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(INDIA)

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CONTENTS

Research Papers

Research Notes

The Effect of Gamma Irradiation on Microbial Load and Sensory Evaluation of White Pomfret and Indian Mackerel Fishes

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Manuscript Received: 13 *November* 1975

Irradiated (150 Krad) white pomfret (*Stromateus cenereus*) and Indian mackerel (*Rastrelliger kanagurta*) as eviscerated whole packed in polyethylene pouches and held at ice-temperature (0-2°C) were examined for their storage life and bacterial flora. The extent of storage life was determined by sensory evaluation and total bacterial counts. It was observed that bacterial groups having high proteolytic activity and those producing H_2S were increased throughout the storage period. The irradiated white pomfret and Indian mackerel in ice remained in good condition for 15-20 days. The suitability of drip for determining total bacterial count and for assessing the keeping quality in these fishes were also examined.

Gamma radiation has been used in radurization processes for fish as well as other foods[1-2]. Food borne microorganisms differ greatly in their radiation sensitivities[3-4]. The qualitative and quantitative differences in the microbial patterns varied mainly upon the dose of irradiation, storage period, packaging conditions and the types of sea-foods irradiated[5-6]. The current radurization process stipulates radiation dose in the range of 100-200 Krad and strict maintenance of temperature below 3°C. The present research in collaboration with Bhaba Atomic Research Centre, Bombay was carried out to study the effect of radiation on the microflora of eviscerated white pomfret and Indian mackerel (whole) during storage and distribution at ice-temperature (0-2°C). The effect of drip for assessing the hygienic quality of such fish has also been examined.

Materials and Methods

White pomfret (*Stromateus cenereus*) and Indian mackerel (*Rastrelliger kanagurta*) used in these experiments were collected from Bombay market and processed as follows at Biochemical and Food Technology Division of Bhaba Atomic Research Centre, Trombay.

Fish were eviscerated, washed, sealed in polyethylene pouches and irradiated in Co^{60} Food Package Irradiator (Atomic Energy of Canada Ltd.) at a dose of 150 Krad. Irradiated as well as unirradiated fish were packed in insulated ice box with a fish to ice ratio of 1:3 to 1:4 and transported by rail to the Jadavpur University, Calcutta. Samples received on 3rd to 4th day of processing, were held in ice at 0-2°C till examined for the sensory evaluation and bacterial flora at intervals of 7 days. The drips formed in both irradiated and unirradiated white pomfret and Indian mackerel were measured and evaluated for determining bacterial load in the fish samples.

Sensory evaluation: Sensory evaluation has been used to determine the acceptable shelf-life of irradiated and unirradiated samples from the two batches of white pomfret and Indian mackerel. Irradiated and unirradiated fish were cooked in 0.85 per cent salt solution and served to a panel of seven members. Cooked samples were assessed for texture, colour, odour and flavour and the results were scored on a ten-point scale with a score of 5 as the limit of acceptability.

Bacteriological examination: The bacteriological examinations of fish as well as that of drips were carried out by the standard procedure of Bhadra *et al.*[7].

Results and Discussion

Measurement of drip loss: Table 1 shows the amount of drip collected at intervals of 7 days in irradiated and unirradiated white pomfret and Indian mackerel from the two batches. Irradiated samples consistently showed 5 to 10 times higher drip than in controls.

Sensory evaluation: On the basis of scoring units computed for sensory evaluation, a score of 5 as the critical level of spoilage for radurized white pomfret and Indian mackerel, storage life for the processed fish was estimated to be 26-28 days as against 10-12 days for the unirradiated samples stored at 0°C (Fig. 1 and 2). Fig. 1 and 2 show that acceptability of irradiated samples tended to prolong at near the border line while in unirradiated samples it ended abruptly.

Bacteriological examination: The changes in total bacterial counts occurring during storage of the muscle and drip of white pomfret and Indian mackerel are shown in Table 2. On the seventh day of storage, bacterial counts in the irradiated white pomfret muscle were 10^3 per gram and in the irradiated mackerel muscle were 10^5 per gram. The counts in the control samples of white pomfret and mackerel fishes were 10^4 and 10^5 per gram respectively.

TABLE 1. FORMATION OF DRIP IN CONTROL AND IRRADIATED (150 KRAD) WHITE POMFRET AND INDIAN MACKEREL HELD AT 0-2°C

Storage period (days)	Drip (ml) formed/100g of fish muscle			
	Control		Irradiated	
	Batch I	Batch II	Batch I	Batch II
White Pomfret				
7	2	4	12	15
14	10	6	16	15
21	3	9	20	22
28	7	a	25	26
35	4	2	30	28
Indian Mackerel				
7	5	2	25	30
14	2	4	26	26
21	3	a	25	28
28	4	10	22	30
35	a	3	26	27

a—Insignificant

TABLE 2. TOTAL BACTERIAL COUNTS IN IRRADIATED AND UNIRRADIATED WHITE POMFRET AND INDIAN MACKEREL DURING STORAGE (0-2°C)

Storage period (days)	No. of bacteria growing at 31°C in			
	One g. of fish muscle		One ml. of drip	
	Irrd.	Control	Irrd.	Control
White Pomfret				
7	3.6×10^3	2.7×10^4	3.7×10^3	3.1×10^4
14	6.2×10^5	2.2×10^6	5.5×10^5	2.8×10^6
21	4.4×10^6	7.8×10^7	4.2×10^6	7.4×10^7
28	7.1×10^7	—	6.5×10^7	—
35	6.0×10^8	—	7.7×10^8	—
Indian Mackerel				
7	2.3×10^5	3.1×10^5	2.0×10^5	2.7×10^5
14	1.4×10^6	6.4×10^6	1.1×10^6	5.5×10^6
21	1.3×10^7	8.1×10^7	2.0×10^6	8.3×10^7
28	6.5×10^7	—	7.1×10^7	—
35	5.1×10^8	—	4.0×10^8	—

The bacterial counts in the drip of white pomfret and Indian mackerel samples both irradiated and control were of the same order as those in fish muscle. Total bacterial counts could, therefore, be determined with reasonable accuracy using simple method of plating serial dilutions of drip formed in the pouches. An identical approach using Ringer's solution has been shown to be useful for determining total bacterial counts[8].

In unirradiated and irradiated samples of both white pomfret and Indian mackerel there was increase in the counts during the storage period but the rate of increase

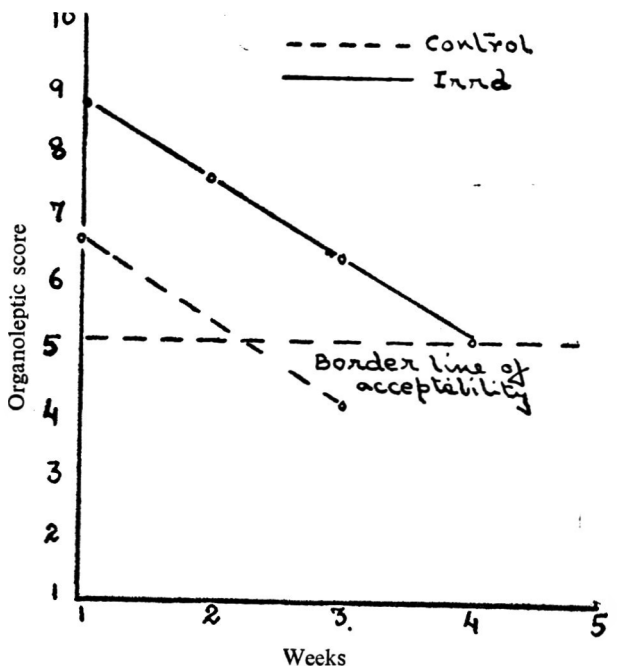

FIG. 1. Organoleptic scores of radurized (150 Krad) white pomfret during storage at 0-2°C.

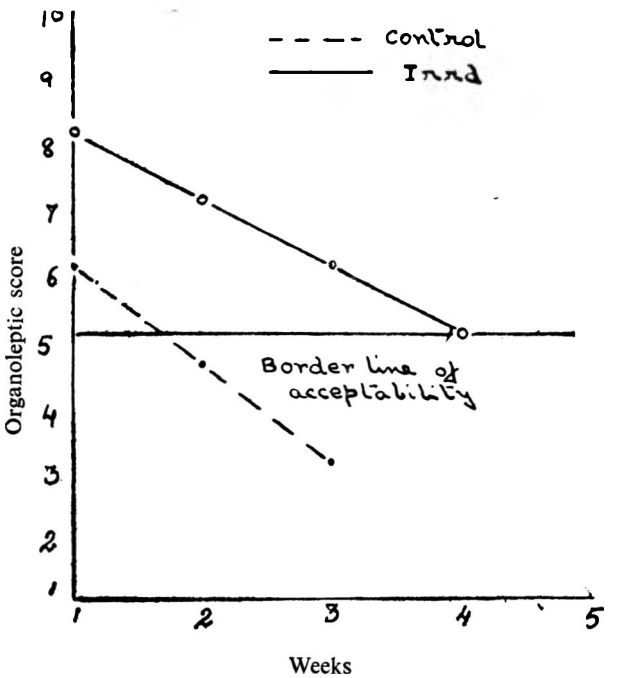

FIG. 2. Organoleptic scores of radurized (150 Krad) mackerel during storage at 0-2°C.

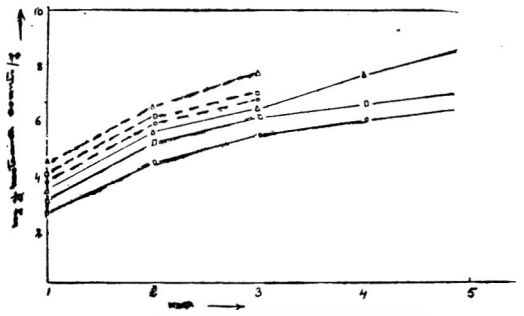

FIG. 3. Changes in proteolytic and H_2S producing bacteria in relation to total bacterial counts in radurized white pomfret during storage at 0-2°C.

— △, TBC; — □, Proteolytic bacteria; — O —, H_2S producing bacteria. —, Irradiated; - - -, Control.

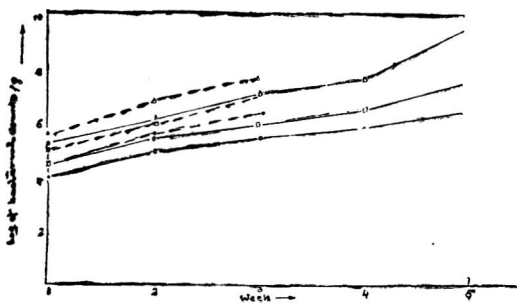

FIG. 4. Changes in proteolytic and H_2S producing bacteria in relation to total bacterial counts in radurized mackerel during storage at 0-2°C,

— △ —, TBC; — □, Proteolytic bacteria; — O —, H_2S producing bacteria. —, Irradiated; - - -, Control.

in the counts was higher upto 14 days of storage in the white pomfret than in the Indian mackerel. Similar effect was observed in irradiated haddock and cod[9], petrale sole[10], and kingcrab[11]. Bhadra *et al.*[7] also observed the same effect on Bombay duck. They emphasized that this effect was due to the post irradiated flora being metabolically less active so that greater numbers were needed to produce an equivalent amount of spoilage. In irradiated white pomfret and Indian mackerel, proteolytic and H_2S producing bacteria increased along with total counts throughout the storage period. However, increase in these counts paralelled the increase in total bacterial counts seen in 1st to 3rd week in white pomfret and in 1st to 4th week in mackerel. Comparison between total bacterial counts and bacteria producing proteolysis and H_2S from one batch of white pomfret and one batch of Indian mackerel are shown in Fig. 3 and Fig. 4 respectively. These observations showed that the spoilage potential of the irradiated fish tissue both of white pomfret and Indian mackerel was of the same order as that of controls.

Acknowledgement

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Gerber Method for Determining Fat Content of Milk without Centrifuging

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A modification of the Gerber method for determining fat content of milk without centrifuging is described. The butyrometer tube after mixing the contents was held in hot water at 87 ± 2°C for 30 min before recording the fat content. This compensated the deficiency in the fat level which closely corresponded with the value obtained by centrifuging. Comparisons were made of the fat contents of 227 milk samples analysed by the two methods. The coefficients of correlation between the fat values, were +0.971 and +0.998 respectively for cow and buffalo milk.

Gerber method is recognised as the standard analytical method of determining fat content of milk. Kothavalla *et al.*[1] reported normal Gerber results, without centrifuging, by allowing the butyrometer with mixed contents to stand at room temperature for 8 hr followed by immersion in hot water at 71.1°C for 5 min. According to the authors the holding time of 8 hr could be reduced to one hour if the butyrometer was held in the water bath maintained at 90.5°C and the immersion time extended by 20 min. Gentilini[2] reported similar degree of accuracy, without centrifugation, by immersing the butyrometer tube in water bath at 80°C for 105 min using sodium salicylate solution in place of sulphuric acid as prescribed in the Gerber method. The present investigation was undertaken to explore the possibility of further reducing the time gap without affecting accuracy of the results. Holding the butyrometer, after mixing the contents, in hot water at 87±2°C for 30 min stabilized the fat column and resulted in the values which closely agreed with those of the Gerber method using the centrifuge.

Materials and Methods

The samples of milk were collected from the daily milkings of the Punjab Agricultural University dairy herd. There were 227 samples comprising 120 of buffalo milk and 107 of cow milk. These were analysed by the Gerber method employing the centrifuge, as recommended by the Indian Standards Institution[3-5] and by the modified method after standardising the procedure which made possible the elimination of the centrifuge in the test.

The effect of variables such as time and temperature of the water-bath on the fat column in the butyrometer tube held in water with stoppered-end downward, was investigated to optimize the time and temperature combination that would adequately compensate the errors and bring the fat level close to that obtained by centrifugation. The temperatures were 65°, 76°, 87° and 98°C with immersion times of 20, 25, 30, 35 and 40 min respectively. Due to charring of the fat column at 98°C, this temperature was excluded from the test. Mixing the contents after dissolution of the curd, was extended by a minute to liberate the small fat globules and permit them to agglomerate and rise to the surface readily, as prescribed in the case of homogenized milk[6].

Holding the butyrometer tube in hot water at 87±2°C for 30 min gave highly comparable results with the standard Gerber method. For comparison, the various samples were, therefore, analysed by the Gerber method using the centrifuge and according to the modified method.

Correlation coefficients were calculated between the fat values obtained according to the standard and the modified procedure.

Results and Discussion

The effect of time and temperature on the fat content of milk is illustrated in Fig. 1. The maximum fat reading was obtained when the butyrometer was held at 87±2°C for 30 min. There was no increase in the fat percentage when the immersion time was increased to 40 min. Immersing the butyrometer in hot water at 87±2°C for 30 min was considered suitable as regards the time and temperature for maximum reading of fat content without centrifuging.

Comparison of the methods: Mean fat content, range, standard deviation and coefficient of variation of the buffalo and cow milk samples determined by the two methods are shown in Table 1.

The agreement between the mean fat content values was very close and the extent of variation in the sample

TABLE 1. COMPARISON OF FAT CONTENTS OF BUFFALO AND COW MILK SAMPLES DETERMINED BY THE STANDARD GERBER METHOD AND BY THE MODIFIED METHOD

Milk	No. of samples	Method	Mean (%)	Range (%)	Stand. deviation	Coeff. of variation (%)
Buffalo	120	Gerber	7.49	5.25–12.90	±1.055	14.08
		Modified	7.41	5.20–12.70	±1.049	14.15
Cow	107	Gerber	5.09	2.20–6.95	±0.968	18.99
		Modified	5.01	2.15–6.85	±0.964	19.22

TABLE 2. RELATIONSHIP BETWEEN THE MILK FAT VALUES

Variable	No. of samples	Correlation coeff. (r)
Gerber vs modified Gerber	120 buffalo milk	0.996**
	107 cow milk	0.971**

**Significant at < 0.01

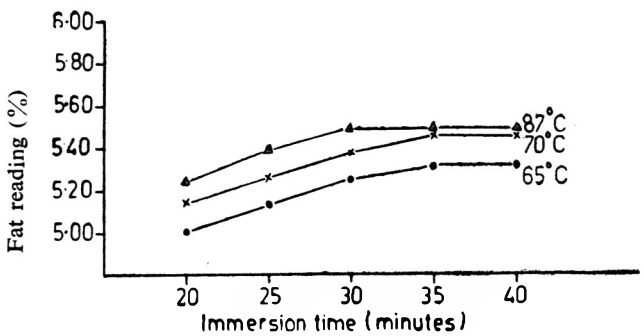

Fig. 1. Effect of water bath temperature and immersion time of butyrometers on fat (%) reading of milk.

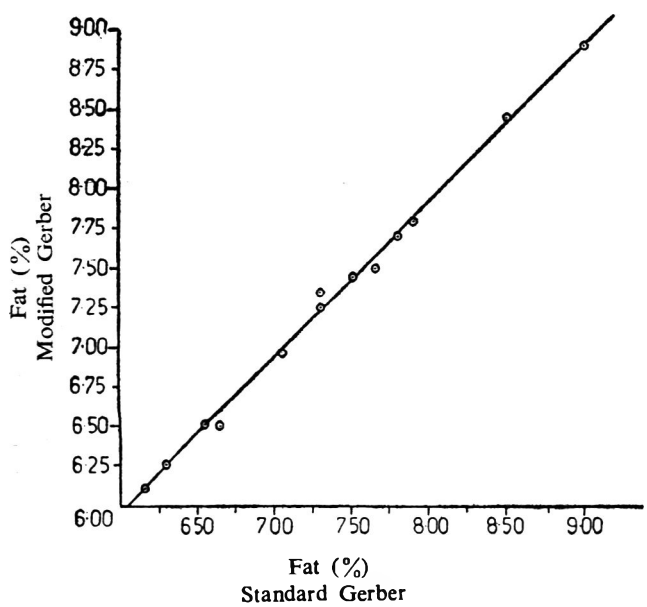

Fig. 2. Fat (%) values of buffalo milk

population was similar in case of buffalo as well as cow milk. The range in the values recorded was also similar. The condition of holding the butyrometer tube at 87±2°C for 30 min, therefore, simulated the effect of centrifuging which is an essential step in the Gerber method. This conclusion was further supported by the highly significant correlation coefficient (Table 2) found between the fat content values determined by the two methods.

The present procedure is considerably simpler as no preliminary holding of the butyrometer tube at room temperature was found necessary as reported by Kothavalla *et al*[1]. At the proposed temperature of water there was no charring of the fat column which was observed at the higher temperature. There are several factors, known to affect the accuracy of the Gerber fat test, such as, temperature of milk, purity and quantity of sulphuric acid and amyl alcohol, the diameter of centrifuge, speed and duration of centrifuging and the temperature of butyrometer tube during centrifuging[7,8]. The proposed procedure gave values which were comparable with

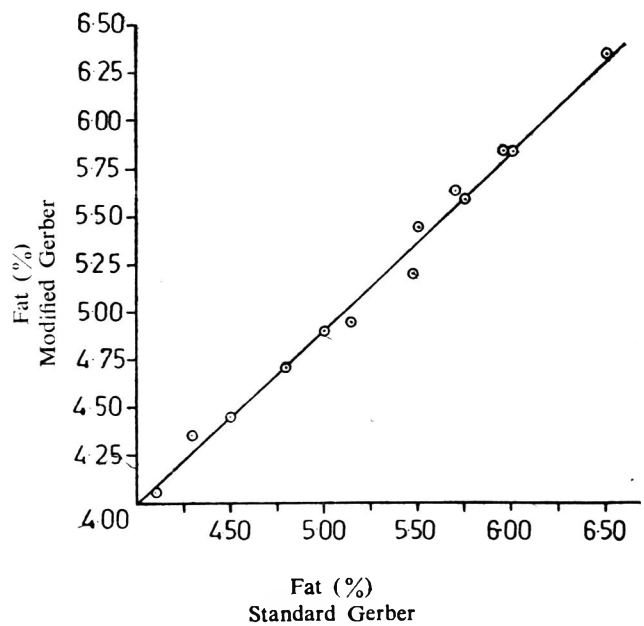

Fig. 3. Fat (%) values of cow milk

those of the Gerber test using the centrifuge. This is further illustrated graphically in Fig. 2 and 3 by the plots of the random values of fat content obtained by the two methods.

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The Changes in the Incidence of the Types of Bacteria in Relation to Spoilage of White Pomfret and Indian Mackerel Fishes at Low Temperature

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The changes in bacterial flora during transportation of irradiated (150 Krad) white pomfret (*Stromateus cenereus*) and Indian mackerel (*Rastrelliger kanagurta*) held at ice-temperature (0-2°C) were examined. The extent in storage life was determined in relation to the incidence of types of bacteria. The microflora of stored unirradiated white pomfret belonged predominantly to *Protues*, *Aeromonas*, *Achromobacter* and *Micrococcus* and in unirradiated Indian mackerel *Flavobacterium*, *Proteus*, *Aeromonas* and *Pseudomonas*. Irradiated white pomfret contained mainly *Micrococcus* and *Achromobacter* while in irradiated Indian mackerel *Micrococcus* and *Flavobacterium* were predominant.

Food borne microorganisms differ greatly in their radiation sensitivities[1-2]. It has been reported that most of the rapid spoilers belong to psychrophilic group of bacteria, viz., *Pseudomonas*, *Proteus*, *Aeromonas* and *Achromobacter* which are suppressed by radiation treatment[3-6], the predominating survivors being mostly gram-positive *Micrococci*, *Bacilli* and occasionally yeast[7]. The qualitative and quantitative differences in the microbial patterns depend mainly upon the dose of irradiation, storage period, packaging conditions and the type of sea-foods irradiated[8-9].

The present study was undertaken to examine the suitability of radiation-processed white pomfret and Indian mackerel for transportation and distribution. This paper describes the bacterial pattern present in white pomfret and Indian mackerel subjected to 150 Krad and the change in the bacterial pattern during the storage of these irradiated fishes kept at 0-2°C.

Materials and Methods

White pomfret (*Stromateus cenereus*) and Indian mackerel (*Rastrelliger kanagurta*) used in these experiments were irradiated in Co^{60} Food Package Irradiator (Atomic Energy of Canada Ltd) at a dose 150 Krad at the Bhaba Atomic Research Centre, Trombay. Irradiated as well as unirradiated fish were packed in insulated ice box with a fish to ice ratio of 1:3 to 1:4 and transported by rail to the Jadavpur University, Calcutta. Samples received on 3rd to 4th day of processing, were held in ice at 0-2°C till examination. Samples from two batches each of white pomfret and Indian mackerel were examined for the incidence and types of bacterial flora at intervals of 7 days.

