baking purpose. Bakers demand a flour of balanced dough characteristics with proportional extensibility and stability. By mixing these two wheats in different proportions, desired dough characteristics can be obtained in the blend. *K*-68 and its blends with *Sonalika* in the ratio 90:10; 80:20; 70:30 and 10:90; 20:80; 30:70 produce the farinograms of strong to weak gluten characteristics. With the increase in proportion of *Sonalika* upto 50 per cent in the blend, increase in stability, decrease in mixing tolerance are noted, later on the stability decreases with the increase in the mixing tolerance and twenty minute drop time. The blends of *K*-68 with *Sonalika* in the ratio of 80:20; 70:30 and 60:40 are very satisfactory while the blends of 50:50 is just satisfactory. The blend of *K*-68 with *Sonalika* in the ratio 40:60 is tolerable.

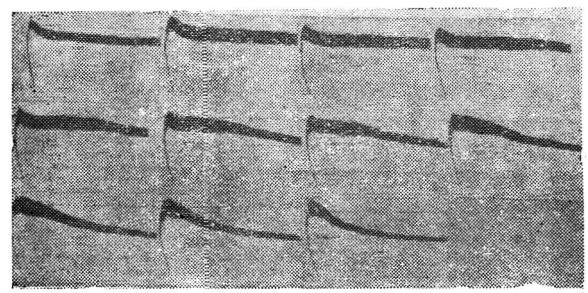

FIG 1. Fairnograms, 1st row from left to right: 100% K-68; 90% K-68 and 10% Sonalika; 80% K-68 and 20% Sonalika: 70% K-68 and 30% Sonalika. 2nd row: 60% K-68 and 40% Sonalika; 50% K-68 and 50% Sonalika; 40% K-68 and 60% Sonalika; 30% K-68 and 70% Sonalika; 3rd row: 20% K-68 and 80% Sonalika; 10% K-68 and 90% Sonalika and 100% Sonalika.

TABLE 1. FARINOGRAPH CHARACTERISTICS OF SONALIKA AND K-68 WHEAT VARIETIES AND THEIR BLENDS

Flour/Blend	STD	MTI	TMD
100% K-68	1.25	90	100
10% S. lika 90% K-68	3.5	70	110
20% S. lika 80% K-68	3.5	70	80
30% S. lika 70% K-68	3.5	60	80
40% S. lika 60% K-68	9.5	40	110
50% S. lika 50% K-68	9.5	40	130
60% S. lika 40% K-68	8.5	50	160
70% S. lika 30% K-68	6.5	50	170
80% S. lika 20% K-68	4.5	100	210
90% S. lika 10% K-68	3.5	130	230
100% S. lika£	2.5	170	250

STD = stablity time in minutes
MTI = mechnical tolerance index
TMD = twenty minutes drop
S. lika* = Sonalika.

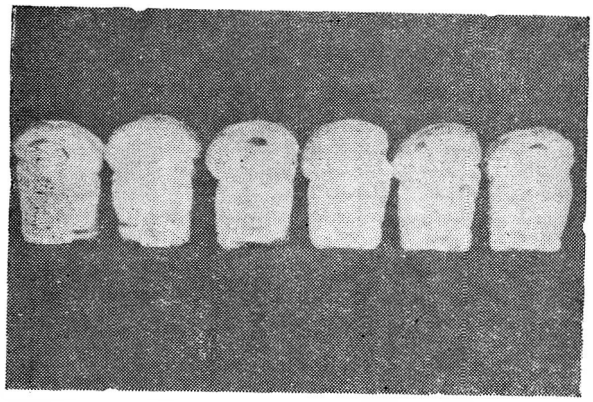

FIG 2A. Bread loaves, from left to right; 100% K-68; 90% K-68 and 10% Sonalika; 80% K-68 and 20% Sonalika; 70% K-68 and 30% Sonalika; 60% K-68 and 40% Sonalika; 50% K-68 and 50% Sonalika.

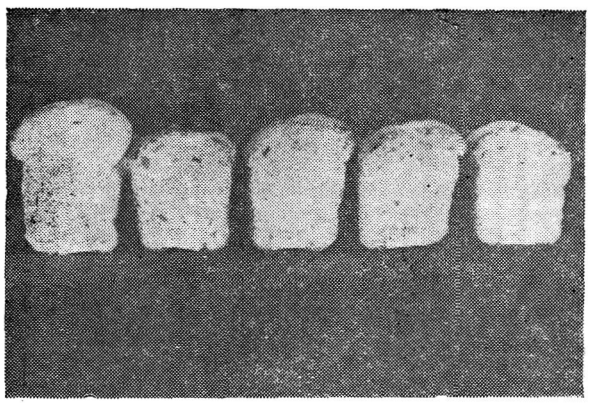

FIG 2B. Bread loaves, from left to right: 40% K-68 and 60% Sonalika; 30% K-68 and 70% Sonalika; 20% K-68 and 80% Sonalika; 10% K-68 and 90% Sonalika; 100% Sonalika.