Bacteriological examination: The bacteriological examinations of fish as well as that of drips were carried out by the standard procedures of Bhadra *et al*[10]. For identification, isolates (50) picked up at random from

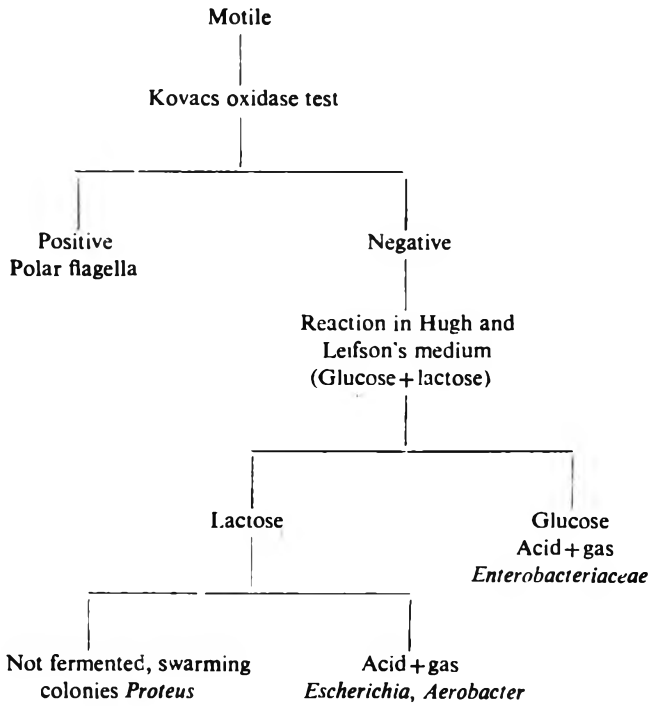

Fig. 1. Modified scheme for the identification of gram-negative bacteria.

the culture plates were classified as per the scheme of Shewan *et al.*[11] with suitable modifications (Fig. 1). Proteolytic and H_2S producing bacterial counts were determined by the method of Levin[12].

Results and Discussion

Incidence and types of bacteria: The bacterial flora in control samples of white pomfret and Indian mackerel were found to be different. Gram-negative organisms, comprising at least 70-75 per cent of the isolates were *Aeromonas*, *Proteus*, *Achromobacter* with occasional occurrence of *Pseudomonas*, *Vibrio* and *Escherichia*. With the storage of the samples, *Aeromonas*, *Proteus* and *Achromobacter* counts increased. *Pseudomonas* also showed a slight increase in the second week and then decreased. *Vibrio* and *Escherichia* were generally outgrown by the end of the second week. Table 1 indicates that *Achromobacter*, *Proteus* and *Aeromonas* were the main spoilage organisms.

In control samples of Indian mackerel gram-negative organisms, comprising at least 80-85 per cent of isolates were *Proteus*, *Aeromonas*, *Pseudomonas*, *Flavobacterium* with occasional occurrence of *Achromobacter*, *Vibrio* and *Escherichia*. The gram-positive isolates were mainly

TABLE 1. QUALITATIVE CHANGES IN THE BACTERIAL FLORA IN IRRADIATED (150 KRAD) AND UNIRRADIATED WHITE POMFRET AND INDIAN MACKEREL DURING STORAGE (0-2°C)

Genus and/or type of bacteria	Proportion of bacteria expressed in percentage during below indicated days of storage															
	7				14				21				28		35	
	Control		Irrd.		Control		Irrd.		Control		Irrd.		Irrd.		Irrd.	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
White pomfret																
Pseudomonas	10	8	4	6	13	10	8	4	8	5	5	4	2	4	2	0
Aeromonas	13	15	10	11	15	17	7	8	10	10	4	6	0	6	0	0
Proteus	15	13	11	8	20	15	10	10	25	25	2	4	2	2	2	2
Achromobacter	16	20	20	28	18	22	30	30	23	20	36	38	38	40	46	44
Vibrio	8	4	0	0	4	2	0	0	2	2	0	0	0	0	0	0
Micrococcus	30	26	46	40	21	30	40	46	26	26	50	45	54	50	50	54
Flavobacterium	4	3	2	4	2	0	0	0	4	4	2	2	0	0	0	0
Coryneforms	2	1	2	2	0	2	2	2	0	0	0	2	0	2	0	0
Escherichia	2	3	0	0	2	0	0	0	0	2	0	0	2	0	0	0
Indian Mackerel																
Pseudomonas	18	15	8	6	20	18	6	4	24	20	4	4	2	2	2	2
Aeromonas	16	13	10	8	18	15	6	10	20	21	4	8	2	0	0	0
Proteus	18	16	6	10	15	18	10	10	21	20	6	2	4	2	0	2
Achromobacter	8	10	10	10	4	10	4	6	2	4	2	4	2	2	0	0
Vibrio	4	4	4	4	2	2	0	0	0	2	0	0	0	0	0	0
Micrococcus	10	12	40	35	6	8	44	38	8	10	50	44	50	50	52	50
Flavobacterium	15	13	20	23	18	20	26	30	25	25	30	34	38	40	45	44
Coryneforms	2	2	0	2	0	2	0	2	0	0	2	0	0	0	0	0
Escherichia	2	4	0	0	2	2	0	0	0	2	0	0	0	0	0	0

The control samples of 28 and 35 days stored white pomfret and Indian mackerel were not acceptable to taste panel and hence no counts are reported.

Micrococci and in a small proportion *Coryneforms* spp. with the storage of the samples, *Proteus*, *Pseudomonas* and *Flavobacterium* counts increased. *Micrococci* showed a slight increase in the second batch. *Vibrio*, *Coryneforms* and *Escherichia* were generally outgrown by the end of the second week. Table 1 indicates that *Proteus*, *Pseudomonas*, *Aeromonas* and *Flavobacterium* were the main spoilage organisms for the control samples of Indian mackerel.

The major survivors in irradiated white pomfret were gram-negative *Achromobacter* and gram-positive *Micrococci*, *Vibrio*, *Flavobacterium*, *Coryneforms* and *Escherichia* which were practically eliminated and other spoilage organisms namely *Proteus* and *Aeromonas* were significantly reduced. Presence of *Micrococci* in radurized white pomfret (Table 1) showed its resistance to irradiation[7]. Its growth during storage however, was almost sur-passed by the gram-negative *Achromobacter*.

The major survivors in irradiated Indian mackerel (Table 1) were gram-negative *Flavobacterium* and gram-positive *Micrococci*. *Vibrio* and *Coryneforms* were practically eliminated and other spoilage organisms namely *Proteus*, *Aeromonas* and *Achromobacter* were significantly reduced. The growth of *Micrococci* during storage was sur-passed by the gram-negative *Flavobacterium*.

In unirradiated white pomfret (Batch I) *Proteus* constituted about 15 per cent of the total count during the first week of storage reaching to 25 per cent by the 3rd week. The Batch II showed changes from 13 to 20 per cent in the same duration. *Proteus* in general constituted one fourth of the total count and was the potent spoiler. *Achromobacter* showed a final proportion of 16-23 per cent (Batch I) of the total count of fish when rejected by taste panel and in the Batch II showed 20 per cent. The change in counts of *Aeromonas* (13-15 per cent), *Pseudomonas* (10-13 per cent) was significant on the second week and then decreased (Batch I). Similar changes were observed in counts of *Aeromonas* and *Pseudomonas* in Batch II, the former showing a gradual increase from 15-17 per cent and then later from 8-10 per cent of the total count. The gram-positive *Micrococci* constituted about 26 per cent of the total count at the time of spoilage of the white pomfret.

In unirradiated Indian mackerel (Batch I) *Proteus* constituted about 18 per cent of the total count during the first week. In the second batch the increase was from 16-20 per cent in the same duration. *Proteus* in general constituted one fifth of the total count. *Pseudomonas* showed changes from 18 to 24 per cent in the Batch I and 15 to 20 per cent in the Batch II of the total count of fish in the same duration. *Aeromonas* showed a final proportion of 16 to 20 per cent of the total count in the Batch I and 13 to 21 per cent in the Batch II. *Flavobacterium* showed changes from 15 to 25 per cent of the total count of fish when rejected by taste panel. *Flavobacterium* in general constituted one fourth of the total count and was the potent spoiler. There was decrease in count of gram-positive *Micrococci* from 10 to 8 per cent in the Batch I and and from 12 to 10 per in the Batch II on the 3rd week.

In irradiated white pomfret at the first week *Aeromonas* and *Proteus* were about 10 and 11 per cent respectively of the total count and hence were not the major survivors. *Micrococci* and *Achromobacter* were the major survivors comprising of about 46 and 20 per cent of the total count respectively. During the later part of storage the flora comprises mostly of *Micrococci* and *Achromobacter* accounting for 50 and 46 per cent respectively of the total count and they were the potent spoilers.

But in irradiated Indian mackerel at the first week *Aeromonas* and *Proteus* were about 10 and 6 per cent respectively and not the major survivors. *Micrococci* and *Flavobacterium* were about 40 and 20 per cent respectively and are the major survivors. During the later part of the storage only *Micrococci* and *Flavobacterium* accounted for 52 and 45 per cent of the total count respectively and were the major survivors.

Acknowledgement

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Some Enzymatic Studies on Bajra *(Pennisetum typhoides)* and Barley *(Hordeum vulgare)* During Malting

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Malt from bajra was prepared and its various properties were compared with that of barley malt. Proximate analysis of two malts showed little difference in their composition. Barley malt had higher amount of maltose. Both bajra and barley malts had comparable amylolytic as well as proteolytic activities. There are very few differences in enzyme activities of two malts. Bajra malt possessed all physical properties of a good malt. However, it developed a bitter taste after a short time.

The demand for malt in the country is likely to increase in the future because besides its use in breweries, it is also used in large quantities for preparing malt extract, processed food for children, sweets, medicinal preparations and in the manufacture of malted vinegar. Malted barley is in short supply in our country. Therefore it is necessary to look for some alternative materials. Preliminary studies conducted on bajra at this laboratory[1] suggested its use for malt production. Moreover, bajra flour is being used for a fermentative preparation (locally known as *Rabri*) especially common in bajra growing areas. Hence, an attempt has been made to prepare bajra malt on laboratory scale and its various properties are compared with barley malt prepared under similar conditions.

Materials and Methods

Three varieties each of bajra ('HB-1', 'HB-3' and 'HB-4') and barley ('BG-1', 'C-138' and 'C-164') were procured from the Department of Plant Breeding, Haryana Agricultural University, Hissar.

Preparation of the malt: Grains (100 g) of the above varieties were washed with 0.001 per cent mercuric chloride to disinfect them. This was followed by washing in tap water and finally in distilled water. The washed grains after steeping in water for an hour were germinated in petridishes having wet whatman No. 1 filter paper. Bajra seeds were germinated at 35°C in an incubator, whereas barley was germinated at 25°C in a refrigerated incubator. Germination was continued for various periods lasting upto 72 hr. The germinated seeds were thoroughly dried in an oven at 35-45°C as suggested by Golik and Zased[2]. These were pulverised in a coffee grinder and used for subsequent analyses.

Proximate analysis: Proximate analysis of malts was carried out as per AOAC methods[3]. Crude protein was determined by micro-Kjeldahl method[4].

Maltose determination: One gram of malt was placed in a beaker containing 20 ml of distilled water. After an hour it was ground using a mortar and pestle. The suspension was centrifuged at 0°C for 15 min at 14,000 × **g** in a refrigerated centrifuge (I.E.C. model B-20). The supernatant was made upto 100 ml with distilled water and used for maltose estimation by using 3, 5-dinitrosalicylic acid[5].

Enzyme assay: For the extraction of the enzyme Nason's method[6] with a few modifications was followed. Total amylolytic activity was measured by Swain and Dekker's[7] modified method[8]. The method of Noelting and Bernfeld[5] was used for determining β-amylase activity. Extraction and assay of α - amylase was done according to the method of Swain and Dekker[7]. The method of Arima *et al.*[9] was used for determining proteolytic (protease) activity. Protein estimation was done by the method of Lowry *et al*[10].

Amylase activity was expressed as mg maltose formed in 3 min at 37°C per ml of extract. Protease activity was expressed as μg of tyrosine formed in 10 min at 37°C per ml extract. Specific activity was expressed as enzyme activity per mg protein.

Results and Discussion

Physical properties of malt: As compared to barley malt the malt prepared from bajra was brown in colour, with satisfactory flavour and desirable taste. However, a bitter taste developed after some time; the cause of this is not known. Attempts are being made at this laboratory to find some suitable process to avoid this bitter taste.

Chemical composition of malt: Table 1 contains the results of proximate analysis of malt prepared from different varieties of bajra and barley. It is evident that the

TABLE 1. PROXIMATE ANALYSIS OF MALTS PREPARED FROM DIFFERENT VARIETIES OF BAJRA AND BARLEY*

Crop	Variety	Moisture (%)	Ash (%)	Crude fibre (%)	Crude protein (%)	Ether extract (%)	Nitrogen free extract (by diff) (%)	Maltose (%)
Bajra	HB-1	7.1	2.30	2.16	16.45	3.20	75.9	20.3
	HB-3	7.3	2.50	2.55	16.80	3.45	75.0	15.4
	HB-4	7.4	2.70	2.31	16.45	3.15	75.4	18.1
Barley	BG-1	8.5	2.44	4.60	12.25	2.20	78.5	42.3
	C-138	9.3	2.58	4.50	12.25	2.15	78.5	32.5
	C-164	8.1	2.70	3.30	14.89	2.35	77.8	39.1

*on dry wt basis

proximate composition of malt of both these grains are comparable except for crude fibre, crude protein and ether extract, the former one being high in barley malt whereas the latter two were high in bajra malt. Maltose content ranged from 32 to 42 per cent in barley malt, whereas in bajra malt it was from 15 to 20 per cent. The chemical composition of barley malt is comparable to that reported by Mutz and Samuel[11].

Amylolytic activity: Total amylolytic acitvity of malts from both the grains showed marked change during germination. In bajra malt (Fig. 1), it increased nearly 20-fold in the first two days of germination and afterwards started decreasing. In barley malt (Fig. 2) amylolytic activity increased continuously during the three days of germination. Maximum activity (15-fold) was observed in 'BG-1' variety, while in the other two varieties, it was only 8-10 fold of zero period activity. Mandl[12] studied various enzymes of malted barley, including amylases and found that the activities of these enzymes declined during steeping, but increased rapidly during germination. Recent studies from this laboratory[8] showed that total amylase increased during germination of both bajra and barley. Thus, the activity *per se* in malt would arise from the activity built up during germination.

α-amylase: There was no α-amylase activity in bajra malt prepared from ungerminated seeds and those prepared after 1-day germination (Fig. 3) but it progressively increased in malt prepared from 2-and 3-day germinated seeds. In malt prepared from 2-day germinated grain specific activity ranged from 5.75 to 11.52 depending upon variety and this was 23.0 to 30.8 per cent of the total amylolytic activity. In 3-day germination, the specific activity ranged from 9.21 to 11.88 and it was 61.5 to 65.5 per cent of total amylolytic activity comparable to bajra malt. Barley malt (Fig. 4) also showed no α-amylase activity in non-germinated and 1-day germinated grains, this activity was low in 2- and 3-day germinated seeds. Unlike bajra malt, this malt exhibited lower percentage of total amylolytic activity as α-amylase activity i.e., 10.5 to 18.20 per cent and 15.0 to 18. 8 per cent after 2nd and 3rd day of germination respectively. As early as 1942, it was reported[13] that α-amylase activity increased during germination of barley. In our recent studies[8] on α-amylase of bajra and barley showed α-amylase activity after 24 and 8 hr of germination, respectively. These findings are similar to our earlier report except that the bajra malt prepared from 1-day germinated seeds, did not have α-amylase activity. It is possible that germinating seeds had low α-amylase activity

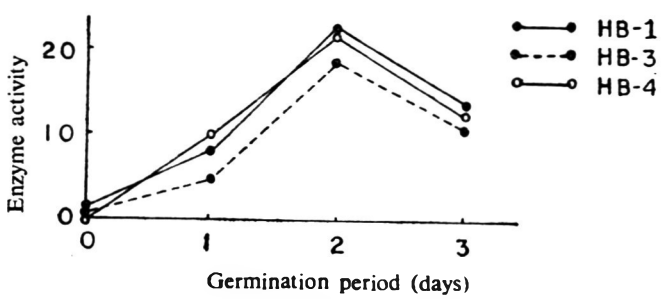

Fig. 1. Total amylolytic activity of bajra malt prepared after various periods of germination.

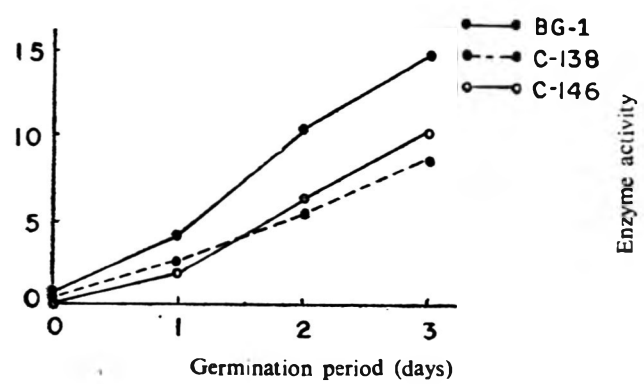

Fig. 2. Total amylolytic activity of barley malt prepared after various periods of germination.

which might have been destroyed during malt preparation and thus could not be detected in the present investigation.

β-amylase activity: Activity of β-amylase in bajra malt increased as the germination of seeds progressed and was maximum in malt prepared from 2-day germinated seeds (Fig. 5). In 3-day germinated seeds it showed a steep fall bringing the level near to that of non-germinated seeds. This was the main factor in changing the total amylolytic activity pattern of bajra malt (Fig. 1, 3 and 5).

β-amylase activity of barley malt (Fig. 6) showed a great increase after 1-day germination and unlike bajra malt, it slowly increased in 2-and 3-day germinated seeds. Unlike bajra malt, it was ∝-amylase which affected the total amylolytic activity pattern of barley malt. Similar changes in enzyme activity have been reported by Kneen *et al*[14], who found a slight increase in β-amylase activity during the first stage of wheat growth which was followed by a decrease. Oparin and Kaden[15] reported that β-amylase increased upto 6 days of germination and then started falling. Dyer and Novellie[16] found that both ∝-and β-amylases were produced during germination of sorghum in any particular malting trial. Saharan and Wagle[17] reported

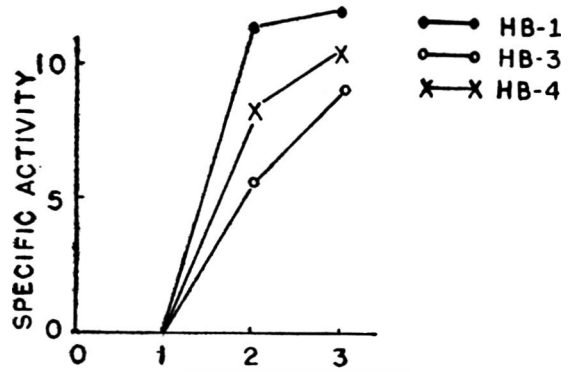

Fig. 3. ∝-Amylase activity of bajra malt prepared after various periods of germination.

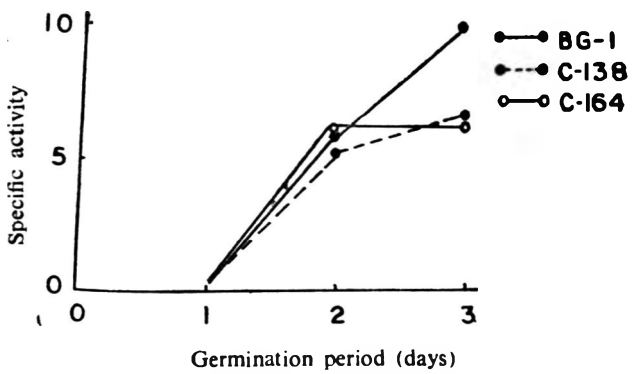

Fig. 4. ∝-Amylase activity of barley malt prepared after various periods of germination.

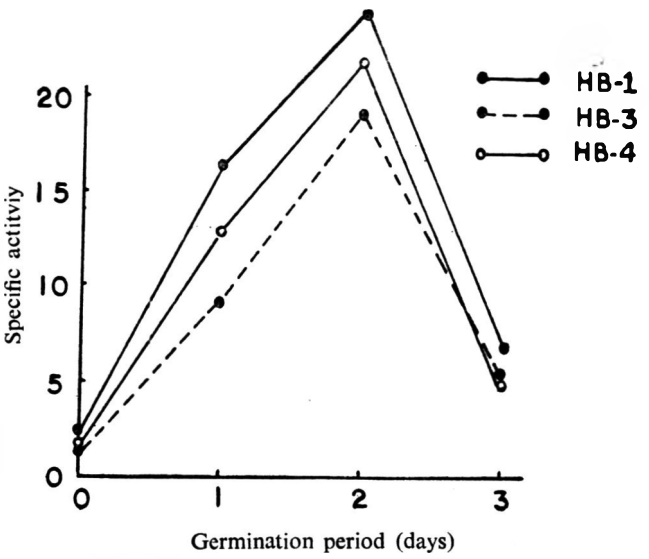

Fig. 5. β-Amylase activity of bajra malt prepared after various periods of germination.

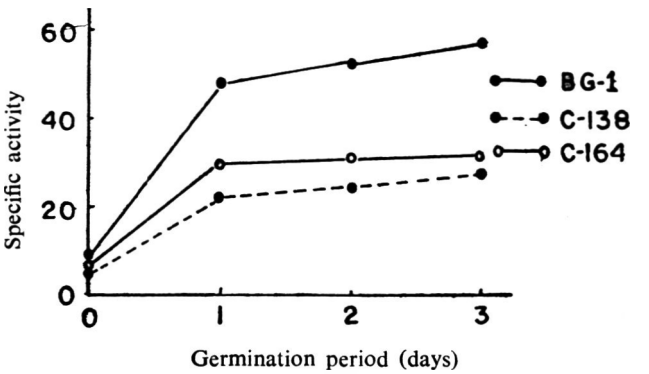

Fig. 6. β-Amylase activity of barley malt prepared after various periods of germination.

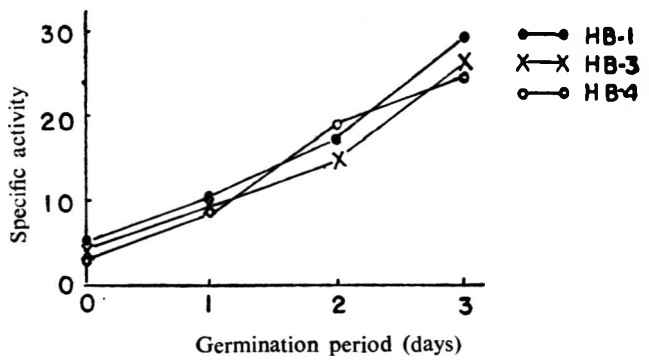

Fig. 7. Proteolytic activity of bajra malt prepared after various periods of germination.

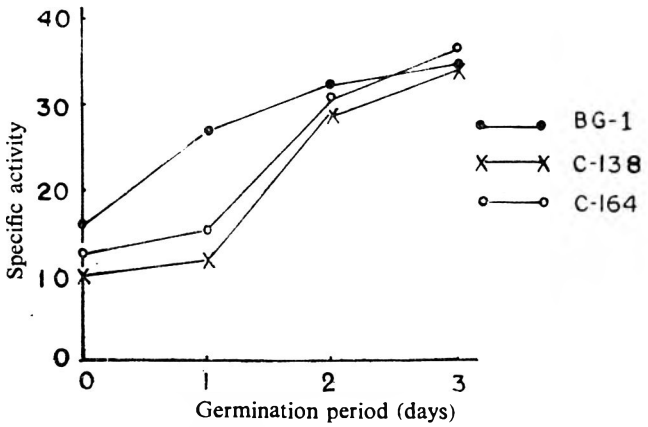

Fig. 8. Proteolytic activity of barley malt prepared after various periods of germination.

increase in β-amylase activity during germination of wheat grain for 96 to 120 hr depending upon the variety and after 192 hr it decreased and became almost equal to that of non-germinated ones. Sheorain and Wagle[8] also found similar changes during germination of bajra.