Baking studies: Baking tests were conducted to determine the effect of blending of the two wheats in different proportions on the baking quality. The bread produced from the two wheats and its blends were shown in Fig. 2 (A and B) and the results are summarised in Table 2.

Bread scoring data as well as the figures indicate that the pure wheat varieties have the poor loaf volume. The grain and texture score are better for *K*-68 flour than *Sonalika.* It is noted from these studies that mixing of *Sonalika* with *K*-68 blend upto 60 per cent increase in loaf volume was obtained. Addition of *Sonalik* in the blend upto 30 per cent resulted in the increase in grain, texture and crumb colour scores. Later on the decrease was noticed in all these characteristics. The *K*-68 and *Sonalika* blends of 80:20; 70:30; 60:40 are very satisfactory in baking quality. Fifty per cent of each in the blend also is just satisfactory. 40:60 blends of *K*-68 and *Sonalika* produced tolerable quality bread. The other blends produced bread loaf of poor quality.

TABLE 2. BAKING QUALITY OF SONALIKA AND K-68 WHEAT VARIETIES AND THEIR BLENDS

Flour/Blends	Volume (100 g flour loaf)	Grain score (out of 15)	Texture score (out of 15)	Colour of crumb (out of 10)
100% K-68	450	7.75	8.0	7.0
10% S. lika 90% K-68	470	8.00	8.25	7.0
20% S. lika 80% K-68	490	8.00	8.25	7.25
30% S. lika 70% K-68	510	8.00	8.5	7.25
40% S. lika 60% K-68	520	7.75	8.0	7.25
50% S. lika 50% K-68	520	7.75	8.0	7.5
60% S. lika 40% K-68	530	6.75	7.0	7.0
70% S. lika 30% K-68	460	6.25	6.0	6.75
80% S. lika 20% K-68	450	6.25	6.0	6.75
90% S. lika 10% K-68	450	6.25	5.5	6.75
100% S. lika	450	6.0	5.5	6.75

Financial support from Wheat Associates of America and Roller Flour Mills Federation of India to one of the authors (SKS) is gratefully acknowledged.

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2 July 1974.

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ISOLATION AND CHARACTERIZATION OF ONION WAX

Onion wax was isolated from ether extract of de-skinned onion by column chromatography and purified by precipitating with methanol. The wax was found to be composed mainly of saturated C_{20} fatty alcohol and C_{16} fatty acid.

The onions contain wax as one of the minor constituents, presumably having a role in protecting the soft tissue from the environmental injury and also perhaps, in retaining the volatile flavour com-

ponents. However, very little information is available on the nature and composition of onion wax. The waxy matter of pigmented outer skin of onion from ether extract was identified as ceryl cerotate[1]. The presence of waxy component was also observed in the ether extract of de-skinned red globe onion[2]. The waxy matter is thus not confined only to the outer skin but also to other tissues of the bulb. The present report relates to some of the characteristics of this wax.

Onion extract was obtained from de-skinned red globe onion (Nasik, Maharashtra) by extracting with peroxide-free diethyl ether according to the method described elsewhere[3]. This extract (0.5 g) was fractionated using petroleum ether (b.p. 60–80°C) as eluting solvent in a glass column (1.5 cm dia × 50 cm length) previously packed with a slurry of 50 g silica gel (BDH) and petroleum ether. The petroleum ether fraction (250) ml containing wax was further purified by precipitating the wax from concentrated solution by methanol. This was followed by washing the precipitate with methanol and finally drying it under high vacuum. The purity of this wax was tested by thin-layer chromatography[2]. Physico-chemical characteristics like melting point, saponification value, iodine value (Wijs) and non-saponifiables of purified wax were examined according to conventional methods[4]. The component fatty acids and fatty alcohols of the onion wax were recovered after saponification with 2N alkali according to usual procedure[4]. The fatty acids were identified by gas liquid chromatography[5], whereas fatty alcohols were analysed by thin-layer chromatography on liquid paraffin impregnated kieselguhr plate using acetone-water (75:25) solvent system[6].