Proteolytic activity: Data on the proteolytic activity in bajra malt (Fig. 7) showed that in non-germinated seeds, it was as low as 3.50 to 4.96 units which increased progressively upto 3rd day of germination. Activity in malt prepared in 3-day germinated seeds from various varieties ranged from 24.96 to 29.63 units, which is nearly eight times that of non-germinated seeds. Unlike bajra malt, proteolytic activity in barley malt prepared from various varieties had high initial activity in non-germinated seeds, it ranged between 10.50 and 16.09 units and the maximum level was reached in 2-day germinated seeds (Fig.8). Prolonging the germination further did not bring any significant change. A two-fold rise was observed in this malt as compared to an 8-fold incrcease in bajra malt. When specific activities of protease of two malts prepared from 3-day germinated seeds compared, the difference was small. As early as 1900 Windish and Schellhorn[18] reported that non-germinated barley exhibits low proteolytic activity but it increased during germination. This was later confirmed by Lhotsky and Vik[19] who found optimum activity around fourth or fifth day of germination. Kringstad and Kilhvod[20] found that insoluble fraction of it showed maximum activity on third day of germination, while others required four or five days germination period to reach that stage. But in the present study, optimum activity was observed in 2 - to 3-day germination.

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Physico-Chemical, Rheological and Milling Characteristics and Bread and Chapati Making Quality of Indian Wheats

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Seventeen varieties of Indian aestivum wheats were evaluated. The range of values for some important quality attributes of white flour (*maida*) were: milling yield, 60.5-72.6%; Kent-Jones colour grade, 5.1-7.9; total ash, 0.44-0.66%; protein (N×5.7), 7.2-12.0%; wet gluten, 19.2-36.3%; diastatic activity, 133-351 units; damaged starch, 6.2-12.1%; sedimentation value, 19.0-37.3 ml; farinograph water absorption, 54.0-70.8%; and loaf volume, 400-585 ml. Variety *Raj*-827 gave the highest milling yield of 72.6%.

Excellent bread as well as chapati could be prepared from *Raj*-842 whereas *D*-134 and *DGPR-LB* gave good bread and excellent chapatis. Inspite of its excellent chapati making quality, *Kalyan Sona* gave poor bread. *K*-68, *WG*-377, *Raj*-857 and *Raj*-821 also gave excellent chapatis. Farinograph water absorption for chapati dough ranged between 46.1 and 57.0% and had no correlation with chapati making quality of wheat varieties.

Mexican hybrid wheat varieties have brought about green revolution in the Indian sub-continent within a short span of five years. The wheat production touched 26 million ton mark during 1971–72 as compared to 12 million tonnes during 1966–67[1]. Adequate information regarding quality attributes of different varieties of wheats are not available for their proper utilisation by the baking industry.

With the stoppage of wheat imports, the roller flour millers are forced to process Indian wheats of widely varying milling quality. Standardisation of milling conditions for optimising the flour yields from these wheats pose many practical problems. The baking industry which depends on roller flour mills for its main supply of wheat flour is also confronted with the problem of getting wheat flour with functional properties suited for bread and biscuit manufacture.

Unlike in the technologically advanced countries of the West, chapati forms a traditional food item in the dietary of majority of the population of the Indian sub-continent. It is an unleavened bread prepared by sheeting a dough from high extraction wheat flour and water and then baking the same on a hot iron plate. Austin and Ram[2] have carried out studies on suitability of several varieties of Indian wheats for chapati making based on some of the subjective quality attributes. They have also used alveograph to study the stability and strength of chapati dough.

Lack of adequate data on the functional quality characteristics of different varieties of wheat developed in recent years calls for a systematic study on the suitability of such wheats for specific end-uses. Studies on different quality characteristics of Indian aestivum wheat varieties and their suitability for bread and chapati making are reported in this paper.

Materials and Methods

Test materials: Seventeen varieties of Indian aestivum wheats were procured from Indian Council of Agricultural Research Stations located in Uttar Pradesh, Rajasthan, Punjab and Haryana.

Physical characteristics: Hectoliter weight and 1000 kernel weight of different wheat varieties were determined according to AACC procedures[3]. Pearling index expressed as percentage of bran portion removed from 100 parts of wheat was determined according to McCluggage using Corcoran Barley Pearler[4].

Milling quality: For assessing the milling quality, 1 to 1.5 kg samples were conditioned overnight to 15 per cent moisture and milled in a Buhler Laboratory Mill (Model MLU-202). For calculating the yield of acceptable grade white flour (locally known as *Maida*), the portion of shorts passing through 10XX sieve was also included. The whiteness of such *maida* samples was recorded in a Kent-Jones Flour Colour Grader.

Chemical characteristics: AACC methods were followed for determining the moisture, total ash, wet gluten, pigments (as β-carotene), diastatic activity and damaged starch in whole wheat flour and/or *maida*[3]. Falling number, an index of α-amylase activity was determined using Hagberg's apparatus[3]. Crude protein (N × 5.7) was estimated by micro-Kjeldahl method.

Rheological characteristics: Using Brabender farinograph and extensograph, bread dough characterisitcs of different *maida* samples were determined according to AACC procedures[3]. Data regarding water absorption, dough development time, dough stability, mixing tolerance index, extensibility, resistance and area under the curve were determined from farinograph and extensograph curves.

Bread making quality: Bread making quality of different *maida* samples was evaluated according to the Remix Baking Test[5]. After determining the loaf volume, different breads were evaluated organoleptically by a panel of judges and graded as excellent, good, satisfactory, fair and poor. The quality criteria for grading were based on loaf volume, crust colour and shape, crumb softness and elasticity, fineness and uniformity of crumb grain as well as the eating quality of the breads.

Chapati making quality: Cleaned whole wheat was ground in a Kamas laboratory hammer mill (Type SLAGY-200A) using 0.8 mm sieve and sieved through 40 mesh to remove the coarse bran fraction. Wheat flour of 93-95 per cent extraction (known as *atta*) thus obtained was used for assessing the chapati making quality of wheat varieties according to the procedure described by Shurpalekar and Prabhavathi[6].

The water requirement of *atta* samples for preparing a chapati dough of the desired consistency was determined in a Brabender farinograph. The samples were prepared in the farinograph mixer and triangular shaped chapati of about 18 cm sides and 1.5 mm thickness was rolled from 35 g dough and baked on hot plate at 176°C for 3 to 4 min. During baking, chapati was turned over once in every 30 sec.

Evaluation of chapatis: The overall quality of chapati was assessed by a panel of six judges. Good quality Punjab commercial wheat, generally considered as excellent for chapati making, was used as standard for comparison. Based on the quality attributes such as appearance, number of laminations, softness, sweetness and eating quality, different chapatis were evaluated as equal to, better than or inferior to the standard. Due to availability of only limited quantity of each wheat variety, the evaluation has been restricted only to comparison with the standard.

Results and Discussion

Physical characteristics: The data presented in Table 1 indicate that more than half of the varieties had hectoliter weight exceeding 80 kg, 1000 kernel weight of more than 40 g and pearling index of less than 15. Varieties *Kalyan Sona*, *Sharbati Sonora*, *Raj*-842, *Raj*-856 had relatively low 1000 kernel weight of less than 34 g. Both the varieties *WG*-357 and *WG*-377 were unique in

TABLE 1. PHYSICAL CHARACTERISTICS AND MILLING QUALITY OF INDIAN WHEATS

Variety	Hectoliter wt. kg	1000 kernel wt. g	Pearling index	White flour yield[a] (*maida*) %	Flour recovered from shorts[b] %	Shorts %	Kent-Jones colour grade value
UP-301	76.0	38.8	16.2	67.8	2.9	12.7	7.9
UP-310	77.0	44.2	19.3	65.6	3.4	13.3	6.8
UP-319	81.5	46.2	19.2	70.7	3.6	12.2	5.8
D-134	81.6	37.2	15.8	67.7	4.3	17.9	7.7
DGPR-LB	79.8	34.9	12.3	63.9	3.1	18.0	6.6
DGPR-65	82.9	41.9	14.9	60.5	3.9	23.5	5.8
Sonalika	78.5	40.5	17.2	69.8	2.0	10.9	6.5
K-68	84.0	46.1	17.9	64.5	3.5	18.8	6.2
Kalyan Sona	74.5	32.9	12.1	65.0	2.8	15.7	5.6
Sharbati Sonora	77.2	33.8	12.4	68.2	1.7	13.3	5.5
Raj-821	81.8	46.7	15.8	69.6	2.6	11.0	5.2
Raj-827	82.4	44.3	14.3	72.6	2.7	11.9	5.4
Raj-842	78.6	30.7	14.2	67.2	2.5	11.6	6.3
Raj-856	79.4	32.5	17.9	64.2	2.4	11.7	6.3
Raj-857	81.3	38.3	14.4	66.7	2.8	13.4	5.6
WG-357	80.0	49.1	14.4	64.8	4.1	20.9	6.1
WG-377	82.0	45.7	12.7	61.9	2.5	19.2	5.1
Average	79.9	40.2	15.4	66.5	3.0	15.1	6.1

[a]Straight-run flour + shorts fraction passing through 10XX sieve

[b]Fraction passing through 10XX sieve

having high hectoliter weight as well as 1000 kernel weight. Their low pearling index was indicative of the high hardness of wheat grains.

Milling quality: The milling characteristics and colour grade value of *maida* (white flour) samples are given in Table 1. It is interesting to note that *maida* yields of only four varieties *UP*-319, *Waj* 827, *Raj*-821 and *Sonalika* were comparable to values of 70-72 per cent generally obtained for hard bread wheats. Majority of the varieties had yields of more than 65 per cent. For half of the *maida* samples, the Kent-Jones colour grade value denoting the whiteness was less than 6, which is generally considered to be satisfactory. The yield of shorts for varieties, *D*-134, *K*-68, *DGPR-LB*, *DGPR*-65, *WG*-357 and *WG*-377 were considerably higher than the normal value of about 16 per cent.

Chemical characteristics: The data on the chemical characteristics are presented in Table 2. Higher ash contents of 0.66 and 0.63 per cent for *maida* from varieties *UP*-301 and *D*-134 respectively were well reflected in their high colour grade values of 7.9 and 7.7 (Table 1). *Maida* from more than half of the varieties had protein contents in the range of 12-14 per cent; while, only *Kalyan Sona* had a low protein content of 8.1 per cent. The poor quality of *K*-68, *Kalyan Sona* and *Sharbati Sonora* for bread making was indicated by their low wet gluten contents (19.2-23.6 per cent). The sedimentation values of different varieties ranged from 19.0 to 37.3 ml. Only *Raj*-842 and *Raj*-856 had significantly high sedimentation values (35-37 ml). With the exception of *UP*-310 *UP*-319, *Raj*-821, *Raj*-856 and *Raj*-842, the remaining varieties had low sedimentation values of less than 25 ml.

The pigments, expressed as β-carotene, in all *maida* samples were significantly lower than the values reported for Indian durum wheats[7]. The high values of falling number for different varieties ranged between 480 and > 1000 and indicated their very low α-amylase activity. This brings out the necessity for use of cereal malt flour as one of the additives in bread recipe. Only 7 varieties had diastatic activity in the desirable range of 225-350 units. The relatively higher values for varieties *K*-68 and *WG*-377 may be partly attributed to the higher starch damage (10-12 per cent) during milling process. Except *WG*-357 and *Raj*-857 other varieties had normal damaged starch content of less than 9 per cent.

Rheological characteristics: Data on the rheological characteristics presented in Table 3 show that half of the varieties had water absorption ranging between 60 and 65 per cent. Varieties *WG*-357 and *WG*-377 had maximum water absorption of 66.4 and 70.8 per cent respectively, which may be partly due to their high damaged starch content of 10-12 per cent. Rattan Singh and Bailey[8] observed that Indian wheats have relatively high water absorption which was attributed by Tara

TABLE 2. CHEMICAL CHARACTERISTICS OF INDIAN WHEATS[a]

Variety	Total ash %		Crude protein (N×5.7) %		Wet gluten %	Sedimentation value (ml)	Pigments as β-carotene ppm	Falling number	Diastatic activity[b]	Damaged starch %
	WWF	*Maida*	WWF	*Maida*	*Maida*	*Maida*	*Maida*	WWF	*Maida*	*Maida*
UP-301	1.57	0.66	12.4	11.8	35.1	20.1	1.49	586	232	8.1
UP-310	1.62	0.55	12.4	12.0	35.9	27.5	1.72	530	178	6.4
UP-319	1.57	0.49	12.5	11.0	30.9	26.9	1.42	571	167	7.2
D-134	1.47	0.63	13.4	11.2	34.4	20.2	2.89	638	242	8.4
DGPR-LB	1.75	0.52	12.4	10.4	29.1	19.5	2.07	738	244	8.9
DGPR-65	1.54	0.55	13.5	10.8	32.5	23.1	2.05	1000	240	8.5
Sonalika	1.45	0.56	10.3	9.8	30.2	19.2	1.76	533	170	6.3
K-68	1.36	0.54	9.6	9.0	23.6	21.5	2.23	642	315	10.1
Kalyan Sona	1.44	0.59	8.1	7.2	19.2	19.0	2.00	492	295	9.3
Sharbati Sonora	1.52	0.58	11.0	9.0	22.7	22.1	2.39	540	209	8.1
Raj-821	1.58	0.50	11.7	9.3	33.2	30.4	1.33	560	158	6.9
Raj-827	1.68	0.49	12.5	9.2	28.7	22.5	2.22	526	191	8.2
Raj-842	1.81	0.54	13.9	11.7	35.7	35.1	2.67	639	133	6.2
Raj-856	1.66	0.46	13.5	10.8	36.3	37.3	1.85	481	137	7.7
Raj-857	1.55	0.54	13.1	11.6	34.0	24.4	1.70	734	157	10.4
WG-357	1.39	0.44	10.9	9.4	28.6	19.9	2.24	540	150	10.3
WG-377	1.61	0.54	10.2	9.2	28.7	20.6	2.36	564	351	12.1
Average	1.56	0.54	11.8	10.1	30.5	24.1	2.02	607	210	8.4

[a]Values expressed on 14 per cent moisture basis [b]Expressed as mg maltose per 10 g flour per hr at 30°C
[c]Whole wheat flour

TABLE 3. RHEOLOGICAL CHARACTERISTICS OF INDIAN WHEATS

Variety	Farinograph				Extensograph			
	Water absorption[a] %	Dough development time (min)	Stability (min)	Mixing tolerance index B.U.	Extensibility (E) mm	Resistance to extension (R) B.U.	Ratio (R/E)	Energy sq cm
UP-301	60.2	4.5	2.0	60	125.0	560	4.50	91.5
UP-310	58.2	5.0	2.0	80	121.5	770	6.40	113.0
UP-319	59.0	4.0	>6.0	Nil	95.5	890	9.35	111.0
D-134	63.0	6.0	>4.0	Nil	120.0	700	5.85	108.0
DGPR-LB	64.5	2.0	6.0	20	110.0	640	5.80	92.0
DGPR-65	63.4	1.5	8.5	Nil	87.0	980	11.30	112.0
Sonalika	62.8	3.0	1.5	80	134.0	615	4.60	109.0
K-68	60.8	1.5	1.0	80	75.0	890	11.90	82.0
Kalyan Sona	61.4	1.0	7.0	40	74.5	825	11.05	74.5
Sharbati Sonora	54.0	1.0	>9.0	Nil	86.5	810	9.35	88.0
Raj-821	62.0	4.0	4.0	20	171.5	685	3.99	155i0
Raj-827	57.0	1.0	>9.0	Nil	102.0	>1000	>9.80	>119.0
Raj-842	59.8	2.5	>7.5	Nil	146.5	>1000	>6.82	>188.0
Raj-857	58.8	2.0	>8.0	Nil	115.5	>1000	>8.66	>157.5
WG-357	66.4	4.0	2.0	80	86.8	855	8.68	94.5
WG-377	70.8	4.0	2.0	100	131.5	640	4.87	111.0

[a]On 14 per cent moisture basis.

TABLE 4. BREAD AND CHAPATI MAKING QUALITY OF INDIAN WHEATS

Variety	Bread		Chapati	
	Loaf volume ml	Overall quality[a]	Farinograph water absorption[b] %	Evaluation[c]
UP-301	525	S	52.9	IT
UP-310	550	G	50.5	IT
UP-319	540	G	49.2	IT
D-134	550	G	53.8	ET
DGPR-LB	555	G	51.6	ET
DGPR-65	525	S	52.9	SIT
Sonalika	545	G	50.7	SIT
K-68	525	S	48.7	ET
Kalyan Sona	400	P	51.0	ET
Sharbati Sonora	475	F	53.0	SIT
Raj-821	510	S	52.7	ET
Raj-827	480	S	46.1	IT
Raj-842	585	E	53.6	ET
Raj-857	530	S	53.3	ET
WG-357	530	S	51.3	SIT
WG-377	530	S	52.6	ET
Punjab Commercial (Control)	570	G	57.0	Std.

[a]Graded as: E—Excellent; G—Good; S—Satisfactory F—Fair and P—Poor

[b]On 14% moisture basis

[c]As compared to standard: IT—Inferior to ET—Equal to SIT—Slightly inferior to

et al.[9] to their high starch damage during milling. With the exception of *UP*-301, *UP*-310, *Sonalika*, *K*-68, *WG*-357 and *WG*-377, all other varieties had good to excellent dough stability.

Majority of the varieties had both high extensibility (>110 mm) as well as resistance to extension (>700 B.U.). Though *Raj*-821, *Raj*-842 and *Raj*-857 had high flour strength as indicated by their energy values exceeding 150 sq cm, their extensibility and resistance to extension differed considerably. It is interesting to note that *Raj*-842 had excellent farinograph as well as extensograph characteristics desirable for bread making. Some typical farinograms and extensograms of the wheat varieties are given in Fig. 1.

Bread making quality: The data presented in Table 4 indicate that *Raj*-842 with maximum flour strength of 188 sq cm is excellent for breadmaking while breads from *UP*-310, *UP*-319, *D*-134, *Sonalika* and *DGPR-LB* were graded as good. Only *Kalyan Sona* showed very poor bread making quality, as seen by its very low loaf volume of 400 ml as well as coarse crumb structure. This can be attributed to the low protein content and sedimentation value. On the other hand, variety *Raj*-842 had a high protein content of 11.7 per cent and the highest loaf volume as well as sedimentation value. Though protein contents of varieties *UP*-310, *UP*-301, *UP*-391, *Raj*-842 and *Raj*-857 ranged from 11.6-12.0 per cent, the loaf volume in these varieties varied widely (525-585 ml).

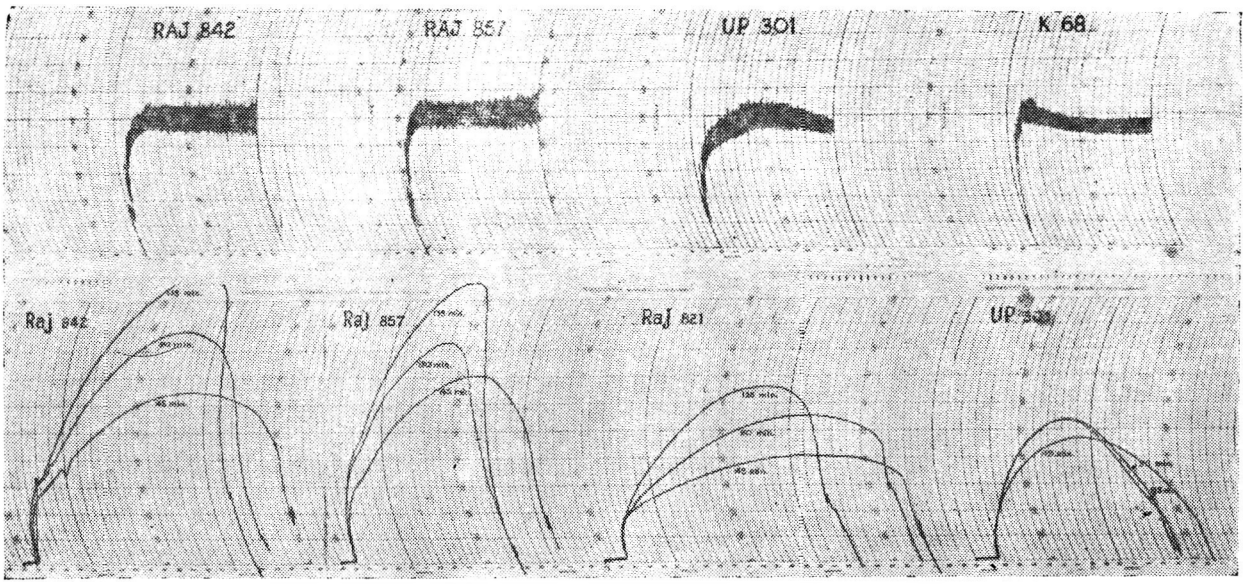

Fig. 1. Farinogram and extensogram curves for Indian aestivum wheats

In spite of their relatively high values for water absorption (59-62 per cent) and flour strength (155 sq cm), *Raj*-857 and *Raj*-821 gave bread of only satisfactory grade. This may be attributed to relatively high extensibility and low resistance to extension of *Raj*-821 and high extensibility as well as high resistance to extension and high starch damage in *Raj*-857.

High water absorption is generally indicative of good bread making potential. It is, however, interesting to note that varieties *WG*-357 and *WG*-377 gave breads of only satisfactory grade in spite of their high water absorption of 66.4 and 70.8 per cent, respectively. This may be attributed to the higher damaged starch content, which resulted in sticky dough.

No correlation, as reported earlier by Pinckney *et al.*[10] was observed between the sedimentation value and the loaf volume of bread. Varieties *D*-134 and *DGPR-LB* gave breads with good loaf volumes of 550 ml though their sedimentation values were as low as 20 ml. With similar sedimentation values, however, *Kalyan Sona* and *Sharbati Sonora* had loaf volumes as low as 400 and 475 ml respectively. In contrast, *Raj*-821 with a sedimentation value of 30.4 ml gave a relatively low loaf volume of only 510 ml. Similar observations for Indian wheats have also been reported by Finney *et al*[11].

Chapati making quality: The water absorption of chapati dough ranged between 46.1 and 57.0 per cent (Table 4). Even the maximum value of 57.0 per cent observed in the present study is considerably lower when compared to the minimum of 68 per cent (based on subjective assessment of the dough consistency) reported by Austin and Ram[2]. Unlike their bread making quality, varieties *D*-134, *DGPR-LB*, *K*-68, *Kalyan Sona*, *Raj*-821, *Raj*-857, *WG*-377 were as good as commercial Punjab (used as control) for chapati making. With the exception of *DGPR*-65, *Sonalika*, *Sharbati Sonora* and *WG*-357 which were only slightly inferior, the remaining varieties were unsuitable for chapati making. No correlation was observed between water absorption and chapati making quality (Table 4).

It may be concluded from the present studies that *Raj*-842 is the outstanding variety possesing all the qualities required for both bread as well as chapati making. In addition to their excellent chapati making quality, varieties *D*-134 and *DGPR-LB* possessed good bread making quality.

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Ripening Behaviour of Mango Fruits Graded on Specific Gravity Basis

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Freshly harvested mangoes were graded into three groups on the basis of specific gravity. They were allowed to ripen at room temperature (26±2°C). Fruits were evaluated for their acceptability on the 14th day. Chemical analysis was carried out for acidity, total sugars, total soluble solids, starch, and carotene. It was observed that the fruits having specific gravity in the range 1 to 1.02 at harvest were at the optimum stage of maturity. Changes in pectin fractions and pectin methylesterase activity have also been noted.