The analytical data of purified onion wax are given in Table 1, which shows that both higher molecular weight fatty alcohols and fatty acids are the constituents of the wax. The yield of onion wax is found to be 15–20 mg per kg of fresh onion. Thin-layer chromatographic analysis of fatty alcohols together with gas chromatographic analysis of fatty acids reveal that the onion wax is composed mainly of saturated C_{20} fatty alcohol and C_{16} fatty acid. However, minor amounts of eventual C_{26} fatty alcohol as well as C_{18}, C_{20} and probably C_{26} fatty acids are also present.

TABLE 1. PHYSICO-CHEMICAL CHARACTERISTICS OF WAX COMPONENT OF DIETHYL ETHER EXTRACT OF DE SKINNED RED GLOBE ONION

	mp C°	SV	IV	% Non-saponifiable	% Saponifiable
Wax	69–70	112.9	Nil	42.0	58.0
Non-saponifiable	70.5	—	—	Fatty alcohols	—
Saponifiable	64–65	—	—	—	Fatty acids

mp = melting point,
SV = Saponification Value
IV = Iodine value

The authors wish to thank Dr B. G. Nadkarni for helpful suggestions.

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EFFECT OF AGE, SEX, SEASON AND LIVE WEIGHT ON DRESSING PERCENTAGE OF GOATS*

Dressing percentage was maximum in male goats of 25-30 kg and females of 10-15 kg. Season did not affect the dressing percentage. Different age groups did not significantly affect the dressing percentage of males, but in females dressing percentage was lower at higher age. More male goats are offered for slaughter at ages less than 1 yr than females.

Dressing percentage of meat animals depends on species, level of nutrition, breed, sex, season and live weight[1]. The relationship of age, sex, plane of nutrition and live weight in sheep has been studied by Chatterjee *et al.*[2]. Singh and Mathur[3], Jarnail Singh *et al*[4]. and Ghanekar *et al*[5]. Johari and Talapatra[6] studied the correlation between age, sex and live weight and dressing percentage in Jamunapuri goats

* Part of the M. V. Sc. thesis submitted by senior author to the G. B. Pant University of Agri. & Tech., Pantnagar in the year 1972.

using a small number of animals. In the present work 508 non descript goats of both sexes ranging in weight from 10 to 30 kg brought for slaughter in the Pantnagar slaughter house were used. The animals brought for slaughter are from the surrounding Tarai region and are generally called animals with unknown feeding history and of ages ranging from less than a year to 4 years. 305 animals were examined in winter and the rest in summer.

The animals were examined antemortem to decide their fitness for meat purposes on the day of purchase, kept without feed but with water till slaughter on the next day. The live weight of the animal and age based on dentition were recorded just before the slaughter. After slaughter, bleeding, skinning and eviseration, the weight of the dressed carcass, pluck, abdominal viscera, skin and head and legs were recorded for each animal. The data collected have been grouped on the basis of 4 live weight groups and 4 age groups to examine their correlation with dressing percentage (Table 1).

The maximum dressing percentage was obtained in male goats of 25–30 kg in winter as well as summer. The difference between the dressing percentage in the two season was not significant. In the case of females, there was no significant difference in dressing percentage in the two seasons but the maximum was observed in the weight group 10–15 kg. While male goats showed a positive correlation of 0.35 and 0.19 in winter and summer to live weight, females showed a negative correlation of 0.14 and 0.17.

The dressing percentage of males in the different age groups was not significantly different in both seasons. But in the case of females the dressing percentage was lower at an higher age. This probably is due to the fact that the females offered for slaughter are no longer useful for breeding. In females the nutrition available goes more for rearing of young kids than for muscle formation. Correlation between age and dressing percentage was positive (0.08 and 0.29) for males and negative (0.28 and 0.36) for females.

In both the agewise and weightwise groupings the dressing percentage in males was higher. Another inference that can be drawn from the data is that more male goats are offered for slaughter at ages less than 1 yr. than females. This is probably due to the practice of retaining only the vigorous and thrifty-males for breeding purposes and culling the others for slaughter. The average age in months of males for the four weight groups was 7.5, 11, 13 and 17 while for females it was 10.5, 25, 31.5 and 37.5. The weights of the different offals do not add anything significant to the conclusion, but were estimated to get a general idea of the by products encountered for profitable utilisation and disposal. The utilisation of by products and disposal of wastes is an important economic factor in slaughter house operation.

TABLE 1. RELATION OF AGE, WEIGHT, SEX AND SEASON WITH DRESSING PERCENTAGE IN GOATS

Live weight	Sex	No.	Dressing % Mean ± S.E.
Winter			
10–15 kg	Male	20	47.4 ± 0.6
15–20 kg	Male	47	50.1 ± 0.4
20–25 kg	Male	16	51.9 ± 0.7
25–30 kg	Male	3	53.2 ± 2.2
10–15 kg	Female	42	44.2 ± 0.4
15–20 kg	Female	81	43.7 ± 0.3
20–25 kg	Female	63	43.7 ± 0.3
25–30 kg	Female	26	42.1 ± 0.5
Summer			
10–15 kg	Male	32	48.8 ± 0.4
15–20 kg	Male	33	49.2 ± 0.4
20–25 kg	Male	17	50.7 ± 0.6
25–30 kg	Male	2	52.8 ± 2.0
10–15 kg	Female	25	44.9 ± 0.6
15–20 kg	Female	52	44.0 ± 0.4
20–25 kg	Female	32	43.4 ± 0.5
25–30 kg	Female	8	42.9 ± 0.8

Age	Sex	No.	Dressing % Mean ± S.E.
Winter			
Less than 1 yr	Male	83	50.2 ± 0.3
1–2 yr	Male	5	51.4 ± 1.3
2–3 yr	Male	—	—
3–4 yr	Male	—	—
Less than 1 yr	Female	66	45.5 ± 0.3
1–2 yr	Female	70	44.2 ± 0.3
2–3 yr	Female	57	42.2 ± 0.4
3–4 yr	Female	24	41.6 ± 0.5
Summer			
Less than 1 yr	Male	76	49.3 ± 0.3
1–2 yr	Male	8	51.2 ± 0.9
2–3 yr	Male	—	—
3–4 yr	Male	—	—
Less than 1 yr	Female	48	46.4 ± 0.4
1–2 yr	Female	—	—
2–3 yr	Female	42	43.2 ± 0.4
3–4 yr	Female	29	41.9 ± 0.5

The first author is grateful to the Indian Council of Agricultural Research for providing Junior Fellowship during the period of this investigation. Authors wish to thank to Dr N. S. Datt, Dean, College of Veterinary Medicine for providing facilities for conducting the present work.

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ERRATA

A Note on New Chromogenic TLC Spray Reagents for the Detection of Some Organo Chlorine Pesticides, by B.K. Mehrotra, S.P. Katrola and S. Ramanujam, 1974, 11(4), 199. Fig. 1 entitled 'TLC of organophosphorous pesticides' is inadvertantly included and this should not be taken as a part of the research note. The name of one of the authors should be read as S. P. Katrolia instead of Katrola.

Food Service Equipment: by Anna Katherine Jernigan and Lynne Nannen Ross, Iowa State University Press, Press Building, Annes, Iowa 50010, 1974, pp. 122; Price $ 3.95.

This book provides information in detail for the selection, location and proper utilization of food service equipment, required by restaurants (big and small) and School Food Services.

The subject matter is covered in nine chapters coverin gaspects like guidelness for proper construction of food service buildings, raw materials receiving and warehousing, food preparation equipment including type of heating arrangements, refrigeration and other needed facilities.

Preparation equipment like ovens, steam and electrically heated kettles, mixers, fat frying equipment are all discussed, including their layout for efficient and convenient operation.

Serving aids like conveyors and carts, with detailed description of different types, are all outlined.

Various types of cleaning and sanitizing equipment are also described, including disposal units.

The concluding chapter describes other small equipment like pans, racks, knives, spoons, laddles and spatulas, etc., required by food service facility and outlines method of preventive maintenance programme for all the equipment.

This book will be of some use to people who are responsible for selection of equipment required by hospitals, health kitchens and restaurants on the western style.

B. S. RAMACHANDRA

Texture Measurements of Foods: Amihud Kramer and Alina S. Szezesniak, D. Reidel Publishing Company, Dordrecht-Holland, Boston-U.S.A., 1973, pp. xiii+175; Price, $ 16.50.

This is a valuable book on texture, a complex food attribute contributing to food selection and acceptance. Appropriately the task of bringing out an authoritative and comprehensive document has been accomplished by the coordinated efforts of specialists from the many disciplines involved in objective and subjective food texture measurements, under the auspices of the American Society of Testing Materials.

As could be expected from a group associated with a standards organization the task of classifying existing usage and meanings of texture terms and relation to other sensory quality attributes and giving a precise definition is admirably and concisely done in the first chapter. It further considers briefly, problems of objectively measuring texture parametres and correlating them to the total concept of sensory texture.