Numerous studies have been carried out to fix the optimum maturity stage for harvesting mango fruits. The criteria utilised are on the basis of physical characters[1], chemical constituents[2-4], and physiological behaviour on the basis of respiratory pattern[7-9]. The present report gives changes in chemical constituents of mangoes of different specific gravities. This will facilitate in deciding the optimum maturity period for harvest in terms of quality and length of storage period.

Materials and Methods

'Alphonso' variety mangoes (1500) were harvested from an orchard near Mysore during the last week of June, 1973 and 1974. Injured and bruised fruits were discarded and only sound fruits were taken for study.

The fruits were graded initially by floating in water, water sinkers were further graded using brine solutions of 3 per cent concentration. Based on specific gravity, the fruits were graded into three groups.

Water floaters with sp gr less than 1 (Group I); brine floaters with sp gr between 1 and 1.02 (GroupII); and brine sinkers with sp gr higher than 1.02 (Group III).

Three hundred fruits from each group were stored for ripening in well ventilated boxes at ambient temperature of 26±2°C and at 60-70 per cent R.H. Six fruits were taken randomly from each group for analysis of Brix, pH, acidity, reducing sugars, total sugars, carotenoids (total and β) and starch. Observations were made at different stages during ripening. Pectin content and pectin methyl esterase activity were studied only in the brine floater group. Results were confirmed in two seasons of June, 1973 and 1974.

Preparation of sample: The edible flesh from the individual fruits was separated, cut to fine pieces and homogenized to a pulp for analysis. Brix, acidity, pH and moisture were determined by the standard methods[10], total and reducing sugars by colorimetric methods of Ting[11], and total and β-carotene by vitamin assay[12]. Starch was estimated in the alcohol insoluble residue by enzyme hydrolysis using amylo-glucosidase(Sigma Co). A standard was run to determine the per cent recovery of starch (AR) as glucosides, after hydrolysis with enzyme. The recovery was 98.5 per cent. The glucosides liberated were estimated titrimetrically by Hane's method[13].

Pectin methyl esterase was estimated by the method

TABLE 1. CHANGES IN PH AND ACIDITY* IN ALPHONSO MANGOES HAVING DIFFERENT SPECIFIC GRAVITIES*

Days after harvest	Sp gr<1		Sp gr 1-1.02		Sp gr >1.02		SE
	pH	Acidity	pH	Acidity	pH	Acidity	
1	2.35[a]	3.60	2.33[a]	3.50	2.43	3.00	±0.02
7	2.73	2.50	3.92	0.61	4.35	0.31	±0.07
14	4.02	0.17	4.53	0.10	5.23	0.08	±0.08

*Estimated as percentage of malic acid (mean of six replicates)
SE = Standard error at 10 degree of freedom and at pH 2.
a = Not significantly different (p = 0.05)

TABLE 2. CHANGES IN TOTAL SOLUBLE SOLIDS* OF ALPHONSO MANGOES HAVING DIFFERENT SPECIFIC GRAVITIES

Days after harvest	sp. gr.<1	sp. gr. 1-1.02	sp. gr.>1.02
1	6.7	6.7	7
7	12	19	20
14	16	18	16

*Mean of six replicates

of Kertsz[14]. For pectin estimation, extraction and fractionation was done by the Versene pectinase method[15]. Estimation of galacturonic acid was done by carbozole assay method[16].

Results and Discussion

The aim of the present investigation was to find out the proper maturity stage for harvest of mangoes based on the specific gravity. Accordingly, the fruits were divided into three groups having different specific gravities and kept for ripening at room temperature. Six individual fruits from each group were analysed at different intervals. The data are presented in Tables 1,2,3 and 4. In Group III (sp. gr. higher than 1.02) the fruits reached edible ripe stage by the 9th day and were over-ripe by the 14th day. Fruits in the other two groups (Group I and Group II) were edible ripe only by the 14th day from harvest. The fruits of Group I, however, were more sour although the flesh colour was comparable to the other groups. This group was maintained beyond 14 days at room temperature to see whether the acidity would decrease to the level of Group II and Group III samples. But this however resulted in shrivelling and spoilage of the fruit. Statistical analysis of the resutls[17] indicated significantly lower values for pH and sugar in Group I than in Group II and Group III.

Thus it appears that the fruits in Group III were over-mature and those in Group I were at the early stage of maturity at the time of harvest. The Group II having

TABLE 4. CHANGES IN CAROTENE* CONTENT OF ALPHONSO MANGOES OF DIFFERENT SPECIFIC GRAVITIES DURING RIPENING

Days after harvest	Sp. gr.<1		Sp. gr.1–1.02		Sp. gr.>1.02	
	Total carotene	β-Caro-tene	Total carotene	β-Caro-tene	Total carotene	β-Caro-tene
1	183	53	528	130	704	216
7	1430	325	3673	897	4700	1737
14	7858	3132	7931	2897	8056	4478

*Mean of six replicates

TABLE 5. CHANGES IN PECTIN AND PECTIC FRACTIONS DURING RIPENING OF GROUP II MANGOES*

Days after harvest	**Alcohol insoluble residue%	Total pectin mg%	Water sol. pectin mg%	Proto pectin mg%	Versene sol. pectin mg%
1	11.45	1.260	0.716 (57)	0.532 (42)	0.471 (41)
8	5.10	0.955	0.590 (62)	0.357 (36)	0.310 (32)
14	2.30	0.690	0.552 (79)	0.130 (19)	0.116 (17)

* Mean of 4 replicates

** On fresh weight basis

Figures in the parenthesis indicate the percentage of total pectin.

TABLE 6. CHANGES IN THE ACTIVITY OF PECTIN METHYL ESTERASE* DURING RIPENING OF GROUP II MANGOES

Days after harvest	Activity/mg protein
1	1.87
5	2.33
7	2.60
10	1.60
14	0.97

*Mean of 4 replicates.

TABLE 3. CHANGES IN SUGAR* AND STARCH CONTENT OF ALPHONSO MANGOES HAVING DIFFERENT SPECIFIC GRAVITIES

Days after harvest	Sp. gr.<1			Sp. gr. 1–1.02			Sp. gr.>1.02			SE
	Sugar			Sugar			Sugar			
	Total	Reducing	Starch	Total	Reducing	Starch	Total	Reducing	Starch	
1	2.06_b	1.4	8.40	2.21^b	1.4	7.10	2.30^b	1.6	9.10	±0.02
7	7.09	4.0	1.90	11.44	3.6	0.50	16.15	3.4	0.40	±0.40
14	13.60	3.3	0.08	15.11^c	3.3	0.09	14.84^c	3.0	0.03	±0.30

SE = Standard error at 2 degrees of freedom.

b and c not significantly different (p = 0.05)

* Mean of six replicates

specific gravity of 1-1.02 appeared to be at the optimum stage of maturity.

In the next series of experiments, changes in pectin fractions and pectin methylesterase activity were studied at various intervals during ripening. The investigation was limited to Group II only. The results are given in Tables 5 and 6. Changes in pectin content confirm the observations made by Mizota and Subramanyam[18] in earlier studies. The pectin methyl esterase activity increases as the fruit reaches the climacteric and shows a decrease on further ripening. Mattoo and Modi[19] have indicated an increase in PME activity during ripening. It thus appears that fruits having specific gravity of 1-1.02 ripen normally at room temperature, fruits with higher specific gravity ripen earlier and seem to be slightly over mature for harvest.

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Amino Acid Composition of the Protein of Some Edible Mushrooms Grown in Synthetic Medium

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Mycelial proteins of five edible mushrooms (viz. *Agaricus campestris, Lentinus subnudus, Calocybe indica, Volvariella volvacea* and *Termitomyces eurhizus*) were estimated after growing them in a liquid culture medium. Their protein content varied between 14-27% on dry wt basis. Eleven amino acids were identified in *A. campestris* and *L. subnudus* by chromatographic analyses of acid hydrolysates of mycelial proteins. Thirteen amino acids including 2 amides were detected in each of *V. volvacea* and *C. indica* while 10 amino acids were identified in *T. eurhizus*. Leucine, threonine, tyrosine and alanine were found to be predominant in *A. campestris, L. subnudus, C. indica* and *V. volvacea* respectively. *T. eurhizus* was a better source of alanine than *V. volvacea*.

Interest in the nutritive value of edible mushrooms has greatly increased in recent years although its importance was realized by earlier researchers. In this connection, the reviews of Stoller[1], Gilbert and Robinson[2], Singer[3], Atkinson[4], Worgan[5] and Gray[6] may be mentioned. Studies on food values of mushrooms reveal that some of the edible species contain a good amount of protein in addition to free amino acids, mineral constituents and

vitamins. Contradictory reports on the nutritional values of several species are also not uncommon. This is not surprising because the age of the sporophore or mycelia, substrates and cultural conditions could markedly affect their nutritive values apart from their individual synthesizing capacity. Nutritive values of several species of edible mushrooms have been estimated by a number of workers but most of them have used complex substrates for growing the organisms.

In the present study, a simple synthetic medium was chosen with alanine as nitrogen source. This was done in order to evaluate the initial protein synthesizing capacity of five local species of edible mushrooms. As the biological value of protein depends upon the relative concentrations of the essential amino acids, it was also thought worthwhile to analyse the amino acids of mycelial proteins of all the test species for comparison.

Materials and Methods

Cultures: Pileus tissue cultures were prepared from the sporophores of *Agaricus campestris* L. ex Fr., *Lentinus subnudus* Berk., *Calocybe indica* P. & C., *Volvariella volvacea* (Bull. ex Fr.) Sing, and *Termitomyces eurhizus* (Berk.) Heim collected from different parts of West Bengal, India and maintained in 3 per cent malt agar slants at a temperature of 28°–30°C.

Estimation of protein content of mushroom mycelia: Agar blocks (3 mm diam) containing 7-day old mycelia of the fungus were punched out from the advancing zone of the mycelial mat and transferred to Erlenmeyer flasks (250 ml) containing 50 ml of sterilized medium (glucose, 10g; DL-alanine, lg; KH_2PO_4, 0.5g; $MgSO_4.7H_2O$, 0.5g; thiamine hydrochloride, 500μg and distilled water 1000 ml) and incubated for 12 days at 26°C in the dark. Mycelia were washed twice with sterile distilled water and collected through two layers of muslin cloth and then dried at 105°C for 24 hr. In order to remove nucleic acid contaminants from protein the method of Schneider[7] was followed with modifications. Dried mycelia (30 mg) were suspended in a known volume of 6 per cent trichloroacetic acid (TCA) and heated for 30 min at 90°-95°C. The supernatant was decanted off, the pellet being washed twice with cold TCA by centrifugation. The residue was digested with 8 mg of copper catalyst and 2 ml of concentrated H_2SO_4[8]. Subsequently, 2 ml of distilled water were added to it and the total nitrogen of the dried mycelia was estimated by the microkjeldahl method. The crude protein content was determined by multiplying the N-value by 6.25. One blank sample was used as control.

Estimation of amino acids of mycelial protein: Crude protein was extracted from fresh mycelia with 0.4N NaOH in cold and then centrifuged. The supernatant was taken and protein was precipitated from the clear extract with 6 per cent TCA by adjusting its pH to 4.5. The precipitate was collected after centrifugation and washed again with 6 per cent TCA. Nucleic acid contaminants in the crude protein were removed by heating the suspension of the precipitate in TCA[7] solution at 90°–95°C for 30 min. The residue was washed successively with TCA solution, ethanol, ethanol: diethyl ether mixture (1:1) and diethyl ether by centrifugation at room temperature (25°C). The protein recovered in the final sediment was dried under air current and stored in the desiccator. A measured amount (10 mg) of dried protein sample was hydrolyzed with 6N HCl (5 ml) in a sealed tube for a period of 24 hr at 110°C[8]. After hydrolysis, the acid was removed completely in a rotary film evaporator and the residue was collected in 10 ml of 80 per cent ethanol which was passed through an ion-exchange resin column (1 × 28 cm) containing Dowex 50W × 8 (20-50 mesh) at a flow rate of 1 ml/min. The resin was previously activated in H^+ form according to Plaisted[9]. The column was rinsed with 80 per cent ethanol and the amino acids were finally eluted with appropriate solvents according to the method of Plaisted[9]. The eluates were evaporated to dryness in a rotary film evaporator at 40°-50°C. The residue was collected in 1 ml of 10 per cent aqueous isopropanol and finally the amino acids in the acid hydrolysates of mycelial protein were determined quantitatively following the methods of Thompson *et al*[10] and Porter *et al*[11]. Aliquots of the solution (100 μ l) were applied to Whatman no. 1 filter paper and amino acids were separated by two dimensional paper chromatography using phenol: water (4:1) as the first solvent and n-butanol:acetic acid: water (4:1:1) as the second.

The chromatogram was sprayed with 0.1 per cent ninhydrin in n-butanol, and heated at 75°C for 15 min. Amino acids and amides were identified by co-chromatography with authentic samples. The individual coloured spots were cut out and eluted with 50 per cent ethanol. The colour density of the eluate was measured with Klett-Summerson colorimeter at 540 nm. To convert these density readings to actual amounts of amino acids, the above procedure was repeated with standard solutions of known amino acids. Values have been expressed without correction for possible destruction of amino acids during hydrolysis.

Results and Discussion

Mycelial proteins of mushrooms: It is evident from the results (Table I) that mycelia of *L. subnudus* and *A. campestris* contained 27 and 14 per cent protein respectively on dry weight basis. Protein content of the remaining three species varied between 16 and 22 per cent. The yield of mycelia was, however, highest in *A. campestris* but its protein content was found to be lowest

TABLE 1. COMPARISON OF MYCELIAL PROTEIN OF FIVE EDIBLE SPECIES

Fungus	Protein content of mycelium (% dry wt.)	*Dry wt. of mycelium (mg)	**Final pH of the culture filtrate
A. campestris	13.86	128.33+	4.8
L. subnudus	26.92	31.00	5.0
C. indica	19.81	20.33	5.1
V. volvacea	16 33	64 67	5.0
T. eurhizus	22.30	18.00	5.0

*Average of 3 replicates (mycelium dried at 60°C for 96 hr).
**Initial pH, 5.4
+ 50 ml medium/250 ml flask.

among the species tested. It indicates that there is no correlation between the rate of growth and protein content of mycelia. Variation in protein content between mushrooms was noted by a number of previous workers. Bose and Bose[12] reported the protein content of sporophore of *A. campestris*. They obtained 2.73 per cent protein (fresh weight) in the fruit body when its moisture content was 95.2 per cent. Anderson and Fellers[13] recorded 3.94 per cent protein (fresh weight) in the sporophore of this fungus but they noted 89.5 per cent moisture in the tested material. There is evidence that the mycelium and sporophore of *A. bisporus* contain 49.1 per cent[14] and 35.6 per cent[15] protein respectively on a dry weight basis. Highest amount of protein (50.4 per cent) was recorded in the mycelium of *A. campestris* by Guha and Banerjee[16] when grown in a medium supplemented with casein hydrolysate but lowest with sodium nitrate (32.0 per cent on dry wt basis). When different amino acids were tested on the growth of the organism, glutamic acid was found to be the best but for protein production medium containing DL-alanine appeared to be most suitable. The mycelium of the present strain of *A. campestris* yielded 14 per cent protein. This difference in protein content may probably be due to strain variation or different cultural conditions.

The percentage of mycelial protein was found to be 27 per cent in *L. subnudus*. In *L. tigrinus* it was 22 per cent (on dry wt basis) according to Jennison *et al*[17]. Gilbert and Robinson[2] in their review noted that the protein content of the sporophores of different species of *Lentinus* varied between 1.56 and 4.53 per cent (on fresh wt basis). The moisture content of these species, however, ranges from 0.26 to 71.71 per cent.

Although the protein content of *A. campestris* is lowest when compared to other test mushrooms, the total yield of protein is highest because of its maximum mycelial growth.

Amino acids of mycelial proteins: Amino acid composition of mycelial proteins and their relative quantities must be considered in evaluating the nutritional value of a mushroom. Chromatographic analyses of acid hydrolysates of mycelial proteins reveal that most of the common amino acids are present in these mushrooms. Of the essential amino acids, threonine occurs in fair amounts in all the test species excepting *C. indica* which contains appreciable amounts of valine (Fig. 1).

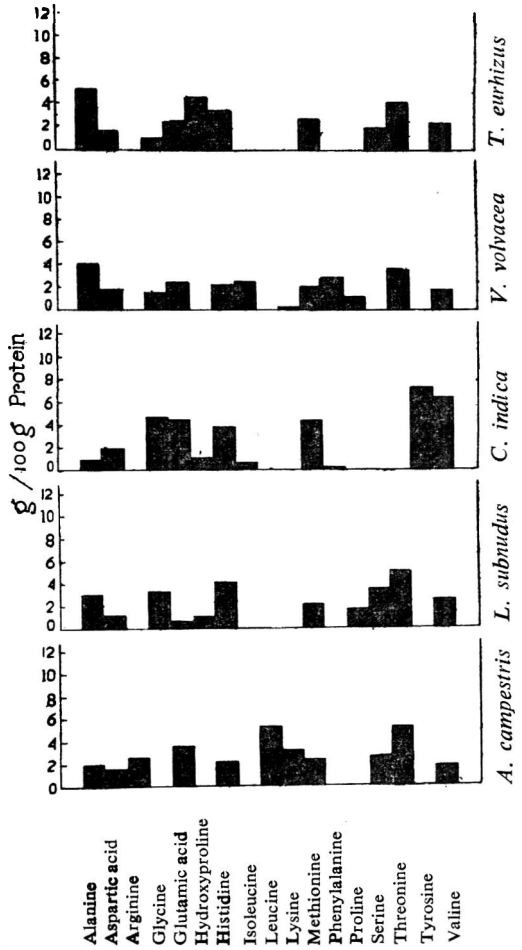

Fig. 1. Amino acid composition of mycelial protein of mushrooms

Altamura *et al*[18] detected a large number of amino acids including uncommon and undetected ones and nitrogenous compounds in the white edible mushroom, *A. campestris* by using an automatic amino acid analyzer following a novel isolation procedure. Among the essential amino acids leucine was found to occur in highest concentration while tryptophan and methionine were present in trace amounts. Besides, a large number of basic amino acids and related compounds such as galactosamine, hydroxylysine, γ-aminobutyric acid, ornithine, 2, 4-diamynobutyric acid, ethanolamine, ammonia, canavanine, creatinine, carnosine have also been detected in mushroom fractions. Guha and Banerjee[19] reported the occurrence of 16 amino acids in the mycelial protein of the same species after acid and alkaline hydrolysis, of which leucine and isoleucine appeared to be highest in

A. campestris. Amino acids of alcoholic extract and acid hydrolysate of *V. volvacea* were analyzed by Orillo and Carangal[20]. They reported 13 amino acids in the acid hydrolysate but excepting for glycine, isoleucine, methionine and asparagine others were in common with the present strain of *V. volvacea*. In case of *T. eurhizus* alanine, hydroxyproline and threonine were comparatively higher than other amino acids[21]. Although Bano *et al.*[22] also detected these amino acids except hydroxyproline in the mature fruit body of an unknown species of *Termitomyces* the percentages of arginine and histidine were found to be higher than the other detected amino acids. As the name of the species, age of the fruit-body and the composition of substrate are not known, it is not desirable to compare the two results. Moreover, the analytical methods employed by different workers are also not similar.

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Changes in the Curd Tension and Heat Stability in Fortified Buffalo Skim Milk Systems

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The effect of fortification of diluted buffalo skim milk with lactose, casein and its fractions on the curd tension and heat stability was studied. Skim milk when adequately diluted to reach solid level as in human milk, exhibited a dramatic drop in its curd tension without much significant changes in heat stability.

Addition of lactose to the diluted milk system resulted in an increase in the curd tension with a small drop in heat stability. Incorporation of acid casein augmented both curd tension and heat stability. Amongst casein fractions, α_s-casein decreased both these properties whereas β-casein, κ-casein and β-k-casein increased the curd tension without significant effect on the heat stability.

Curd tension and heat stability of milk are two critical parameters in the manufacture of infant foods[1,2]. Sirry and Shipe[3] reported that curd tension increased with rennet coagulation time but decreased with increasing salt concentration. Ashworth and Nebe[4] observed that curd tension was increased by 20-25 g for each 1 per cent

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increase in solids. Iwaida and Tsugo[5] found that homogenization decreases the curd tension. Abdel-Salam *et al.*[6] observed that removal of fat increased the curd tension while heat treatment reduced the curd tension. Boiling brought more reduction in curd tension. Schultz and Ashworth[7] studied the fortification of α- and β-casein in skim milk and observed that α-casein fortified skim milk produces weaker curd than β-casein fortification. On the addition of calcium chloride in the system, both fractions formed a firmer curd with α-casein slightly stronger than β-casein. Koops and Westerbeek[8] demonstrated that hydrogen peroxide strongly affects the heat stability of concentrated milk. deKonig *et al.*[9] reported that protein composition and seasonal variation in the heat stability is maximum during winter season. Kruk *et al.*[10] observed that *k*-casein and β-lactoglobulin either separately or together increased the heat stability rather than α-lactalbumin.

In the endeavour to humanize buffalo milk in this laboratory, the possible reorganization of the milk constitutents has been tested[11,12]. The proteolysis of fortified buffalo milk has been also reported by Kuchroo and Ganguli[13]. In the present paper the changes in the curd tension and heat stability in a similar buffalo milk system is reported.

Materials and Methods

Samples of buffalo milk (pooled) were collected from Murrah breed maintained at the Institute. Skimming of milk was done at room temperature within an hour of collection using Alfa-Felix cream separator.

Isolation of casein fractions: Acid casein was isolated from buffalo skim milk by isoelectric precipitation according to Gupta and Ganguli[14]. α-Casein and β-casein were prepared from buffalo skim milk by the procedure of Hipp *et al*[15] and Aschaffenburg[16]. Zittle *et al*[17] method was followed for isolating α_s-casein from buffalo skim milk.

β-*k*-casein was prepared following the method of El-Negoumy[18] with necessary modification.

Sample preparation: Buffalo skim milk was diluted with three volumes of water. Lactose (4.0 g/100 ml) and casein fractions (0.5 g/100 ml) were added separately to these systems. These samples were then homogenised using a Potter-Elvehjem homogenizer.

Determination of curd tension: The method adopted for curd tension measurement in the present study is the one used by Chandrasekhara *et al.*[19] with necessary modification.

Determination of heat stability: Similar method was followed as developed by Davies and White[20] and modified by Jai Ram *et al.*[21].

Determination of total solids: Total solids in fortified buffalo skim milk was determined by the method described in ISI[22].

TABLE 1. CURD TENSION AND HEAT STABILITY OF BUFFALO MILK

Additions	Curd tension (g)	Heat stability (min)	Total solids
Nil	43.0	48.4	9.75
Water (1:3)	11.5	49.7	2.91
Lactose in dil. milk	12.4	44.5	6.79

Results and Discussion

Effect of dilution and lactose on buffalo skim milk: Data on the effect of dilution of skim milk on curd tension, heat stability and total solids are given in Table 1. The curd tension of diluted buffalo skim milk was reduced almost four times on dilution as compared to that of skim milk. This reduction might be due to reduction in the level of α_s-casein and calcium in the skim milk after dilution. Schultz and Ashworth[7] have also reported the impact of calcium on curd tension. Total solids decreased considerably as compared with skim milk whereas heat stability increased.

Table 1 further shows the changes in the fortified skim milk with added lactose. The curd tension increased almost by 1.0 g, but there was decrease in the heat stability. Total solids increased almost two and half times when compared with the diluted skim milk.

Effect of addition of casein fractions on diluted skim milk: The values obtained for curd tension, heat stability and total solids after fortification of casein fractions in diluted skim milk are given in Table 2. Among casein fractions added, acid casein increased the curd tension followed by β-casein, α-casein and β-*k*-casein. Among these fractions, α-casein showed weaker curd than β-, and β-*k*-casein throughout the investigation. Schultz and Ashworth[7] reported that β-casein shows firm curd strength than α-casein when added to skim milk. Our results in case of α-, and β-casein fractions fortified in diluted skim milk concur with their findings. In case of acid casein there was increase in

TABLE 2. EFFECT OF CASEIN AND ITS FRACTION ON THE CURD TENSION AND HEAT STABILITY OF MODIFIED BUAFFALO MILK

Additions	Curd tension (g)	Heat stability (min)	Total solids
Acid casein	15.0	50.5	3.31
α_s-casein	8.6	46.0	3.35
β-k-casein	13.0	48.5	3.15
α-casein	14.0	52.5	3.05
β-casein	14.5	51.0	2.99

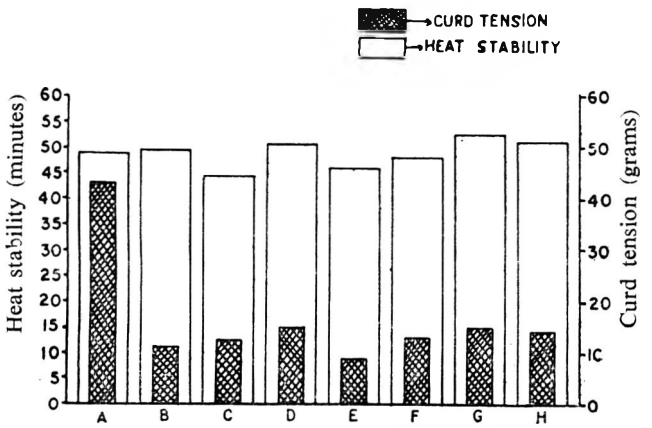

Fig. 1. Curd tension and heat stability profile of modified buffalo skim milk systems.

A, Skim milk; B, Skim milk + water; C, Skim milk + water + lactose; D, Skim milk + water + acid casein; E, Skim milk + water + α_s-casein; F, Skim milk + water + β-k-casein; G, Skim milk + water + β-casein; and H, Skim milk + water + α-casein.

heat stability comparable to diluted skim milk, but α-casein and β-casein increased the heat stability when compared with acid casein and diluted skim milk. In case of α_s-casein, the curd tension and heat stability decreased as compared to other fractions. The curd tension and heat stability of the milk samples fortified with lactose and casein fractions are depicted in Fig. 1. Considerable reduction in the diluted skim milk was observed as that of whole skim milk, but there was a slight increase in heat stability. Lactose showed a reverse trend as there was slight increase in the curd tension, but decrease in heat stability. Among casein fractions, highest curd tension was observed with acid casein followed by β-casein, α-casein and β-*k*-casein. Heat stability of diluted buffalo skim milk fortified with α-casein was maximum followed by that of β-casein acid casein, and β-*k*-casein. α_s-Casein showed lesser heat stability and curd tension when compared with other casein fractions. Dilution of skim milk resulted in a slight reduction in the curd tension whereas the heat stability of the system increased.

While processing, curd tension and heat stability are the two major parameters in the manufacture of infant food. These data will help in preparing an improved infant milk food from buffalo milk having more nutritional resemblance with human milk.

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Effect of Grinding on the Quality of Whole Wheatmeal

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The whole wheatmeals of three varieties ground in different stone mills showed notable differences in quality characteristics. Manually operated quern type stone mill produced coarser meals compared with those of power and water driven stone grinders. The whole wheat meal prepared in water driven grinder had more than twice the maltose values and three to four times the damaged starch content of the meal ground in manually operated mill. The average farinograph water absorption of 66.1% recorded for the meal from hand driven mill increased to 72.5 and 77.7% when the wheats were ground in power and water driven stone mill respectively.

In developing countries, wheat is used predominantly as whole wheatmeal of 95–100 per cent extraction for making unleavened pan cakes (*chapatis*). The meals are prepared generally by grinding wheat without pretreatment in stone mills, called *chakkis*. The quern type mill is manually operated; the bigger stone mills are run by power. No comparative study of the quality characteristics of the meals prepared by grinding wheat in different devices has so far been reported. The results presented in this paper show notable differences in the granulation, water absorption, mixing time and amylolytic parameters of the wheat meals as influenced by grinding in different ways.

Materials and Methods

Three varieties of extensively cultivated commercial wheats viz., 'K 227', 'PV 18' and 'C 306' were ground in power, water and hand driven stone mills. Hand driven *Chakki* is a native device used in villages, usually operated by woman folk for preparing the meal for the day to day use. The capacity of such a grinder is only 2 to 3 kg/hr. The water driven *chakki* is found mostly in submountainous regions where water from irrigation channels is directed to a steep decline to rotate the upper circular stone of the grinder which weighs 4-5 quintals. The upper stone rotates at about 120 rpm with an output of 20 to 30 kg/hr.

Electrical and diesel oil powered mills operate at higher speeds than the water-driven mills. Considerable heat is generated due to friction while grinding the grist between the chiselled stone surfaces. The upper stone weights 5-6 quintals and the output is about 300 kg/hr. The meals were prepared under conditions of adjustment normally employed by the trade. The meals were preserved in air tight tins and withdrawn for analysis when required.

Granulation: The procedure described by Hart and Fisher[1] was followed. Weighed quantity (100 g) of test meal were sifted for 5 min in a set of circular sieves arranged in the descending order of apperture sizes, viz., 335, 250, 210, 180, 150 and 125 microns in a Rotap machine. The residues on each sieve were weighed separately.

Farinograph water absorption: Fifty grams (14 per cent moisture) of each sample were mixed with an appropriate amount of water in the small bowl of the farinograph to a consistency of 500 B.U., using the constant flour AACC method[2]. The amount of water absorbed per 100 g flour (14 per cent moisture) is referred to as farinograph water absorption.

Dough development time: The time in minutes for which the dough is mixed to attain 500 B.U. consistency using appropriate water absorption is designated as dough development time (DDT).

Moisture: This was determined in accordance with the AACC air oven method[2] at 130°C.

Protein: Analysed according to the micro Kjeldahl method described in AACC.

Maltose value: This was determined by the Blish and Sandstedt procedure[3] employing concurrent blanks to correct for the free-sugars present in the meals. The results are expressed as maltose value (per cent).

Damaged starch: This was determined according to the AACC[4] (enzymatic) and Stewart methods[5] and by the colorimetric method of Williams and Fegol[6] as described by Tara and Bains[7].

Results and Discussion

Hand driven grinder produced significantly coarser meals than those of power and water driven grinders (Table 1). The residues on the 355 micron sieve were: 37.0, 12.7 and 4.7 per cent of meals of hand, power and water driven mills respectively. The water driven grinder produced relatively fine meals as shown by the high per-

TABLE 1. EFFECT OF GRINDING ON THE GRANULATION OF WHOLE WHEAT MEALS

Variety	Overs (%) indicated at different sieve apperture						
	355	300	250	210	180	150	125*
Hand driven stone mill							
PV 18	36.9	8.2	8.0	9.9	4.3	22.4	9.2
C 306	37.8	7.7	8.4	10.2	3.9	26.6	4.5
K 227	36.2	8.2	8.1	9.9	3.8	26.5	6.8
Average	37.0	8.0	8.1	10.0	4.0	25.2	6.8
Power driven stone mill							
PV 18	11.1	6.2	12.0	17.6	3.0	31.2	16.9
C 306	15.8	8.0	12.4	21.4	2.5	36.8	2.0
K 227	11.1	6.3	13.4	20.5	2.6	35.1	9.0
Average	12.7	6.8	12.6	19.8	2.7	34.4	9.3
Water driven stone mill							
PV 18	4.3	1.2	2.6	9.3	3.9	77.2	0.2
C 306	5.0	1.1	1.9	9.2	2.1	72.0	6.0
K 227	4.8	1.1	2.5	14.7	4.8	68.6	1.2
Average	4.7	1.1	2.3	11.0	3.6	72.6	2.5

*Throughs nil for hand and water driven *chakki* meal and 0.4 to 0.7% for power-driven *chakki* meal, respectively.

that of water driven mill by two and half times the value of the hand driven *chakki* meals. The damaged starch contents increased similarly from 1.75 to 2.73 (as per AACC[4]), 2.24 to 3.42 (as per Stewart[5]) and 2.37 to 4.37 (as per Williams and Fegol[6]) times the values of the meals produced in hand driven *chakki*. Compared with an average farinograph water absorption of 66.1 per cent for the hand driven *chakki* meal, the absorptions by power and water driven grinder meals were 72.6 and 77.7 per cent, respectively. The differences in maltose values and starch damage due to varieties caused during grinding were insignificant. 'PV 18' and 'K 227' wheats are relatively harder and contained higher amounts of protein than that of 'C 306' (Table 2). There was consistency in the dough development time of 'K 227' meal independent of the type of grinder used in its preparation. Mixing time of 'PV 18' decreased by about 31 per cent as a result of grinding in power driven grinder compared with that of hand driven *chakki*. Damaged starch usually assoicated with increased water absorption appears to be of considerable significance in the quality of whole wheatmeals.

TABLE 2. EFFECT OF GRINDING WHEAT ON THE MALTOSE VALUES, DAMAGED STARCH, WATER ABSORPTION AND DOUGH DEVELOPMENT TIMES OF WHEATMEALS

Variety	Maltose values	Damaged starch			Protein (N×5.7)	F.W.A.	D.D.T.
		AACC[4]	Stewart[5]	Williams & Fegol[6]			
	(%)	(%)	(%)	(O.D.)	(%)	(%)	(min.)
Hand driven stone mill							
PV 18	1.72	4.9	3.6	0.53	12.7	66.0	8.0
C 306	1.90	5.9	3.8	0.60	11.0	66.6	9.5
K 227	1.99	6.2	4.0	0.65	12.8	66.5	9.5
Average	1.87	5.7	3.8	0.59	12.2	66.1	9.0
Power driven stone mill							
PV 18	2.92	10.0	8.5	1.40	12.9	73.0	5.5
C 306	2.69	10.0	8.2	1.30	11.3	72.0	7.0
K 227	2.92	10.1	8.7	1.50	13.1	72.8	9.0
Average	2.84	10.0	8.5	1.40	12.4	72.6	7.1
Water driven stone mill							
PV 18	4.50	15.4	12.8	2.50	12.6	78.0	5.5
C 306	4.33	15.5	12.5	2.60	11.1	77.0	5.5
K 227	4.65	15.8	13.8	2.63	12.8	78.0	9.0
Average	4.49	15.6	13.0	2.58	12.2	77.7	6.7

centage of residues (72.6 per cent) on 150 micron sieve compared with 25.2 and 34.4 per cent of the whole meals obtained in hand and power driven grinders respectively. The granulations of the meals were influenced more by the type of grinder used than by the variety of the wheat. Damaged starch contents, maltose values and water absorption of meals were notably influenced by the differences in the severity of mechanical action of the grinders (Table 2). Maltose values of power driven *chakki* meals increased by about one and half times and

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Leaching Losses During Commercial Parboiling of Paddy by the Hot Soaking Method

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Soaking of paddy in water either by cold or hot water methods results in loss of rice solids by leaching and by microbial action. Use of sodium-chromate during cold soaking eliminates the foul smell and reduces the loss of rice solids. An attempt has been made to find out the loss of rice solids by leaching during hot soaking in paddy varieties procured in different seasons. The loss of rice solids by leaching was found to be more for paddy procured at high moisture and stored in silos and godown as compared to those procured at lower moisture.

A hot soaking method of parboiling was developed to eliminate the foul smell normally associated with paddy parboiled by the traditional cold soaking method[1]. This method has been widely adopted by rice mills in India. Recently the use of sodium chromate for eliminating the foul smell in the cold soaking method has been found to increase rice out-turn by 1-2 per cent. It has been postulated that the use of sodium chromate eliminates the loss of rice solids by leaching and microbial action in the customary cold soaking method[2]. This author also suggests that leaching losses occur even in the hot soaking method of parboiling[2]. Some data on rice yields from paddy commercially parboiled at the modern rice mill, Tiruvarur lent support to the above suggestions. Controlled studies on yield of paddy at different stages of the parboiling process to estimate the leaching losses were conducted and the data obtained are reported herewith.

Materials and Methods

Batches of paddy varying from 14-16 per cent moisture contents in six varieties stocked at the rice mill were mechanically delivered into the parboiling tanks and subjected to soaking at 70-75°C for three and half hours. Foreign matter like chaff and immature paddy which floated in the soak water was removed by skimming, and its weight was recorded after drying. The soaked paddy was steamed after draining the soak water

TABLE 1. INVISIBLE LOSS IN PROCESSING OF PADDY IN MODERN RICE MILLS

Variety	Net wt. of paddy (Ton)	Net wt. of chaff and foreign matter (Ton)× (a)	Wt of cleaned parboiled paddy (Ton) (b)	Total of (a+b) (Ton) (c)	Wt of cleaned raw paddy* (Ton) (d)	Loss** (d–c) (Ton) ××	Loss** %(××)	Moisture at procurement (%)	Storage method	Storage period (months)
ADT-27	5.560	0.175	5.067	5.242	5.458	0.216	3.96	18–24	Silo	3
Co-33	6.510	0.167	6.510	6.677	6.783	0.106	1.56	,,	Godown	13
IR-20	4.890	0.173	4.848	4.979	5.102	0.123	2.41	,,	,,	5
Co-25	6.215	0.159	5.848	6.007	6.016	0.009	0.15	15–16	,,	3
Ponni	6.820	0.124	7.156	7.280	7.330	0.050	0.68	15–17	Silo	4
IR-8	5.350	0.116	4.827	4.943	4.983	0.040	0.80	15–16	Godown	2

(×) Measurable visible loss. (××) Unmeasurable invisible loss.

*Adjusted to equal moisture of parboiled paddy.

**Contributed by fine dust and soluble losses washed with soak water and carried by hot air.

and then mechanically dried by hot air at a temperature of 120°C. After drying the parboiled paddy to 14 per cent moisture and overnight tempering it was milled for 24 hr. Foreign matter like sand, stones, chaff, etc. separated by the paddy cleaner was collected and its weight recorded.

Results and Discussion

The data on the soaking losses (Table 1) varied widely among the paddy samples. The smallest loss (0.15 per cent) was for Co 25 which had been procured at low moisture and stored in bags in a flat godown. The largest losses were found in paddy samples which had been procured at moisture of 18-24 per cent and stored as such without any further drying in the silos available with the mill. The leaching losses for such paddy samples procured at high moisture varied from 1.56 to 3.96 per cent. For paddy samples which had been purchased at lower moisture contents and stored in godowns or silos, the losses varied from 0.15-0.80 per cent.

The present data suggest that paddy procured at high moisture and stored as such suffered very high leaching losses during parboiling by the hot soaking method as compared with the paddy which had been procured at lower moisture. The deteriorative changes during the storage of high moisture paddy resulting in higher production of sugars is probably responsible for the very high leaching losses. Although no data on the amount of soluble solids in the soak water have been collected, these results do indicate the high soluble losses when such high moisture paddy is stored and parboiled after storage. It was also found that the parboiled rice from the first three varieties (Table 1) procured at high moisture were brownish and highly discoloured. The imperative need for thorough drying of paddy before storage both to preserve the quality of rice as also to prevent the quantitative losses during soaking at the parboiling stage are indicated from the present study.

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RESEARCH NOTES

UTILIZATION OF MANGO WASTE: PEEL AS A SOURCE OF PECTIN

Good quality pectin (grade 200 to 240) could be prepared from ripe 'Totapuri' mango peel by aluminium precipitation (yield, 10.3%) or alcohol precipitation (yield, 15.7%) methods. It contained moisture, 4.8; ash, 0.94; methoxyl, 8.31% and 1094 equivalent weight.

Mango waste obtained during processing of ripe mangoes into different products is hitherto not used for any useful purpose. The huge quantities of waste pose severe disposal problem to the fruit processing factories. Mango waste in the form of peel, fibrous pulp and stones constitutes 40-60 per cent of mangoes depending on the variety. Peel forms nearly 15 per cent of mango fruit. Pectin is an essential ingredient in the manufacture of fruit products like jams, jellies, marmalades, etc., Besides this, it has various uses in pharmaceutical products also. The total annual requirements of pectin in India is estimated to be nearly 30-40 tonnes.[1] As yet, the production of pectin is not upto the requirements of the country and large quantities have to be imported to meet the local demand. Recovery of pectin has been tried from a number of local raw materials like jack fruit and wood apple[2], limes[3], Assam oranges[4] and lemons[5], papaya[6], orange waste[7,8] apple pomace[9], and guava[10]. But nobody has so far reported recovery of pectin from mango peel, which is available as waste in large quantities from canneries engaged in processing of mangoes. This note gives the first hand information on the potential for the manufacture of pectin from ripe mango peel.

The proximate composition of mango waste was determined by us[11] to explore various avenues for utilization of waste. The estimated pectin value of 12.85 per cent held a great promise for the manufacture of pectin from mango peels. Further trials for the recovery of pectin were, therefore, carried out on waste mango peels of 'Totapuri' variety, collected as left-overs after extraction of mango pulp from a fruit processing factory at Hyderabad. The peels were washed in running water to remove excess of pulp and later dried in a cross flow drier. The dry material was ground to 8 mesh size in a laboratory mill and used for extraction of pectin. In each case 100 g of peel were extracted for 30 min with 15 times water acidified with hydrochloric acid to have a pH of 1.5 and containing 0.1 per cent sodium hexa-meta-phosphate (Calgon). The contents were strained through cloth and extraction of peel repeated twice with 10 and 5 times water containing acid (pH 1.8) and 0.1 per cent calgon or 30 min each time. All the extracts were filtered through supercel and combined. In alcoholic precipitation method 1 per cent HCl was added to the combined pectin extracts and pectin precipitated by addition of double the quantity of absolute alcohol. The precipitates were washed successively with 66, 80 and 95 per cent alcohol with retention time of 30 min in each washing. In the aluminium precipitation method, 20 per cent aluminium chloride solution was added to the combined extracts of pectin at 0.5 per cent level. The pH was adjusted to 3.5 by addition of sodium carbonate solution and the aluminium pectinate lumps so formed were filtered off, broken into smaller particles and dissolved in concentrated hydrochloric acid added at 10 per cent level. Pectin was reprecipitated with 95 per cent alcohol added in equal quantity and washed succesively with 70 per cent alcohol containing 5 per cent acid and later with 80 and 95 per cent alcohol. These pectin samples dried at 70°C and powdered to 60 mesh size were analysed for moisture, ash, methoxyl contents and equivalent weight by the methods of Owen *et al.*[12].

The yield and quality of pectin recovered from dried peels by the two methods are given in Table 1. The recovery of pectin was 15.7 per cent in the case of direct alcoholic precipitation method and only 10.3 per cent in aluminium pectinate method. The yield in the latter method may be less due to precipitation difficulties caused by polyphosphates. The aluminium precipitated pectin was dull grey in colour as compared to attractive white colour of alcoholic precipitated pectin. Pectin from mango peel with moisture, 4.8; ash, 0.94; methoxyl contents, 8.31 per cent and 1094 equivalent weight and over 200 pectin grade was well comparable with pectins from other well known sources of pectin as reported by earlier workers[2-7,9,10].

The above data indicate that mango peel of 'Totapuri' variety is a good source of pectin of high quality. The free and plentiful availability of mango peels as waste from mango processing factories and the ease and advantage in its handling and drying, make it a valuable raw material for the manufacture of pectin. Out of

TABLE 1. YIELD AND QUALITY OF PECTIN BY DIFFERENT METHODS OF PECTIN RECOVERY

	Alcohol pptd pectin	Al pptd. pectin.
Yield of pectin (%)	15.7	10.3
Moisture (%)	4.87	5.333
Ash (%)	0.94	1.007
Methoxyl contents (%)	8.31	9.561
Equivalent wt.	1094	875.8
Grade	200–220	220–240
Jelly units	31.40–34.54	22.66–24.72

10,000 tonnes of mangoes processed annually by the industry, 1,500 tonnes of fresh peel or about 500 tonnes of dried mango peel will be available. Further work will be necessary to assess the quantity and quality of pectin available from other varieties of mangoes, commercially used for the manufacture of mango products. Even the three major factories of South India processing nearly 2000 to 3000 tonnes of mangoes, mostly 'Totapuri' can recover 15 to 18 tonnes of pectin annually.

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PRELIMINARY STUDIES ON SOME CHARACTERISTICS OF BANNUR MUTTON

Earlier reports from this laboratory[1] as well as others[2-4] have identified that Bannur breed of sheep has good meat traits. The salient features like pH, proximate analysis and peroxide value of fresh Bannur mutton have been reported in this study.

Bannur sheep of either sex comprising three age groups—lamb, yearling and mature were slaughtered and dressed as per standard practice[1]. Three large and easily recognisable muscles—longissimus dorsi, triceps brachii and rectus femoris were selected for studies. pH, moisture, fat, protein[5] and peroxide value[6] were determined. The dressed carcasses were stored at (*i*) ambient temperature (26-30°C); (*ii*) refrigerator temperature (5±1°C); and (*iii*) frozen temperature (−8±1°C). The initial pH was measured 2 hr post mortem and subsequently after 2, 6 and 24 hr in carcasses stored at ambient temperatures and 24, 48, 72, 96 and 120 hr in the case of carcasses held at refrigerator and frozen temperatures. In cold stored carcasses pH determination was done after holding for some time outside to attain room temperature.

The initial pH of 6.0-6.5 was lowered to an ultimate pH of 5.5-5.6 within 6, 48, and 72 hr at ambient (28°C), refrigerated (5°C) and freezing temperatures (−8°C) respectively (Table 1 and 2). The rate and extent of pH fall was affected by the environmental temperature. The effect of temperature on the rate of fall of pH is in conformity with the observations of earlier workers[7-9]. The increase in rate of fall of pH at higher temperature is reported by Marsh[9] due to increase in post mortem glycolysis. The rise in pH in meat kept at 28°C after 6 hr and 5°C after 72 hr may be due to autolysis and bacterial growth indicating signs of decomposition[10], whereas in case of meat kept at −8°C the rise in pH was observed after 96 hr which may be, as observed by Vanden Berg[11] and McCarthy and Mackintosh[12] due to increase in the concentration of soluble material in the liquid phase as a direct consequence of ice formation. Precipitation of salts thus appears to be the cause of large pH changes.

Table 1. Effect of age and sex on the rate of postmortem pH changes at 28°C in different muscles of bannur sheep

Changes in pH at indicated time (hr) of postmortem.