Avoiding too academic approaches, the physiological aspects of texture perception, rheological concepts, structure of foods as they influence rheological properties and their relation to aspects of food texture are reviewed comprehensively and concisely in chapters II, IV & V. These chapters clearly indicate that inspite of much progress in the understanding of basic phenomena underlying the multidimensional nature of textural properties of food, the attribute as a whole is best evaluated by sensory evaluation, with all its limitations of methodology and psychophysiological problems. Sensorily evaluated texture also remains the reference point (s) by which data from other objective methods can be judged for accuracy and relevance. Chapter III critically and neatly reviews the different sensory tests, from simple difference to complex profile tests, their areas of application and the care to be taken in choosing and conducting the tests.

Instrumental methods of measuring food texture has been in existence since early twentieth century primarily developed as a quality control measure for raw materials, process and product. The many mechanical devices attempt to measure the resistance of the food to applied force which should be relatable to the sensorily perceived effect. The developments in sophisticated instrumentation now available are all based on our understanding, that texture is a composite of several parameters and of the many variables that affect the relation between the application of force and measure of resistance. The developments of instrumental methods are critically reviewed in chapter VI by one of the editors who herself has been responsible for development of one of the instruments and a subjective method which can be used to get a comprehensive picture of the total texture of foods. Particularly useful appendices to this chapter are the lists of many named apparatus in literature and a list of commercially available equipment with addresses of the manufacturers/distributors. In such a

comprehensive list one wonders why some of the instruments recently developed for nondestructive testing, such as resonance and compressibility are not mentioned. The texture of some foods, judged by sight is also omitted, possibly because of the definition proposed to be adopted for texture as 'the sensory property relating entirely to senses of touch and feel'. Chapter VII, summarizes the useful indirect objective methods related to texture measurement. The methods have been more useful in research work than as practical methods for texture evaluation.

Quantification of sensory experience is the real problem of sensory evaluation and much attention is now being paid to this area in defining the relevant terms, in the development of scales of measurement and in establishing relationships between physical measurements and total subjective perception. Psychophysics, as this area is called is reported in chapter VIII, in its infancy and the authors predict significant developments of much promise.

The aim of analytical groups being to evolve quick, reproducible objective methods for purposes of quality control, the correlation of instrumental results to that of subjective results is very important. Selected theoretical and practical procedure of association between the two types of data, correlation and regression and sources and inherent problems in improving these relationships are reviewed critically and comprehensively in the final chapter.

All the references mentioned, essentially from english publications, are collected into a bibliography at the end and is convenient. The book is produced excellently. It is recommended as a must for all interested in food science and technology.

V. S. GOVINDARAJAN

Packaging Stations for Fruits and Vegetables: International Institute of Refrigeration, 177, Boulevard, Malesherbes, 75017, Paris, 1974, pp 305; Price: $ 12.

The working group on "packing stations for fruits and vegetables" initiated by the technical board of the International Institute of Refrigeration with representatives from Commission IV and V has brought out this report based on several meetings of the Commission since 1966. The publication is printed in Engilsh and French for the benefit of member countries and to many people interested in packing stations, producers, traders and administrators alike.

Based on the expertise of the Commission members and for the benefit of the reader, the report is divided into 17 chapters. The first 8 chapters deal with general principles such as introduction, lay out, management, grading and packing rooms, the cold store, precooling requirements, facilities for refrigeration during transport and economical aspects of the packing houses.

Rest of the chapters deal with important commodities such as apples, pears, citrus, grapes, peaches, bananas, tomatoes, potatoes and onion wherein general principles regarding quality, harvesting, packing, cooling, storage, post-storage treatments and storage disorders are discussed in depth.

Latest developments in post-harvest problems of fruits and vegetables and low temperature technology in packing house operations are discussed in the light of suggestions and recommendations made by the Commission members in several of their meetings.

Naturally this report from a premier organisation like International Institute of Refrigeration, should find a place as standard reference, in Government and Administrative Managements besides, for all those interested in fresh fruits and vegetables.

H. SUBRAMANYAM

Recommended Conditions for Land Transport of Perishable Food Stuffs: (Revised 3rd Edition) International Institute of Refrigeration, 177, Boulevard, Malesherbes, 75017, Paris, 1974, pp. 42, Price: $ 3.

The revised third edition on the "Recommended Conditions for Land Transport of Perishable Foodstuffs" released by the International Institute of Refrigeration is a compendium of the discussions on draft proposals by the members of the commission D-2. This summarises good practises that are adopted in refrigerated transport of perishable foods without involving in contreversial aspects.

The recommendations are provided briefly in English and French and deals with definitions of various foods, transport vehicles, loading and unloading operations and optimum temperature during transport for different foods.

Definitions of standards for special equipment, specifications of thermal containers, scheme for measuring the temperature of a cargo are dealt in brief in the 3 annexures.

The organizational management system, objectives, activities and publications of the Institution, described here, serve as useful guidelines for all concerned in the growth and welfare of the International Institute of Refrigeration.

H. SUBRAMANYAM

Toxicological Evaluation of Some Food Colors, Emulsifiers, Stabilizers, Anticaking Agents & Certain Other Substances: (Seventeenth Report of the Joint FAO/WHO Expert Committee on Food Additives); WHO, 1211, Geneva, 27, Switzerland, 1974, pp. 40 Price: Sw. fr. 5.

This is a collection of monographs resulting from the deliberations of the Joint FAO/WHO Expert Committee at Rome from May 27 to June 4, 1969, on the toxicological evaluation of a number of food additives. The report has been organized into an introductory section defining the types of ADI (Acceptable Daily Intake)—conditional, unconditional and temporary—assigned to the various food additives, followed by a series of Tables summarizing the actual limits and types of ADI allocated by the Committee.

The toxicological data have been considered critically and in more detail in a series of monographs on individual substances in the following pages. Each monograph follows a general pattern of discussion under the broad heads—'Biological data', Comments, Evaluation and References, the 'Biological data' comprising (wherever available) data on biochemical aspects, acute toxicity and short and long term animal experiemental studies. The comments attempt to weigh the experimental evidence in relation to the toxicity of the additive so as to arrive at a fair evaluation i.e. the allocation of the appropriate ADI.

In cases where biological data are inadequate, temporary ADI's are recommended and additional data are asked for within a prescribed time limit to settle the issue one way or other. Wherever the available data clearly establish the hazardous nature of an additive e.g. citrous red-2 (p. 30) the material is categorically excluded from acceptance. When the data are extremely scant as in the case of carob bean gum (p. 99) or distarch phosphate (p. 78), judgement is withheld as "not possible on the data available."

In an area like Food Additives where national legislations are far from uniform and where the safety and well-being of the consumer, irrespective of nationality, should be of prime concern, it is gratifying that the FAO/WHO have been addressing themselves to the task of formulating international specifications of purity standards as well as of the safe acceptable daily intake of Food Additives. These recommendations would provide guidelines for National Agencies to revise or modify existing regulations to fall in line with uniform international codes and standards.

It may be relevant to comment on the 'temporary' acceptance accorded to certain additives like turmeric (and annatto) for which additional data have been called for within a specified time limit. The temporary status, in any event is not likely to continue indefinitely and may even be withdrawn. It may, therefore, be in the national interests of developing countries (including India) which happen to be the producers of these commodities and which have a major stake in the export trade of these materials to be aware of and alert to this situation and to sponsor research aimed at collecting additional toxicological information regarding the safety of these materials, which have been traditionally used for generations as food additives.

It is suggested in the Introduction that this report is to be read in conjunction with a companion volume (13th Report of the Joint FAO/WHO Expert Committee on Food Additives, in press). The publication is an important document which should find a place in the Libraries of Educational as well Research Institutions dealing with Food Science and also of Government establishments concerned with food additives regulations and food law enforcement.

N. P. DAMODARAN

Seminars

The following Seminars were arranged in collaboration with CFTRI at the head quarters.

Dr E. Graham Bligh, Director, Fisheries Research Board, Halifax Laboratory, Canada, delivered a lecture on "Challenges in seafood technology" (15th Oct. 1974).

Prof. T. Drawert, Professor of Food Technology, Institute of Analytical Chemistry and Food Technology, University of Munich, Germany delivered 5 lectures on (1) "Organisation of food science and technology research in Germany, (*ii*) "Biogenesis of flavours"; (*iii*) "Isoelectric processing of protein and its application to classification" (*iv*) "Radio chromatography in flavour analysis" and (*v*) "Volatile compounds in fermented beverages. (21st, 23rd, 29th October and 5th and 7th November 1974).

Prof. Dr. med. K. H. Plattig, Physiologisches Institute, University of Enlangen, Nurenberg, delivered a lecture on "Physiology of perception of odour and taste" (6th November 1974).