Classes (age)	Sex	Triceps brachii				Rectus femoris				Longissimus dorsi			
		0*	2	6	24	0	2	6	24	0	2	6	4
Lamb	M	6.0	5.7	5.5	6.0	5.9	5.5	5.5	5.9	5.9	5.5	5.5	5.9
	F	6.2	5.8	5.5	5.8	6.4	5.7	5.4	5.9	6.3	5.7	5.4	6.0
Yearling	M	6.5	5.8	5.5	5.9	6.8	5.7	5.4	5.8	5.7	5.6	5.5	5.8
	F	6.1	5.7	5.4	5.8	6.3	5.8	5.5	5.9	6.3	5.8	5.5	5.9
Mature	M	6.0	5.6	5.4	5.8	6.1	5.7	5.5	5.9	6.3	5.7	5.6	6.0
	F	6.1	5.7	5.4	5.8	6.1	5.8	5.5	6.0	6.3	5.7	5.4	5.8

*Initial reading at 0 hr pertains to 2 hr post slaughter.

TABLE 2. EFFECT OF AGE AND SEX ON THE RATE OF POSTMORTEM PH CHANGES AT 5 AND –8°C IN DIFFERENT MUSCLES OF BANNUR SHEEP

pH at indicated time (hr) of postmortem.

Classes (age)	Sex	Triceps brachii						Rectus femoris						Longissimus dorsi					
		0	24	48	72	96	120	0	24	48	72	96	120	0	24	48	72	96	120
											5°C								
Lamb	M	6.0	5.7	5.6	5.6	5.8	5.8	5.9	5.7	5.6	5.6	5.8	5.9	5.9	5.6	5.5	5.6	5.7	5.7
	F	6.2	5.6	5.5	5.6	5.8	5.9	6.4	5.8	5.6	5.6	5.9	5.9	6.3	5.6	5.6	5.6	5.9	5.9
Yearling	M	6.5	5.8	5.6	5.6	6.0	6.0	6.8	5.7	5.5	5.6	5.8	5.8	6.7	5.6	5.6	5.7	5.7	5.7
	F	6.1	5.7	5.6	5.6	5.8	5.8	6.3	5.7	5.6	5.6	5.9	6.0	6.3	5.6	5.6	5.6	5.8	5.8
Mature	M	6.0	5.5	5.5	5.6	5.8	5.8	6.1	5.5	5.6	5.6	5.8	5.8	6.3	5.7	5.5	5.5	5.8	5.8
	F	6.1	5.6	5.5	5.5	5.9	6.0	6.1	5.5	5.5	5.6	5.8	5.8	6.3	5.6	5.6	5.8	5.8	5.8
											–8°C								
Lamb	M	6.0	5.6	5.6	5.6	5.6	5.8	5.9	5.7	5.7	5.5	5.5	5.7	5.9	5.7	5.5	5.5	5.5	5.7
	F	6.2	5.9	5.8	5.5	5.5	5.6	6.4	6.0	5.8	5.6	5.6	5.8	6.3	6.1	5.8	5.6	5.6	5.8
Yearling	M	6.5	5.8	5.8	5.6	5.7	5.7	6.8	6.0	5.6	5.6	5.6	5.7	6.7	5.8	5.6	5.5	5.5	5.8
	F	6.1	5.8	5.6	5.5	5.5	5.6	6.3	5.9	5.7	5.7	5.7	5.7	6.3	5.8	5.6	5.6	5.7	5.7
Mature	M	6.0	5.7	5.6	5.6	5.7	5.8	6.1	5.9	5.6	5.5	5.6	5.6	6.3	5.8	5.6	5.5	5.5	5.8
	F	6.1	5.7	5.6	5.6	5.8	5.8	6.1	5.9	5.6	5.6	5.7	5.8	6.3	5.8	5.5	5.5	5.6	5.6

Leading at 0 hr pertains to 2 hr post slaughter.

TABLE 3. CHEMICAL COMPOSITION OF DIFFERENT MUSCLES IN BOTH SEXES OF BANNUR SHEEP

Classes (age)	Muscle	Protein (%)		Fat (%)		Moisture (%)		P.V. (milli eq. O_2/kg fat)	
		M	F	M	F	M	F	M	F
Lamb*	TB	15.66	16.90	2.62	2.10	78.93	75.98	4.044	4.142
	RF	18.26	15.60	1.47	1.20	76.47	76.86	4.194	4.230
	LD	16.40	17.30	2.07	1.62	75.38	78.80	4.146	4.155
Yearling*	TB	15.74	17.02	5.75	1.79	76.68	75.46	4.350	4.325
	RF	15.03	16.52	5.08	1.89	77.44	77.62	4.250	4.074
	LD	17.63	16.32	4.46	1.86	75.98	76.35	4.270	4.239
Mature	TB	17.79	15.98	2.24	1.78	77.25	77.80	4.163	4.225
	RF	16.76	16.29	1.40	2.00	77.19	77.29	4.050	4.108
	LD	16.29	16.59	1.68	1.77	76.15	76.88	4.216	4.316
Mean		16.56		2.37		76.92		4.194	

TB: Triceps brachii; RF: Rectus femoris; LD: Longissimus dorsi; PV: Peroxide value; M: Male; F: Female.
*Lamb male and yearling female.

The ultimate pH and the rate of fall was in conformity with the observations of others and is typical of mammalian muscle[7]. The segregation of animals for 14 hr without feed but with plenty of water appears to provide adequate conditions for segregation of mutton animals before slaughter.

Age, sex and type of muscle did not show any appreciable effect on the initial or ultimate pH, proximate analysis and peroxide value (Table 3). Proximate chemical composition of Bannur mutton observed after 2 hr slaughter was protein, 16.56; fat, 2.37; moisture, 76.92 per cent and peroxide value, 4.194 milli equivalent of oxygen per kg of fat.

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FUNGI ISOLATED FROM THE SEEDS OF *AMOMUM SUBULATUM* ROXB

Among the different fungi isolated from *Amomum subulatum*, *Aspergillus flavus* and *Aspergillus niger* were predominant.

Spices get heavily contaminated with microorganisms during storage. In India some workers[1-5] have reported the presence of microorganisms including moulds from a few spices and spice mixtures. *Amomum subulatum* Roxb. popularly known as large cardamom is used as a condiment in the preparation of sweet-meats and for flavouring beverages. Samples of fruits were procured from the local market. Martin's agar medium fortified with rose Bengal and streptomycin were used for the isolation of fungi from the seeds. The following fungi were isolated from the seed surface.

Alternaria alternata (Fr.) Keissler, *Aspergillus chevalieri* (Mangin) Thom and Church, *A. flavus* Lk., *A. fumigatus* Fres., *A. niger* van Tieghem, *A. nidulans* (Eidam) Wint., *A. oryzae* (Ahlb.) Cohn., *A. ochraceous* Wilhelm., *A. sydowi* (Bain and Sart.) Thom and Church, *A. terreus* (Thom, Turesson,) Gote and Svensk, *A. temarii*, Kita, *A. versicolor* Vuillemin, *Chaetomium biapiculatum* Lodha, *C. indicum* Corda, *Cladosporium* sp., *Curvularia lunata* (Walker) Boedijn, *Fusarium moniliforme* Sheldon, *Helminthosporium* sp., *Penicillium diversum* Raper and Fennell, *P. funiculusum* Thom, *P. oxalicum* Currie and Thom and *Rhizopus* sp.

It was observed that under the prevailing conditions of storage in the local market, the incidence of fungi is very high, *Aspergillus flavus* and *A. niger* being the most abundant.

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STUDIES ON THE PROTEASE OF *BOTRYODIPLODIA THEOBROMAE* PAT.

A strain of *Botryodiplodia theobromae* Pat., isolated from coconut was found to elaborate an acid protease active at pH 3.0 and stable at pH 4.0 for one week under refrigeration. Its insensitivity to certain inhibiting agents indicates that it may be an acid protease. The enzyme has been partially purified and some of its properties have been studied.

Acid proteases of mould origin are much preferred in several aspects of food processing[1]. They have been reported from *Aspergillus saitoi*[2], *A. niger*[3], *A. oryzae*[4], *Rhizopus chinensis*[5], *Penicillium janthinellum*[6] and *Trametes sanguinea*[7]. *Botryodiplodia theobromae* isolated from coconut kernel was found to elaborate a protease[8]. Attempts were made to characterise this enzyme and the results are presented here.

The organism was cultivated on wheat bran extract—peanut meal medium in shake flasks at 30°C for 96 hr and protease activity was measured as described[8]. The culture filtrate was dialysed at 4°C against 0.01 M sodium phosphate buffer of pH 7.0 for 5 hr. The dialysed retentate was exposed to a blast of cold air till the material was concentrated to a protein level of 8 mg/ml. Eight ml of this concentrate (64 mg protein) were applied on a DEAE cellulose column (45 × 1.9 cm) equilibrated with the above buffer. Fractions were eluted with the same buffer but containing 0.02 to 0.1 M NaCl. A recovery of 85 per cent of the activity was obtained. The specific activity rose five fold.

Calcium ions have been shown to be essential for the activity and stability of many extracellular enzymes. Calcium acetate was incorporated into the growth medium at 0.5 per cent level. After 96 hr of growth, the culture filtrate contained 49.54 units per mg in the absence of added Ca^{++} during growth, the activity of the culture filtrate was 35.0 units per mg. Culture filtrates treated differently viz. no added Ca^{++}, Ca^{++} added after growth, Ca^{++} added before growth, were stored for 15 days at 5°C when their activities were 35.0, 46.0 and 59.0, units per mg respectively. Hence it appears that Ca^{++} stabilizes the enzyme during storage and perhaps during growth.

Determination of acitivity at different pH levels (1-2, KCl-HCl: 3-8, citrate-phosphate) showed that the optimum activity was at pH 3.0 (118 units/mg protein), at pH 4.0 it had only 10 per cent of this activity and at pH 2.5, 80 per cent as active. Incubating the enzyme with substrate and buffer at temperatures ranging from 25 to 60°C indicated maximam activity at 35°C. The enzyme was stable on heating at 45°C for 10 min but was completely inactivated at 55°C for 5 min. Samples of the enzyme stored at room temperature, were assayed for activity. The results showed that the enzyme was stable for a week at pH 4.0 and at 3-8°C.

Selected enzyme inhibitors such as diisopropyl fluorophosphate (10mM final concentration), p-chloromercuri-benzoate (1 mM), ethylene diamino tetraacetate (1 mM) were used at pH 4.5 in the reaction mixtures. It

was found that the enzyme was not sensitive to any of these agents. Hence it may be an acid protease.

The present investigation suggests that the enzyme under study is similar to those elaborated by *Aspergillus saitoi*[2], *Trametes sanguinea*[7] and *Penicillium janthinellum*[6].

A detailed paper on these investigations will appear elsewhere.

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BOOK REVIEWS

Cottonseed Chemistry and Technology: by K. S. Murti and K. T. Achaya. Publications and Information Directorate, CSIR, Hillside Road, New Delhi, India 1975, pp. 348; Price Rs. 77.00, $ 32.00, £13.00.

A major portion of cottonseed produced in India is utilized as cattle feed in the form of whole seed. This results in the loss of valuable oil. Cottonseed crushing industry is growing fast in the country and has great potentialities for augmenting the fat resources of the country. Further, this industry will also provide valuable supplies of lint and hull which are vital raw materials for the manufacture of explosives, art silk, paper, plastics, furfural, etc. The defatted meal is a valuable source of good quality protein. The book under review deals with various aspects of cottonseed and consists of 14 chapters.

The first chapter gives a vivid picture of the cottonseed crushing industry in India before and after partition. An illustrative project report for processing 100 tonnes of cottonseed per day is included.

World production of cottonseed, their varieties, cultural aspects, harvesting, ginning, delinting and storage have been discussed in the second chapter. Precautions to be taken during storage to control the free fatty acid content and colour of the seeds have also been discussed.

The third chapter describes the physiological processes involved in the development of cottonseed. Apparently climatic conditions influence the oil and gossypol content of the seed to a great extent.

Pigments present in cottonseed have been discussed in the fourth chapter. These include gossypol, carotenoids, flavones and anthyocyanin pigments. Other pigments related to gossypol are gossypurpurin, gossyfulvin and gossycerulin. These are the transformation products of gossypol. In recent years the isolation of another pigment, gossyverdurin, has been reported. The chemistry of gossypol, its physical and chemical properties, important derivatives, reaction products with metals and proteins, amino acids and carbohydrates, and its synthesis are dealt with in detail. Separation of pigment glands of cottonseed by gland floatation, differential settling, air classification and liquid cyclone process is also described. Gossypol possesses antioxidant and antipolymerising properties. Other interesting application is as an intermediate in the production of antiseptics, pharmaceuticals, plastics and explosives.

The fifth chapter deals with the biochemical changes that occur in cottonseed either in the field or during storage. Any damage caused to seeds will result in an increase in the free-fatty acid (FFA) content and in imparting dark colour to the oil and meal.

Determination of grade and standards for cottonseed oil, cake, meal and edible quality flour have been discussed in sixth chapter.

The seventh chapter deals with common pretreatments like cleaning, decortication, delinting, breaking and conditioning and flaking of the meat for extraction of oil.

The recovery of oil from cottonseed is described in the eighth chapter under (*i*) cooking and drying of the flakes; (*ii*) oil extraction by pressure; and (*iii*) solvent extraction. Hydraulic processing, screw processing, prepress solvent processing, direct solvent (hexane) extraction have been described. Mention has also been made of the Skipin process and the extraction practices in USSR. In India about 90 per cent of the cottonseed oil is obtained from expeller processing.

Processing of cottonseed oil which includes refining or purifying the extracted oil is discussed in the ninth chapter. Alkali refining and bleaching techniques have been described in detail with a bias towards commercial processes.

Industrial hydrogenation is the subject discussed in the tenth chapter. The catalysts employed and the transformation taking place in the fatty acids during hydrogenation have been covered exhaustively. Originally, Vanaspati was manufactured in the country only from expeller pressed groundnut oil. In recent years, cottonseed, mustard, soyabean, safflower, sunflower and sesame oils are also being used.

Deodourisation of the oil is achieved under a high vacuum to remove traces of volatile materials which give odour or flavour. The process is applied to refined and bleached oils and hydrogenated products that are used for edible purposes. These aspects are covered in the eleventh chapter.

The quality specifications of the oil such as specific gravity, refractive index, melting point, iodine value, colour, the content of unsaponifiable matter and amount of free fatty acids, etc. have been described in the twelfth chapter. Crude cottonseed oil is reported to be slightly more digestable than either the refined or the hydrogenated oil. This may be due to the presence of phospholipids in the crude oil which influence fat digestibility. Cottonseed oil has a surprisingly high content of linoleic acid (50 per cent).

The chapter on cottonseed cake and flour describes the developments in the production of cottonseed cake in India. The various methods used for detoxification of the cake to obtain edible flour are discussed and these

are (*i*) controlled heating in the presence of moisture to cause the gossypol to interact with other components; (*ii*) complexing of gossypol with metal ions or chemical combination with aniline, ammonia, boric acid; etc; (*iii*) solvent extraction of cottonseed meals with acetone, or acetone/water/hexane; (*iv*) air classification or liquid medium separation techniques; and (*v*) selective breeding for glandless cottonseed. The various uses of edible cottonseed flour are also mentioned.

The last chapter deals with the types of linters, production of linters, quality specifications for Indian cotton linters, grading and utilisation. Linters have a wide application ranging from upholstery filling to the manufacture of rayon. Purified and bleached cotton linters are used in paper making, as plastic fillers and artificial suede and in the preparation of surgical dressings. Hulls are used as source of roughage in dairy cattle feed, as a soil conditioner, in phenolic plastics as filler, for the production of furfural and as bedding material in road construction.

The book thus deals with various aspects of cotton seeds in an exhaustive manner. It contains a number of useful tables and illustrations. Each chapter is provided with a complete list of references. The monograph is compiled after gleaning and evaluating information from diverse, authentic sources. It has an extensive subject and author index. The get up of the book is excellent. It will prove most valuable not only to oil technologists but also to nutritionists and food technologists.

K. HANUMANTHA RAO
M. S. NARASINGA RAO

Fabricated Foods: George E. Inglett. The AVI Publishing Company, Inc., West Port, Connecticut, 1975; pp. 215;

This book comprises of selected papers from a Short Course on Fabricated Foods sponsored by the Agricultural and Food Chemistry Division of the American Chemical Society and held in Las Vegas, Nevada during March 1974. It consists of 16 chapters contributed by different authors and covers a wide range of subjects. The chapters are (1) Fabricated Foods in Perspective; (2) Fabricated Foods in Our Economy; (3) Government Regulations Affecting Fabricated Foods; (4) Strategic Considerations Behind Fabricated Foods Development; (5) Marketing of Fabricated Foods; (6) Physical-Chemical Principles of Food Fabrications; (7) Soy Proteins for Fabricated Foods; (8) Carbohydrates for Fabricated Foods; (9) Textures by Extrusion Processing; (10) Sensory Analysis. Theory, Methodology and Evaluation; (11) Texture Properties and Evaluation of Fabricated Foods; (12) Flavouring Fabricated Foods; (13) Nutritional Aspects of Fabricated Foods; (14) Nutritional Evaluation of Fabricated Foods; (15) Protein Considerations for Fabricated Foods; and (16) Vitamin and Mineral Fortification.

Whereas all the other chapters deal with general aspects, the two chapters—Soy Proteins for Fabricated Foods and Carbohydrates for Fabricated Foods—deal with two specific types of raw materials especially for the preparation of Textured Vegetable Proteins (TVP). The chapter on soy proteins describes the known chemical and physico-chemical proteins of soybean. The chapter on carbohydrates deals with the basic principles involved in the different methods of texturisation such as spun fibre, chewy gel and extrusion cooking techniques, The chapter on Extrusion Cooking gives the process details for extrusion cooking.

The words Fabricated Foods have been defined for the purpose of the book as "foods that have been designed, engineered or formulated from various ingredients, including additives, will be called fabricated foods". These obviously include both imitation foods and those not known in nature and encompass a whole range of products such as dairy., beverages, desserts, prepared cereals, soft drinks, salad dressing, vegetable protein products. Inspite of this broad base, the reviewer notice a bias towards TVP in the book. This is obviously because of the promise that "meat analogues" and "meat extenders" hold in USA and European countries. It would have added to the value of the book if other types of fabricated foods had also been discussed in equal detail.

It is inevitable that in a multi-authored book the coverage and presentation will not be uniform. This book is no exception to this rule. Whereas some chapters have an in-depth coverage others deal with the subject in a general way. However, the book makes good reading and contains a lot of valuable information, some of which is new and codified for the first time. The get up of the book is good and the reproduction of some of the figures is excellent. Except for one or two typographical errors, the reviewer did not notice any serious mistakes. The book will definitely be a useful addition to the library of Food Technologists.

M. S. NARASINGA RAO

Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables: Edited by ER. B. Pantastico; AVI Publishing Company, Inc., Westport, Connecticut; 1975; pp: 560;

This Book with 560 pages and 23 chapters presents six important sections on different topics dealing mainly with postharvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. The first Section, 'General Introduction' begins with the chapter on structures of fruit/vegetable wherein the information on the physical and anatomical characteristics of fruit/vegetable is given in respect of their function related to ripening, loss of moisture and susceptibility to mechanical injuries. The Second Chapter describes the preharvest factors affecting quality and physiology after harvest with emphasis on the environmental influences such as climatic conditions, cultural practices, chemical spray applications, etc., as the major factors governing the fruit or vegetable physiology. The third Chapter in this section lists some physical and chemical changes in tropical and subtropical fruits.

Section two on post harvest physiology includes five chapters. In this Section are described the various methods of detecting stages of maturity in fruits for harvesting for long term storage and better quality product; effect of ethylene on the ripening of fruits; respiration rate and climacteric and chemical changes during ripening and senescence. The last chapter deals with morphological changes during maturation and senescence.

Section three entitled regulation on ripening and senescence is covered in three chapters. The first one describes the chemical modification by application of different growth regulators like kinins, kinetins, gibberellins, maleic hydrazide, alar, cycocelm MENA etc., to different fruits and vegetables. In addition to this, the chapter describes metabolic inhibitors like cycloheximide and actinomycin D, vitamin K, maleic acid, ethylene oxide and ethylene absorbants of fruits and vegetables. The next chapter in this section on Controlled Atmosphere Storage is presented in three parts. The first part on biochemical considerations explains the term modified or controlled atmosphere storage and its effect on the metabolism of the fruit/vegetable in respect of rate of respiration, acid accumulation, acetaldehyde formation, sugar increase and decrease in alcohol soluble and protein N, pectin changes and chlorophyll degradation. This part also reports the adverse and toxic effects of controlled atmosphere storage on fruit/vegetable. The second part presents the survey of the physiological effects and practical implications of regulating oxygen and carbon dioxide levels. Moreover the recommended conditions for long and short CA (controlled atmosphere) storage requirements are given with the goal of establishing time susceptibility response for specific commodities. The third part deals with CA storage requirements of fruits like avocado, banana, citrus, mango, lychee, papaya and pineapple and some vegetables like potato, onion, peas, okra, lettuce, tomato, sweet potato, etc., The next Chapter on irradiation describes the effect of ionizing radiation on several fruits and vegetables in extending their storage life by delaying ripening changes; minimizing insect infestation and microbiological spoilage and sprout inhibition. Biochemical changes and nutritional values due to ionizing radiation have been reported in some of the tropical fruits like mango and papaya. The Section four on harvesting and handling is covered in five chapters. The first one presents the techniques of harvesting 12 tropical fruits and several vegetables including underground structures like roots, tubers, and bulbs. The second one illustrates the bulk handling methods of commodities in boxes, baskets, etc. The authors trace various changes in bulk handling of produce to development of equipment for use in the field, packing houses and canneries. Bulk handling of some temperate fruits (apples, apricots, pears, and peaches) and vegetables (carrots, corn on the cob, potato, tomato, and beans) are discussed briefly. The next chapter on packing house operations describes various operations such as curing, degreening, precooling, washing, drying, waxing, grading, sizing, disinfectant treatments and color adding of different fruits and vegetables. The next chapter on the principles of packaging is divided into two parts. The first part, 'General Considerations' describes the benefits of good packaging, types of containers and packaging materials and lists some important steps in bulk and consumer packaged produce. The part two on consumer packaging with plastics presents various types of flexible plastic packaging materials and their permeability characteristics. The last chapter in this section 'storage and commercial storage operations' presents principles of storage, factors affecting storage, chemical changes during storage and types of storage operations with and without refrigeration.

Section five on 'Physiological Disorders and Diseases with three chapters describes the nature and possible mechanism of the chilling injury and their control in various fruits/vegetables at suboptimal temperatures. The next chapter on physiological disorders other than chilling injury is presented in three parts. The first, second and third part deals at great length on the physio, logical disorders other than chilling injury in citrus, tomato and other fruits and vegetables respectively. In citrus fruits, the disorders oleocellosis and rind break down have been described and their causes explained. Similarly in tomato, the causes of blotchy ripening have been listed and suggestions regarding overcoming such defects are listed. Some typical disorders in fruits like banana, lychee, avacado, fig, pomegranate, pineapple.

mango have been described. The last chapter in this section on post harvest pathology is presented in two parts. The first part on General Principles describes the infection process and factors influencing the development of diseases. The second part describes the control of the post harvest diseases in different fruits and vegetables.

The last Section on distribution and utilization includes four long chapters. The first one lists the principles of transport and commercial transport operations. The modes of transport, the pretransit treatment, packaging and transit environment have been described. In the next chapter, the quality of the raw materials suitable for processing has been presented. The third chapter on the market preparation of tropical and subtropical fruits is written after taking into consideration the type of economy of the region, local marketing practices and export potential. The fourth chapter describes the marketing and handling practices of different fruits prevalent in South East Asia, Thailand, Fizi Islands, Western Samoa, Hawaii and West Indies.