The Eastern Regional Branch of the Association in collaboration with the Institute of Standards Engineers, Calcutta, conducted a group discussion on "Standardization and Quality Control in Processed Fruits and Vegetable Products", at Calcutta Management Association Auditorium, Calcutta (11th September 1974).

The Hyderabad Chapter of the Association conducted a get togehter to hear a talk on "Comprehensive Nutritional Study Systems" from Mr. S. Rajagopalan, Officer on Special Duty, Govt. of India, Ministry of Agriculture, Dept, of Food, at Food Crafts Institute Hyderabad (7th November 1974).

Minutes of the Meeting of the Bangalore Chapter held on 17th September 1974.

At the request of the Secretary, Shri Bhavani Shankar Rao was kind enough to take the Chair.

Introducing Dr N. N. Dastur to the members, the Secretary, observed that Dr Dastur was too well-known to warrant an introduction and requested him to address the Association.

Speaking on "Dairy Industry", Dr Dastur observed that India was one of the largest and the oldest agricultural countries in the world, where agriculture was the main stay of the millions of people and where a person's social and economic position was judged by the number of cattles he owned and the milk produced. He went on to say that food habits of the Indians were such that milk formed the bulk of their diet.

Explaining the uses of milk, Dr Dastur said that milk was a perfect and wholesome food containing all nutrients essential for body building, repair and energy, but cautioned that utmost care should be taken while consuming and preserving milk as it is an excellent food for bacteria and could promote "Tuberculosis" if proper precautions are not taken. Narrating the stages at which milk could attract contamination, he emphasised the need for maintaining high standards of hygiene and cleanliness in a Dairy Industry. Coming to the Dairy Industry, Dr Dastur said that it was a sophisticated Industry which helped to preserve and produce many by-products like butter, cream, cheese, milk powder, curds, condensed milk, etc. Explaining the beauty of the balance of Nature, Dr Dastur said that the cattle while ate what man did not eat, gave back in return milk essential to every human being. Dairy Industry he said was being run as a cottage Industry confined to families or localities the products of which never reached others. Refuting the oft repeated allegation that the Dairy Industry was charging exorbitant rates for its products, Dr Dastur explained that the following factors contributed to the high selling prices. (1) Capacity of the milk dairy and the amount of milk consumed, (2) cattle and the food available for them, (3) Scarcity of cattle feed in India, (4) production cost, (5) purchase of milk powder, etc. to maintain the fat consistency, (6) problem of transportation of milk to rural areas, (7) improper care of the cattle and (8) the reverence held by the Indians for the cow.

He said that about 150 dairy plants were installed in India, many with some foreign collaboration. But most of them did not work satisfactorily due to inadequate supply of milk and were producing about 20,000 litres milk per day, which is wholly unsatisfactory. He therefore emphasised the need to step up the production of milk so that the daily requirements of millions and millions of people could be met. He also pointed out that buffalo milk was equally good if not better though its meat was not acceptable in India.

The talk was followed by an interesting discussion and at the end Shri Bhavani Shankar Rao thanked the Speaker for the informative lectrue given by him.

Minutes of the Meeting of the Bangalore Chapter held on 15th October 1974

The Secretary requested Dr Dastur to take the Chair and Shri Bhavani Shankar Rao to address the members.

Shri Bhavani Shankar Rao commenced his address saying that his talk would be confined to the poor, the sick and the under previleged sectors of the society who were mostly ill-fed and who cannot afford even a single meal a day. He narrated how the urchins crowded around dust bins and municipal markets to grab whatever they can to fill their hungry stomachs. He strongly felt that this category of people should be taken care of and educated by the Association and others who are in charge of the Food-Service.

Continuing, he said such people should be enlightened as to the cheap source from which their food requirement could be made. Explaining further, he said that carbohydrate requirement of these people would be fully met by advocating the use of ragi, maize, colocacia, tapioca, edible canna, amarphophyllus and other tubers. Ragi, maize, etc., he observed when pounded would make the food easily digestible and palatable. Similarly he said that proteins could be got from horse gram, Bengal gram, and groundnut; fat from ground nut oil; mineral salts from green vegetables and vitamins from cheap fruits like guava, banana, etc. He strongly advocated the use of sprouted grams to enrich the food and the use of ground nut milk and curds in place of cows milk and curds which have become very expensive. Explaining how the Association could help these under previleged people who mostly live in villages, he suggested giving demonstrations in villages with the assistance of Gram Sevakas & Sevikas with regard to preparation of ground nut milk, ground nut curds, *kosambaris*, *huri hittu*, *hurigalu*, etc. He also suggested the starting of *gana* (oil mill) in every village to enable the villagers to make use of them for extraction of oil, the meal being used for cattle feed.