The information contained in this book on post harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables is very useful to those who are interested in post harvest handling of different fruits and vegetables. To the research worker engaged on the post harvest technology in food sciences, this may serve as a guide and to the Fresh Trade this book offers many useful and practical suggestions on the post harvest handling of fruits and vegetables grown in tropics. For the first time in a book of this type, marketing and handling parctices in different fruits and vegetables in South East Asia, Figi Islands, West Indies and Hawaii are presented. This book makes a very interest ing reading and undoubtedly will serve as a reference manual in many developing countries which are engaged on producing large quantities of fruits and vegetables and developing methods for their longer storage with minimum of spoilage during transportation and marketing. This book is a welcome addition to any library of food science and technology.

V. B. DALAL

Refrigeration Applications to Fish, Fruit and Vegetables in South East Asia: Proc. of the International Short Term Training Course held at Durgapur, India, in Jan. 1974, pp. 240;

This is a compilation of the proceedings of the international short-term training course held at Durgapur, India in January 1974 under the auspices of the FAO of the United Nations and the International Institute of Refrigeration, Paris. The short-term course was attended by 15 participants from 10 South-East Asian countries including India and by 11 observers from India. In addition, to lectures by experts in the field on different aspects of refrigeration and its application to fish, fruits and vegetables, a large amount of time was also spent in discussions for exchange of information in sharing the experiences and practices obtaining in different countries of the region.

The Proceedings has been divided into 5 parts and the second part dealing with a detailed account of lectures delivered by experts in each field and discussions at the end of each lecture, is the one that is most important and highly informative. It brings into focus the latest information in each field of application.

In the first lecture, Mr. M. Lorentzen of Norway has given a general survey of the entire field of refrigeration for conservation of perishable foods, including freezing and freeze drying, controlled atmosphere storage etc., and has indicated clearly the prevailing practices of storage, transport, marketing,e conomics etc. for developed and developing countries. The survey indicates the need to establish and expand cold chains from the field to the kitchen on a very large scale.

In the second, third and fourth lectures, Dr. E. G. Hall of C.S.I.R.O., Australia has dealt with the biological aspects on the cooling and freezing of fruits and vegetables, the techniques employed for pre-cooling and different types of long term storage and refrigeration of tropical fruits and vegetables. The lecture on composition, maturation, ripening and respiration deals with respiration rates, maturity standards, nutritional factors, optimum storage conditions, moisture loss, controlled atmosphere and skin coatings as means to increase storage life; freezing and its techniques and related matters and biological and microbiological aspects of freezing preservation. In the next lecture, Dr. Hall has dealt with such items as precooling methods, quality control in long cool storage, methods of loading and unloading merchandise, controlled atmosphere storage methods and structures, techniques of freezing etc. In the third lecture of Mr. Hall, storage of specific tropical fruits and their behaviour during cold and freezer storage like bananas, mangoes and citrus fruits and vegetables like sweet potatoes and tomatoes have been discussed.

Dr. J. H. Merritt has in two subsequent lectures dealt with both biological aspects and techniques of cooling, freezing and storage of fish.

Dr. Londahl has in two lectures given a general account of refrigerated transport system by sea, rail, road and air and the techniques of handling and distribution of chilled and frozen fruits and vegetables.

In the concluding lecture, Mr. M. Anquez has dealt with the economic aspects of the various applications of refrigeration.

The lectures contain lot of useful data and information for those engaged in the field of refrigeration and the compendium of lectures will be a very handy data book on the shelf of such workers. Such periodical meetings in different parts of the world will focus attention on the development of refrigeration in all the countries of the world and the I.I.R. is doing a useful service in this regard by publishing such proceedings.

S. K. LAKSHMINARAYANA

Plastic Films and Packaging: by C. R. Oswin, Applied Science Publishers Ltd., London; 1975; pp. 214;

Since entire books devoted to different aspects of packaging are very few, the introduction of this book by the well known packaging scientist is most welcome. This book is an another addition to the fast developing field of plastics film applications for packaging. The book is divided into 9 chapters dealing with various aspects of the manufacture, properties and application or uses of polymeric materials.

The introductory chapter deals with the 'structure and properties of polymers,' commencing from the descriptions on melting, glass transition and decomposition temperatures of plastics. Various physico-chemical properties such as the modulus of elasticity, permeabilities to water vapour and oxygen are described taking polymethylene as the paradigm. As has been pointed out by the author himself (pp. 4, 11 & 27) it would have been better to take as an example for describing the properties, 25 micron low density polyethylene film since the properties of this material are well studied and are more useful than those of polyethylene. Other properties of film manufacture described are antistatic, slip, blocking and additives, together with the pretreatment for printing—"keying" and other characteristics such as stress-strain relationships, and finally barrier properties of polymethylene. The various physico-chemical properties mentioned above are described with a view to acquaint the reader with the selection criteria of the plastic materials. The energy consumption values for the production of plastics are also given.

In the chapter comprising of polyolefin films, are included high density polyethylene and its production techniques, polypropylene as chill cast and oriented films and L.D.P.E. Since these two polyolefins are of greatest commercial importance, their characteristics and properties are described in detail. In the discussion on LDPE film, the values of various properties, viz., thickness, yield, tensile strength, elongation, young's modulus, resistance to water vapour and oxygen are given in terms of SI units and the corresponding familiar units. The values of these properties are given in a tabulated form for all the films described in detail. Other polyolefins, the properties of which are mentioned in brief are polyisobutylene, poly p-xylyline and a few copolymers of polyethylene and polypropylene, which include Ionomers (PE co A crylates). An important property of Ionomers is that they have better resistance to oils and fats compared to LDPE which is not mentioned. In the third chapter we have descriptions of substituted olefins which form the major group of commercial plastics such as polystyrene, polyvinyl alcohol, polyacrylonitrile, PVC of plasticized and unplasticized grades, polyvinylidene chloride and its copolymers, and the fluoropolymers. It is significant to note that benzoyl peroxide catalyst reduces the energy consumption by about a fifth for the polymerization of styrene.

The chapter on polyethers comprises of newer plastics such as polyoxymethylene, polyoxy ethylene, PPO, polysulphones and other established plastics like cellulose nitrate, cellulose acetate, ethylcellulose and alginate. Regenerated cellulose film (although strictly not a plastic) is included in this chapter. Because of the volume of production and diverse grades available to meet many end-uses, the manufacture, structure and properties of cellulose films are described in detail, but many characterestic types such as one-side coated film used for fresh meats and laminations, opaque grades used for protecting foodstuffs sensitive to light have not been mentioned. The group of condensation polymers-polyesters and polyamides which are growing in importance as packaging media are described in the next chapter. Polyester films find varied uses such as boil-in-the bag and for few electrical puposes, and these are highlighted. Poly-carbonate and polyimides are also described in brief. In general, the book is selective and aims at showing why certain polymers because of their properties are suitable as protective wrappings.

The major usefulness of the book, apart from the descriptions of structures and properties of plastics is to be found in the chapters 6 and 7. Under the chapter-materials and Mechanisms, topics included are papers, aluminium foil, laminates, machine-forming characterristics such as sheet-feed, heat-sealing, rigidity, styles of pack, bag making, different types of wraps, form-fill-seal machines and thermoforming. Chapter 7 details the selection of films for packaging uses. In this chapter, package functions and the proper selection of films to protect goods packed against hazards such as mechanical, climatic and biological are described. The

author has described succinantly the package-life prediction, its equation and a few examples of calculating the approximate shelf-lives of commodities sensitive to moisture. The packaging requirements of wares such as milk, biscuits, hardware etc. are also given. Although plastics are widely used in the packaging field, their applications in other domains like electrical equipments, adhesive tapes, weaving, crop-growth etc. are described.

In the last chapter of the book, the author describes the costs and benefits of packaging as a system in the present context of energy saving and environmental pollution. Although it is generally contended that all modern industrial innovations are energy consuming, it has been shown that how packaging could also be "energy saving".

The get up and printing of the book are attractive and its format is handy. The book is relatively free from typographical errors, but the units of resistance to water vapour permeability of UPVC and OPVC (p. 65) should read as MN.S/mol and reference of the properties table for cellulose film (p. 209) should read as 99 instead of 98. It would have been better to give units of various properties of materials in the familiar CGS units along with those of SI units since many are not yet familiar with the latter. The book is very useful for all the personnel involved in the packagings of foods, cosmetics and drugs.

K. R. KUMAR

British Medical Bulletin: 1975, *Vol.* 31, No. 3. Published by the Medical Department, The British Council, London.

This number of the Journal is specially devoted to highlight the undesirable effects of chemicals in our food and environment. This encompasses the whole area of environmental pollution and puts this problem in the right perspective with appropriate historical background. The introductory chapter of Dr Neuberger is an explicit analysis of the problem of environmental pollution. The cause and effect of relationships and their further implication in human health. This is followed by a statistical treatise of the acceptance of several risks faced by mankind during his life span and plan his living amidst these risks whether occupational or accidental. The third article is by Dr. Roy Goulding on chemical hazards in the home which deals with different types of poisoning hazards of gases and vapours, household products, garden chemicals and alcohol and points out that medicines and drugs still present a major poisoning hazard. Subsequent article by Dr. Barnes emphasizes the hazards of low levels of toxin substances and concludes that it is difficult to arrive at an innocuous level. In the article entitled "Analytical Surveys of Food", Harold Egan presents valuable data on organo-chlorine residues in mutton and beef kidney fats and other food materials consumed in British Isles. Of great interest is the information on nitrosamines in high protein foods. The next article by Dr. Crompton and Charlesworth discusses on the occurrence of natural toxins in food including carcinogens and oxalates. The problems posed by essential food preservatives have been dealt with in sufficient detail by Dr. Lloyd and James and it is pointed out that the benefits conferred by these preservatives seem to overweigh the hazards. The next article by Dr. Spencer is titled "Toxicological Assessment of New Foods" but it deals largely with hazards associated with different items of foods. Mr. Austwick has discussed the problem of mycotoxins in sufficient detail which stimulates considerable interest in the field. Dr. Higgins' article on the importance of epidemiological studies relating to hazards of food to environment carries a number of illustrative examples and affirms the importance of such studies. The next three articles by Drs. Barlara Claybon, L. Magos and M. Webb are concerned with metal contaminations of foods and their health hazards covering lead, mercury and cadmium. Dr. Martin deals with the important problem of water supplies of the future and the recycling of drinking water and gives broad guidelines for the future policy that deserves everybody's attention. The last article by Dr. Lawther deals with carbon monoxide, its source and hazard as a public health problem.

Thus, this number includes a wide range of topics which are of utmost importance as a public health problem. This serves as a good reference book for all those working on industrial and environmental pollution problems and serves as a useful guide for research scientists as well as public health workers.

V. SREENIVASA MURTHY

Pesticide Residues in Food: Report of the 1974 Joint FAO/WHO Meeting. Technical Report Series 574, WHO, Geneva; 1975; pp. 37. Ann. Subscription: sw. fr. 90.

The Expert Committee has classified the information under the following main headings, viz. Introduction, General considerations, Specific problems, Evaluation of data for residue limits, Comparison of potential daily intake of pesticides in diets with the acceptable daily intakes, Future work and Recommendations. Thirty references from FAO/WHO have been cited.

Annex 1 tabulates the recommendations concerning acceptable daily intakes and residue limits made at the 1974 meeting.

Annex 2 denotes further work or information required (or desirable) for Aldrin/Dieldrin (use patterns and residues in fruits), Amitrole, Azinphos-methyl, Captan, Chinomethionat, Chlordane, Chlorothalonil, 2. 4-D, (Storage and fate in food animals, residue data in soils and crops extraction procedures), Dichlofluanid, 2, 6-Dichloro-4-nitrobenzenamine (Dicloran), Dicofol, Dinocap, Dithiocarbamates (residue studies for ethylenediamine moiety and ethylenethiourea, fate of residues during processing with particular reference to ETU), Dodine, Endosulfan, Fenamiphos, Fenitrothion (further observations in man, effect of cooking on residues, post-harvest residues in oats, barley, rye), Folpet, Leptophos, Lindane (long-term studies on carcinogenecity, supervised trials on vegetables in countries where it is used widely), Pirimiphos-methyl, tecnazene.

Most of the lacunae of information centre round toxicity studies, and it is recommended that WHO seek the cooperation of the World Federation of Associations of Clinical Toxicology Centres and Poison Control Centres and other organizations in developing the relevant data Banks.

M. MUTHU

The Market for Cloves and Clove Products in the United Kingdom: by A. D. Adamson and S. R. J. Robbins. Published by Tropical Products Institute, London, 1975, pp 37, Price: £ 0.60.

The Tropical Products Institute has brought out a series of such reports on various spices, from data collected pain-stakingly. The report gives an insight into the trade in cloves within U.K., the uses to which it is put, and the future prospects for cloves and clove products. The information is of some importance to countries producing cloves. Since the dealers and commercial users of spices and spice products do not readily divulge correct information about the quantities used, the estimates are unfortunately not very reliable. However, an idea of the pattern is obtained, and is useful.

Y. S. LEWIS

Fenaroli's Handbook of Flavour Ingredients: Edited, translated and revised by Thomas E. Furia and Nicolo, Bellanca, CRC Press Inc., Cleaveland, Ohio 44128, U.S.A., 2nd Edition in two volumes, 1975, Vol. I. pp 551; Price: $ 32-95; Vol. II, pp. 928. Price: $ 43.95.

Reading through the volumes one realises the enormous effort that has gone into producing these hand some and informative volumes on flavours. The volumes are the expanded second edition of Fenaroli's Handbook of Flavour Ingredients, which has been popular with those using flavours in the food and beverage industries and R & D. The necessity for publishing it as a two volume edition has chiefly arisen due to inclusion of some of the comprehensive reviews on food science and technology previously published by the CRC Press. While these reviews are comprehensive and highly informative, these do not fit the pattern of the handbook and the intended users. If they had been edited to avoid, for example repetitions as in the reviews of sulfur compounds, details of mechanisms of formation of aroma compounds, extensive spectral data, etc., but containing flavour significant principal compounds, their odour description, threshold, effective use levels etc., it would be more readable and useful and less confusing to the general users of food flavours. It is also not clear why these reviews have been distributed in the two volumes, instead of forming a volume of basics for the emerging flavourist.

Our further comments should be seen from the point of view that the field is replete with confusion. Though there is a chapter on definitions, it does not clear up matters by defining terms or giving the definitions now adopted by international and national standard organisations, ISO, ASTM, BSI and ISI. The word flavour is used almost synonymous with taste instead of the now accepted total impression of aroma, taste and other feeling factors. Rus Schay has however subsequently used the term flavour with the full meaning. Palatable, unpalatable are not flavour class but affective reactions to the flavour. It is necessary to make a distinction between affective characteristics, which is purely subjective and sensory attritubes which could be objectivised with respect to standards. Much of the book really deals with volatile and aroma components from natural material or synthetic volatile and the emphasis on use data is, as an aroma compound. The write-up on history and sensory mechanisms are adequate summaries for the flavourist and the references are adequate for those who wish to pursue further. It could have been made clear that all these theories are only with respect to what happens at the site of reception but the mechanism of coding and decoding the message is much less understood, though important to explain mechanisms of adaptation, learning, etc.

The reviewer wishes that the topics on biogenesis, instrumental identification and sensory evaluation had been treated at greater length and not so scantily as in this volume, so that the flavourist understands the com-

plexity of a natural aroma concentrate and the enormous research effort and sophisticated instrumentation necessary to work in this area. It is precisely because of this separation analysis and identification coupled with sensory evaluation that many nature—identical synthetic flavour formulations are now available, Some of these information are available in the CRC reviews now included but is lost among a mass of other information. The topics on flavour potentiation and relationship of taste to flavour are fairly adequate to give the proper perspective though some references for further study by those interested would help. Ray Schay's treatment of classification and preparation are the near ideal for the purpose of these volumes except that an expanded reference could have been given. These topics could profitably be given much earlier in the volume.

The rest of Volume 1 contains valuable and usable information on natural flavours, currently approved for use in the United States under the Federal Food and Cosmetics Act. The Volumes would be more universally useful if the official and usage status of the compounds in other countries as United Kingdom, Europe and Japan are also included. The reviewer would like to suggest that the organoleptic characteristics be better called flavour characteristics and uniformly the odour and taste are given. It is confusing to read for example: 'Strong, fresh, somewhat spicy odour; warm, slightly burning taste' for Dill and 'Caraway like odour and flavour' for Dill, Indian; 'Aromatic bitter taste' for Juniper; 'Bitter flavour' for Kolanut; warm spicy odour with biting flavour' for *Schinus molle*; characteristic lemon-leaf odour; sour, bitter taste' for lemon and 'intensely fresh citrus aroma; astringent; sweet sour flavour' for lime. Also some items such as sesame, are described as used for flavouring but no flavouring characteristics are given.

It is possibly necessary to differentiate between flavour ingredients and adjuncts and omit from this volume items as cork oak, corn silk, senna, sugar beet extract base, peanut stearine, etc. Some of the information under the individual monographs will have to be corrected as in: Cacao: parts of plant used should read seeds fermented and toasted'; instead of 'seeds (toasted or fermented).

Cardamom: The information given under description needs revision. Malabar, Mysore, Ceylon are all probably different cultivates; the seeds are not taken out for sorting but the whole dried fruit. The Mysore variety is processed by a bleaching treatment before drying resulting in uniform light coloured but plump dried fruits while the Malabar and Ceylon varieties are straight dried and so are green.

Cubeb: is the whole dried berries and not the seeds extracted from berries.

Davana: The part of the plant used is the stalk and leaves and not the flowers.

Ginger: The main pungent constituent of the extracts are gingerol and shogaol and not zingerone, as seen from the work of Connell *et al.* given under bibliography.

Grape fruit: Nootkatone, one of the few characteristic aroma compounds identified should be mentioned.

The reviewer would like to suggest that however individualistic, it would be considered information on the flavour quality difference between closely related flavour ingredients such as Lemon petitgrain, lemon oil cold pressed, lemon oil steam distilled and like oils be given to initiate the starting flavourist in flavour nuances.

Vol. II of this Handbook has more than 1100 entries on the synthetic flavours in part III, which as is familiar to the users of the first edition, is a very valuable source of information for those engaged in flavour development and flavour research. In the second edition, the natural occurrence information is updated, data on new synthetic flavour ingriedients appearing in FEMA lists 4 through 8 (upto 1974) and additional references are included.

The few suggestions given, in the reviewer's view will improve the presentation and not confuse the flavourist who is not generally a structural organic chemist.

(*i*) Formulae presentation should be uniform in representation of the rings and side-chain. Cyclohexyl cinnamate has two modes of representating aromatic nuclei.

3-Nonanone formula runs into the adjoining column, when 2-nonenol with the same chain length is shown within the column.

Different shaped furan forms and side chain representation for the formulae for 2-pentylfuran and pentyl-2-furylketone.

(*ii*) Synthesis of some products are not given as in p. 459 and in some cases rather extensively with formulae as in p. 377.

(*iii*) The natural occurrence information could be related to the compounds in food products only; some are noted 'not reported' and others left blank.

(*iv*) The FDA status of many compounds are not given.

(*v*) Organoleptic (flavour) characteristics are not given in the case of a number of compounds and the use of the words taste and flavour is again confusing as in strawberry taste (p. 423); winey....fruity flavour (p. 468); floral fruity odour (p. 482), vanilla like odour and flavour (p. 491). etc.

(*vi*) The organoleptic characteristics should relate to use levels; It is also not clear if the characteristics given

are descriptions by Mr. Fernaroli from literature. If the later, references are required which will be of much use to the flavourist.

(*vii*) While zingerone and piperine are given, other cheaper synthetic pungent compounds are not given.

There are a few obvious errors as zingerone being reported in ginger essential oil and having an odour reminiscent of ginger (p. 563) and a reference to updated list on pineapple aroma compounds on p. 664 while what is given there is aroma compounds of coffee.

Part IV, besides three major reviews on 'Role of Enzymes in Food Flavour', 'Meat Flavour' and 'Bread Flavour' deals with the use of flavor ingredients in food and discusses a number of formulations for different fruit flavors, bitter flavors, liqueut flavors, flavor for baked goods etc. There are also general description of the methods of making beverages, candies, dairy products, fish, vegetables and miscellaneous products including animal feeds. It is not clear why these general methods are included and without further elaboration on aroma components could be conveniently deleted.

The usefulness of Section IV, giving the formulations could be debated but as the volumes are intended for budding flavourists, they will serve as useful starting points. It should, however, be necessary to give guidelines on the selection of the aroma and taste components and the basis of the formulations.

An interesting feature of the two volumes is the fairly comprehensive, bibliography classified by the entries of topics and index pertaining to each volume.

V. S. GOVINDARAJAN

Potato Processing: by W. F. Talburt and Ora Smith. The AVI Publishing Company Inc. West Port, Connecticut 3rd, Ed. 1975, pp: 715; Price: domestic £ 39 and foreign £ 40.

Practically all the chapters in this 3rd edition have been revised by including literature published upto first half of 1974. Some of the chapters have been rewritten. Latest information on technology of growing, harvesting, storing and processing potatoes into various products has been incorporated.

With the rapid growth in potato processing and accompanying problems of waste disposal and water pollution, it has become necessary to substantially change processing procedures and equipment to minimise these problems. Latest theory, engineering data, equipment and procedures including both aerobic and anaerobic removal of soluble solids as adopted by a number of major potato processors are discussed in depth.

One of the recent significant developments in potato processing has been the "fabricated potato chip" in which dehydrated potatoes are generally used as an ingredient. This and other developments in the industry including changes in cultural practices, improved storage installations and new varieties are detailed in the review of scientific and patent literature covered in the book.

Even though the book covers technology of potato processing in America, it will be useful in the present day Indian conditions where potato production is increasing every year and surpluses may find useful outlet for processing into various products discussed in the book.

The book will be a useful addition to the libraries of Agricultural Universities, Home Science Colleges and for food technologists and production chemists in canning and dehydration factories.

B. S. BHATIA

Food Service Facilities Planning: by Edward A. Kazarian; The AVI Publishing Company, Westport, Connecticut, U.S.A. pp. 230.

'Food Service Facilities Planning' amply justifies its objectives of providing systematic methodology in the planning of food service facilities by identifying thelements, indicating the complexities in different situations and illustrating how effectively planning and equipping can be done, once the variables are identified and understood. Norms for wise space allocation, principles for establishing flow of materials, planning to effectively use labour, flexibility to adjust to change, are comprehensively covered, giving clear and concise details.

The book can be a valuable text book for students of Hotel and Catering Management courses, where food facilities planning and equipment purchase, form an important subject. It is also an excellent reference book for architects involved in planning and equipping food facilities of institutional, industrial and commercial operations.

THANGAM E. PHILIP

NOTES AND NEWS

Twentyeight Years of Standardization in India—Indian Standards Institution

As on 31st March 1975, over 8,100 Indian Standards were in force of which 75 per cent were implemented by important organisations; and about 4,300 licences covering annual production value of Rs. 8,500 million had been issued under the ISI Certification Marks Scheme. This is revealed in the Annual Report of the Indian Standards Institution, released recently, covering the period April 1974 to March 1975 and marking the completion of 28 years of its service to planned industrial development through standardization and quality control.

The total number of Indian Standards in force as on 31st March 1975 reached the figure of 8,105 covering a wide range of materials, industrial and agricultural products, test methods and codes for design and construction practices. This achievement reflects the cooperative efforts of some 29,000 technical experts constituting the membership of over, 2,000 Councils and Committees of the Institution drawn from Central and State governments, industrial establishments, commercial organizations, universities, research and other technical institutions, and organized consumers and purchasers in the country.