Concluding he said that every one concerned should fight this enemy and come to the rescue of lactating women, pregnant women and school going children and see that their food requirements are procured at a low price. Starting of vegetable gardens in every house in a village would go a long way in augmenting their food requirements, he said. He strongly advocated that people should stop criticising Government Planners and others and that every one should work in the interest of the Society and try to eradicate poverty completely. This was followed by interesting discussion and Dr Dastur thanked the Speaker for the address.

New Members

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Mr. C. M. Mehta, Britannia Sea Foods, C-36, Road No. 28, Wagle Industrial Estate, Thana-400 604.

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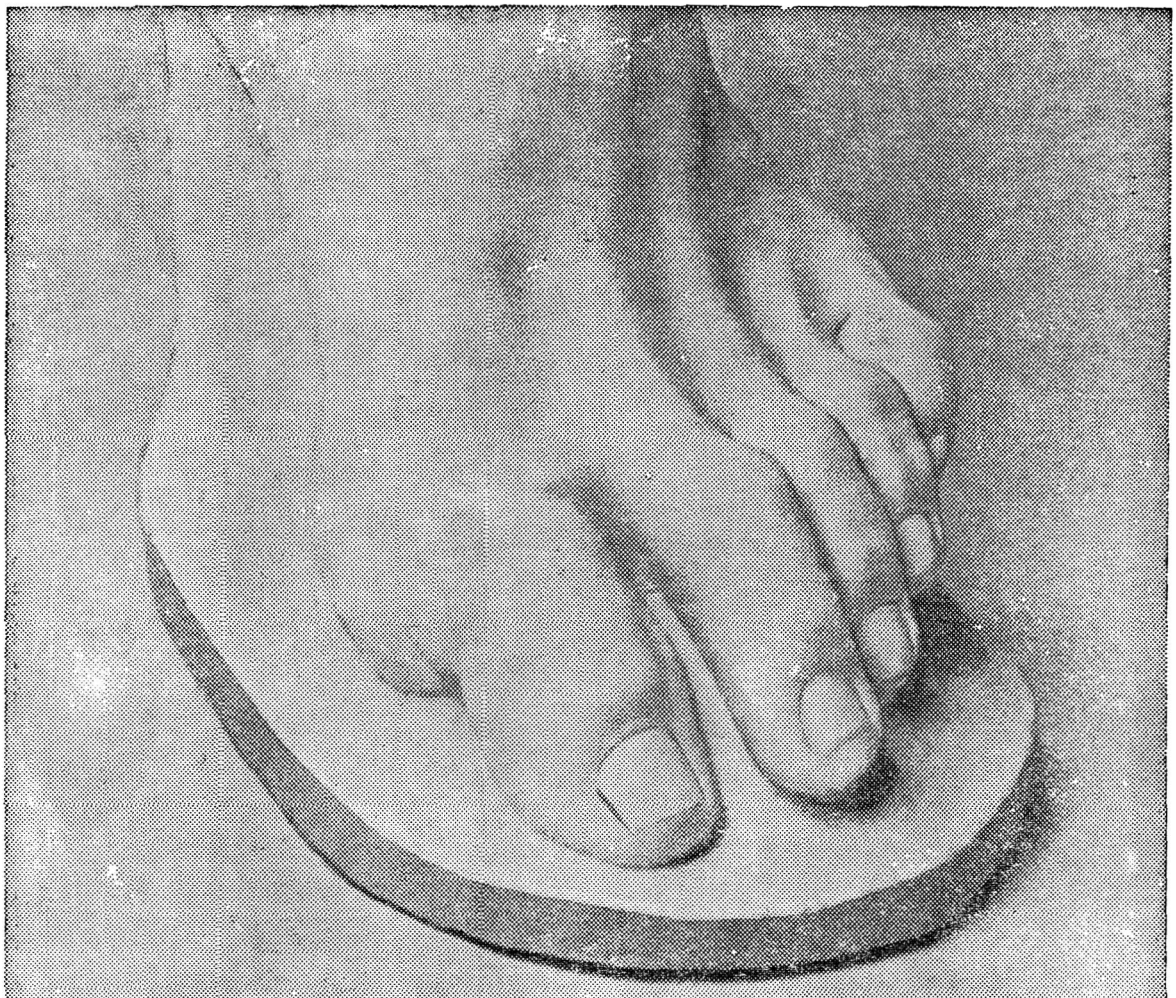

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