Coupled with the drive for wider implementation, concerted efforts were made to improve the utility of standards by integrating the concept of quality control with standardization. As a result, about 75 per cent of standards were adopted by various departments of Central and State Governments local bodies and industrial undertakings in public and private sectors. Vigorous steps were taken to promote implementation of the National Building Code of India—a comprehensive guide dealing with the entire question of building construction from bye-laws through design and construction to installation of all services and assistance was rendered to various organizations to align their building bye-laws with the provisions of the code.

Against 8,708 applications received under the ISI Certification Marks Scheme as on 31 March 1975, 4,284 licences covering goods with the annual production value of Rs. 8,500 million were granted. Some new products of consumer interest, brought within the scope of the Scheme, included aluminium milk boilers, chewing gum, bubble gum, cotton yarn (gregy), DDT (technical), ferry-alloys, food-colour preparations, insecticidal spray, rubber soles and heels (moulded solid), soda ash (fused and technical) spark ignition engines, sprayers (atomizer type) and steel sections for industrial buildings.

More organizations accorded preference to ISI marked products in their manufacturing and purchase programmes. The steel industry-both primary producers and re-rollers—has been certifying structural steel under the ISI Scheme for some years now. According to a government notification, it was proposed to extend the coverage of various types of alloy steels and cast billets produced by mini steel plants. Union Ministry of Petroleum and Chemicals advised formulators of pesticides that they would not be eligible for allocation of raw materials for such formulations as are not covered by ISI Mark. State Governments of Assam, Bihar, Meghalaya and West Bengal agreed that only ISI—marked pesticides would be permitted to be used for plant protection work. Registrars of cooperative societies of all States and Union Territories were told that consumer cooperative stores should purchase ISI certified goods wherever available.

In order to carry the economic benefits of standardization to plant level operations, the Institution continued its efforts to promote in-plant or company standardization activities. Special emphasis was laid on "Extension Services" which were offered to the industry for promoting company standardization activities, metricization and quality control. A number of units benefited from these services during the year under report.

In its efforts to promote educational utilization of Indian Standards, the Institution organized a number of orientation courses aimed at acquainting technical teachers with the work of ISI. These were intended to prepare the ground for introducing the concept of standardization in technical education. As on 31 March 1975, 1,688 faculty members drawn from 305 technical institutions all over the country had participated in these Orientation and Review Programmes of the Institution.

The Institution took active part in standardization at the international level, maintaining close liason with the International Organization for Standardization (ISO) and the International Electro-technical Commission (IEC).

The Institution continued to render assistance to the developing countries of Asia, Africa, and Latin Amreica in their standardization activities. During the period under report, seven persons from Panama, Ethiopia, Trinidad, Sudan and Egypt were trained as standards engineers, bringing the total as on 31st March 1975 to 71 technical personnel from 20 countries who had received training at the Institution.

Seminar on food and agro-based industries

A Seminar on the Potentialities and Prospects for

Food and Agrobased Industries in Tamilnadu and Pondicherry was held at Madras, on the 14th November 1975 under the joint auspices of the Small Industries Service Institute, Madras, Association of Food Scientists & Technologists (India), Madras, Food & Nutrition Board, Government of India. Director of Industries and Commerce, Government of Tamilnadu, Tamilnadu Small Scale Industries Association and other agencies in collaboration with the enterprising entrepreneurs and large, medium and small scale sectors of the industry.

Following recommendations were drawn during the course of the Seminar.

1. *Manufacture of mango products:* Large quantities of mangoes are being sent from Krishnagiri in Dharmapuri District to far off places like Bombay and other markets where they are processed and sent abroad. The efflux is going on for a considerable part of the year. The scope for starting an industry for the manufacture of mango products in Tamilnadu may be explored.

2. *Tamarind based industries:* Keeping in view the very good domestic market and export demand, it was considered worthwhile to take up tamarind concentrate manufacture especially in Dharmapuri District, where resources are available in plenty. The CFTRI, Mysore had already done a lot of useful work on tamarind pulp. There was already a brand available in the market viz. TAMCON. It can be expected that entrepreneurs in larger numbers will come forward to set up this industry. The possibilities of starting tamarind concentrate units in the State may be examined further.

3. *Starch from tamarind seed:* It was felt that there was good scope for manufacture of starch from tamarind seeds, especially in areas like Dharmapuri which abound in tamarind trees. Tamarind starch is used for sizing of jute textiles and of low count cloth in cotton textiles. The possibilities of starting tamarind starch units in Districts like Salem, Dharmapuri, etc., may be examined in detail.

4. *Manufacture of essential oils:* The Seminar felt that good scope exists for the manufacture of essential oils, the areas having potentialities being Coimbatore, Madurai and the vicinity of Madras Small units for the extraction of jasmine oil could be set up. Regarding roses it was felt that the variety known as "Edward Rose" was more suitable for the extraction of oils and may have to be preferred to the "Red Rose".

5. *Fruits and vegetable preservation:* The Seminar felt that a selective approach has to be made with regard to the development of fruit and vegetable preservation industry. The market aspects are to be kept in mind. The cultivation of fruits and vegetables has to be done with an eye on the duration of the crops and their seasonal nature. For example mango is grown in plenty in the country. There is very good scope for canning of mango and exporting the same. Mango pulp also has lot of export demand. Similarly tomato concentrates have a high demand even in the developed countries. All these factors underline the necessity for a careful and selective approach to the issue of the development of fruits and vegetable preservation industry.

6. *Starch from tapioca and maize:* The possibilities of starting units for the manufacture of starch from tapioca and maize in the State will have to be further explored. Maize starch, though costly, is used in superfine cloth manufacture and for sizing synthetic fibres.

7. *Soyabean milk:* It was felt that possibilities for the introduction of soyabean in Tamilnadu were very good. Some experiments on soyabean have already been carried out in a few of the Agricultural Research Stations in Tamilnadu, holding very good promise. The possibilities of introducing soya milk from soyabean a novel item, in the State may be explored.

8. *Peanut butter:* The Seminar felt that possibilities for the extension of peanut butter manufacture in the State may be examined. As regards the packaging materials for peanut butter, it was felt that glass bottles were the best, although costly. Much of extension efforts may have to be done for the wider usage of peanut butter. The nutritional value of the same will have to be articulated.

9. *Process know-how & demonstration by Small Industries Service Institute:* In order to accelerate the pace of development of food and agro-based industries in the rural areas in Tamilnadu, the Small Industries Service Institute, being the promotional agency, may take necessary steps for the dissamination of information and process know-how on feed and agro-industrial possibilities and also for the demonstration of the processes wherever necessary.

10. *Policy for the planned development of food and agro-industries:* It was felt that a committee may be constituted at the national level with the specific responsibility of evolving a policy for the planned development of food and agro-industries in the country. The need for a policy statement and a committee to go deeper into the problems of agro-based industries was felt keenly in the context of the fact that these industries have not developed in our country to any significant extent during the last two decades. Development of food and agro-based industries, utilising locally available raw materials and factoral endowments, being an essential tool for rural development, the Seminar felt the need for a co-ordinated policy for the development of food and agro-based industries.

11. *Development of low cost cold storage facilities:* It was felt necessary at the institutional level to develop

less expensive cool rooms or cold storages for easy adoption by farmers and fruit and vegetable growers. The Seminar felt that non-availability of cool rooms or cold storage facilities at reasonable cost has been the major impediment for the proper storage of fruits and vegetables and horticultural products at the growing and collection points. This has resulted in decay and damage of fruits and vegetables. Hence design and development of less expensive cold storages is an absolute necessity. Development of cool rooms or cold storages is a pre-requisite for promoting fruit and vegetable processing industries in the country.

12. *Reducing the delay in the processing of applications for starting food industries:* The time factor involved in the various stages of processing of applications and clearances required from the different agencies like the Panchayat Boards and other local bodies, factory inspectorate, electricity department, etc., before the registration of small scale units, should be examined and ways and means devised to complete the formalities expeditiously and reduce the time lag to the minimum.

13. *Royaly & licence fees:* This Seminar recommends that the question of reducing royalty fees and licence fees for the commercial exploitation of the processes developed in the field of food and agro-industries by the National Laboratories, to entrepreneurs desirous of setting up industries in rural areas should be considered favorably so that new food and agro-based small industries could come up especially in backward areas which are having the necessary resource endowments.

14. *Liberalised financial assistance to food and agro-based industries in the backward areas of Tamilnadu and Pondicherry:* It was resolved that the financing institutions should be urged to give loans and other types of financial assistance on a more liberalised basis to food and agro-based industries especially in the backward areas of Tamilnadu and Pondicherry. It was also resolved that government agencies like Tamilnadu Small Industries Development Corporation, State Industries Promotion Corporation of Tamilnadu, Industrial Investment Corporation, etc. may be requested to provide liberal facilities and greater importance to feasibility studies relating to food and agro based industries.

15. *Supply of levy sugar to small scale units:* It was felt that government may consider allotment of levy sugar to meet the requirements of small scale industries, especially the food industry. The need for such a preferential treatment was felt because of the present constraints of non-availability of sugar at reasonable costs.

16. *Subsidised licence fees:* It was resolved that the Tamilnadu Small Industries Development Corporation and the Pondicherry Industrial Promotion Development and Investment Corporation may be requested to examine the proposal for giving subsidy to cover the licensing fees of NRDC. It was resolved that NRDC may be persuaded to make its terms liberal and attractive for its processes for food & agro-based industries in the small scale sector, the SIDCO and PIPDIC could be exhorted to take an early decision in the matter of subsidy for covering the NRDC Charges.

17. *Marine products industry:* It was resolved that the following bottlenecks faced by the marine products industry may be brought to the notice of the Directors of Fisheries, Tamilnadu and Pondicherry and other concerned agencies for further follow-up action.

(*a*) *Lack of facilities for proper landing:* Preservation of catches without allowing them to spoil is a fundamental requisite for the fishing industry. There should be a chain of ice plants in working condition at the landing points along the coastal belt of Tamilnadu and Pondicherry. There should also be proper roads from the landing centres and facilities for transporting the material to the processing centres. The losses due to spoilage of material are high because of lack of those facilities.

(*b*) *Power cut:* The convulsions through which the fishing industries passed in the periods of power cut made many units pull down their shutters. It was resolved to request the government to consider a totally export-oriented industry like fish processing industry on a different basis as compared to other industries which depend on indigenous market in times of power crisis and give them maximum concession.

(*c*) *Purchase tax:* The Government of Tamilnadu has introduced a purchase tax of 5% on all marine products bought within the State. If the industry which is in its infancy in Tamilnadu is to grow further, it is necessary that this tax which is detrimental to its growth is immediately withdrawn. It was resolved to request the Government to help the industry attain pre-eminent position in the country in the export of marine products, by adopting a lenient policy in the matter of taxation.

(*d*) *Regular sea transport facility:* The frozen cargo at present from Madras is shipped to Japan and USA. But the sailings are not at all regular from Madras to UK and Continental countries. It was resolved that careful attention has to be given to this point.

(*e*) *Dried marine products:* For dried fish, Sri Lanka is the principal market. For various other commodities which are exported, government gives cash subsidies and other incentives so that the prices of the goods exported could be at the international level. Dried fish is not a sophisticated item and it can earn foreign exchange without spending any foreign exchange. It was resolved

to request the Governments of Tamilnadu and Pondicherry to protect this age-old industry in the State and bring home to the government of India the necessity to give cash assistance to export dry marine products in order to help the same to compete with other countries who are exporting the same.

(*f*) *Shark fins:* It has been reported that shark fins can be further processed before export. However, there is need for studies in the foreign market by people who are really engaged in this industry. It was resolved to request the Govenrment to sponsor a delegation for studying the possibilities for accelerating the export of these items which have not developed very much now.

(*g*) *Export of froglegs:* It was brought to the notice of the Seminar that the introduction of standards according to U.S. specification resulted in rejection of processed frog legs within Europe. While the European buyers were not insisting on these standards, the Government of India insisted that the U.S. standards may be followed even for exports to Europe so much so, it was contended that India lost its export to European markets. Ultimately, the buyers of Europe had to come and advise the concerned agencies that the specifications for export to Europe need be the same as used to be earlier and not the one introduced as per the understanding with the USA. There was a time lag of nearly one year for the Inspection Agency to accept this contention. In the meanwhile, the country had lost much of its trade. It was felt by the members during the discussion in the Seminar that the whole issue may be reviewed and decisions about standards taken in future at least after establishing proper dialogues with buyers and sellers.

(*h*) *Programme for deep sea fishing:* An assessment of the existing situation in relation to the availability and distribution of raw materials, infrastructure facilities and the policies governing industry has to be done before more units are allowed to come into this field. If the existing capacity is sufficient to process the available catches, measures should be immediately taken for enhancing the raw material availability through deep sea fishing and diversification to new product lines like canned tuna, frozen and pickled varieties of fish, frozen cuttle fish, canned turtle and crab meat, fish meal, fish oil, etc. These are exportable items. Once there is a programme for deep sea fishing, varieties of fish now available in the west coast like sardines, mackerels, pomfrets, etc. can be caught and processed in the Eastern Coast as well. For all these new items of marine products and many new products like fish paste, fish cake, instant soup, etc., developed by some of our research laboratories, there is good scope for expansion, and it was resolved to appraise the Government of Tamilnadu and Pondicherry of these possibilities and request them to prepare in the light thereof a planned programme for the growth of the industry in the State.

Sixth All India Piggery Development Conference

This Conference was held in Shillong, Meghalaya, on 11th and 12th September 1975. It was inaugurated by Capt. W. A. Sangma, Chief Minister of Meghalaya, and the Hon'ble Minister of State for Agriculture and Irrigation, Government of India, Shri Anna Saheb P. Shinde was the guest in chief. Shri E. Barah, Minister for Agriculture and Animal Husbandry, Meghalaya, presided over the Inaugural Session and Dr. M. N. Menon, Animal Husbandry Commissioner was the principal speaker. The welcome address of the Conference was given by Shri K. K. Sinha, Secretary, Agriculture and Animal Husbandry, Government of Meghalaya; Dr. L. R. Bora, Director, Animal Husbandry, gave the vote of thanks.

The four technical sessions included:

(*a*) Breeding, Management and Nutrition of Swine; (*b*) Problems of Swine Diseases; (*c*) Technology, Quality Control and Marketing of Pork Products; (*d*) Swine Production as Economic Enterprise through SFDA/ MEAL Scheme.

The chief minister of Meghalaya, in his opening address said that there was ready and effective market for pork and pork products in North Eastern States. His Government is extermely keen to encourage pork production programme.

Dr. Menon, explained in detail the objectives for organising the All India Piggery Conference in Meghalaya and how it is going to benefit all the animal husbandry workers who are associated with the different disciplines of pork production in India, viz., production, technology and marketing of pork and pork products. He indicated that the development of swine husbandary on right lines would improve the economic conditions of the small and marginal farmers and it would also help the progressive farmers to a considerable extent. He was of the view that pork production has started developing as an economic enterprise at all India level, particularly, to the people of North-Eastern States. Pork meat price is relatively much higher in North-Eastern Region than in any other part of the country. He felt that the pork production has significant role to play in the animal husbandry programme in the North-Eastern States since a significant amount in the budget of the Animal Husbandary Development work in North-Eastern Region is ear-marked for piggery development.

In short, it was a unique conference for the development and research workers who are associated with pork production and technology. Since pig husbandary

is one of the very important activities of the animal husbandary development programme in all the North-Eastern States, this Conference had a special significance and impact upon the common pig growers of this region.

The recommendations made are as follows. The Seminar recommended.

Breeding, management and nutrition of swine.

1. That there has to be clear cut breeding policy for the pigs in two areas i.e., the regional pig breeding stations where exotic stock is kept and another for the piggery development blocks at village level. Selective breeding policy for the exotic pigs maintained at the Regional Pig Breeding Stations should be followed and grading up of nondescript stock by the exotic boars from the regional stations at the piggery development block level should be undertaken immediately.

So far extremely limited number of pigs have been imported from outside India. Government of India may import more foundation stock of improved genetic traits for distribution to the regional pig breeding stations to avoid in breeding.

2. That for the North Eastern States under the Danish Programme, pigs of both black (Saddle-Back and Bershire) and white strains (Large White & Landrace) may be imported for establishment of foundation stock. The economic traits of these breeds may be studied under organised farm and field conditions. The breed more suitable for this area may be selected for large scale improvement of the local non-descript pig population.

3. That there should be co-ordinated pig breeding programme of various regional stations with occasional exchange of breeding stock so as to avoid any inbreeding.

4. That in some of the South East Asian Countries, artificial insemination of pigs are also done with great success. Efforts should be made so that artificial insemination technique for breeding of the pigs at regional pig breeding stations, pig farms of the Agricultural Universities and Research Institutions could be undertaken.

For this purpose necessary arrangements should be made to get the persons suitably trained.

5. That the use of creep feed for the suckling pigs should be undertaken at the pig breeding farms. This will encourage growth rate and heavier weaners. The use of iron injections to check piglet anaemia is desirable.

6. That separate grower and finishing rations may be given to the growing and finishing pigs.

7. That liberal feeding of concentrates to the breeding sows/gilts may be avoided. Efforts should be made to replace the costlier grains by the grain by-products keeping in view that growth and feed efficiency is not appreciabely affected. Experiments have shown that grains can be reduced to 30% in the rations of growers and finishers without affecting growth rate of pigs. Efforts should be made to produce the lean pork by restricting energy ration during finishing period.

8. That quality control of pig's feed is very important. Necessary steps should be taken to see that uniform quality control of the pig feed is maintained. The Regional Pig Breeding Farm should have a nutritionist for the quality control of the pig feed.

9. That the Indian Standards Institution have the specifications of feed requirements for various classes of pigs. The feed compounding industry should come forward for the preparation of various types of feeds for the pigs.

10. That the pigs kept in the intensive piggery development blocks are generally non-descript and they normally feed by scavenging, or on kitechen/restaurant wastes and on agro-industrial by products. Since in this practice the cost of feed is very less, this practice has to continue, however, the local supplements (including concentrates and minerals) which are available may be analysed and their incorporation in the pig ration has to be studied under field conditions on scientific lines so as to improve the growth rate of pigs.

11. That about 30% of the piglets die before the weaning time, to overcome this, proper farrowing pens should be provided at pig breeding farms.

12. That personal attention at the farrowing time is extremely important to reduce the death loss of the piglings. The organised farms and the government farms in particular should adopt a system of recording farrowing times of the pigs.

13. That proper housing for grower and finisher pigs should be provided.

14. That proper records area must for the each pig breeding farm so that the production cost of pigs could be arrived at without any difficulty. System of maintaining proper record to determine the economic traits of swine herd and their production cost in the farm is extremely important.

Problems of swine disease

1. That village level workers should be trained in local language by the veterinarians regarding the problem of swine diseases and its control.

2. That more stress on preventive measures should be given for the pigs maintained at the pig breeding farms and for pigs maintained by the farmers.

3. That Agricultural Universities should arrange its curriculum and syllabus in such a way so as to produce

specialist in the field of pork production and technology. At present, this aspect of specialization is not adequately covered in the Agricultural University syllabus.

4. That idea of composite livestock farm should be discouraged as some diseases are communicable from other species to the pigs. Further work should be encouraged in the metabolic diseases of pigs. Regular testing against tuberculosis and brucellosis should be carried out at the pig breeding farms.

5. That at least a post of Assistant Disease Investigation Officer (Pigs) should be created in all States, so that proper attention could be paid to pig health at state level.

6. That advance indents for the swine fever vaccine should be sent to the Indian Veterinary Research Institute, by the States so that the Institute can cater for the need of the States without any difficulty and can arrange its production schedule accordingly.

Technology, quality control and marketing of products:

1. That the results of the researches carried-out under various organisations on pork processing and qulity control should be made available to bacon factories for improving their economics and quality control of the processed products.

2. That attempts should be made to utilize the by-products of the bacon factory viz., bones, blood, glandular products, intestines and offals in the scientific manner for getting better returns.

3. That for proper implementation of the meat products control order with the object of improving hygienic conditions and quality control of the meat processing plants, uniform and practicable standards for processing, quality control, sampling testing and packing should be laid down by the implementing agency. The Meat Control Order should also be made applicable to the production and sale of fresh meat to ensure supply of wholesome and hygienic meat to the consumer both internal market and export trade.

4. That extension literature on pork production and technology in regional languages should be made available.

Swine production as an economic enterprise through SFDA/MFAL Programme:

1. That the importance of increasing swine production through small and marginal farmers to improve socio-economic conditions of the poorest and weaker sections is well recognised and it should receive adequate attention of State Animal Husbandry Department to implement the programme.

2. That it is necessary to identify suitable blocks, village and farmers within a given SFDA/MFAL District. The selection should be on a compact basis so that inputs could be provided quickly and marketing and follow-up are done efficiently.

3. That advance action may be taken by each State Animal Husbandry Department to ensure that the required infrastructure would be made available in respect of trained personnel, supply of pigs, supplementary concentrate feed, veterinary aid, marketing and extension education facilities so as to make the programme a great success.

4. That as far as possible, efforts should be made to organise producers cooperatives on the lines of dairy cooperatives (Amul pattern). The workers in cooperatives should be properly trained in extension education of pig farming, accounts and audit keeping.

ASSOCIATION NEWS

National Seminar on Mango and Its Utilization, organised by the Eastern Regional Branch of AFST.

The Seminar held on 6th and 7th March 1976 was inaugurated by Dr S. B. Chattopadhyay, Vice-chancellor, Bidan Chandra Krishi Viswavidyalaya, on 6th March 1976 at Jadavpur University. About 200 scientists, technologists and industrialists, representing different parts of the country and abroad took part.

Dr. Chattopadhyay stressed the need for boosting export of mangoes and mango products. To achieve this, he felt it was necessary to (*a*) increase the number of exportable varieties; (*b*) implement the recent government decision on land ceiling; and (*c*) select right type of raw materials and pay attention to preservation and appropriate packaging.

He further mentioned that export of this product in a small way was started as for back as 1896 and in a regular manner in 1932/33. Dr. Chattopadhyay requested the scientists, technologists and industrialists to study closely the overseas consumers preferences and try to meet their requirements.

Prof. A. N. Bose, Chairman, Seminar Committee, highlighted in his speech the objectives of the Seminar. He outlined the topics to be considered which included raw materials, technology of green and ripe mangoes, their quality control and marketing. He also hoped that the discussions would be of interest and will be of benefit to the country.

Shri N. P. Bhargava, Chairman, the Processed Food Export Promotion Council, New Delhi in his keynote address pointed out that for the development of mango and mango product industry in our country, proper attention should be paid to increase the area of production and to adopt improved technique of harvesting, plucking in right time, etc. He also stressed the need for appropriate packing and storing to suit the overseas buyers' requirements. Research work for the improvement of mango and its processed products has since been started in different parts of the country. Shri Bhargava felt that the industry is not being fed with adequate developmental data on various aspects. In his opinion, for the better utilization of a greater number of varieties either in the domestic market or abroad, detailed investigation and improvement are still to be done.

In his welcome address Shri K. C. Dé president of the Eastern Regional Branch of AFST thanked the scientists, technologists and others present and hoped that the exchange of ideas and views through technical deliberation would help solving problems that is being encountered both by the industry and the growers.

Prof. Sunit Mukherjee, Vice-president of the Association, extended a hearty vote of thanks to the participants, who took the trouble to attend the Seminar and make it a success.

Life Members

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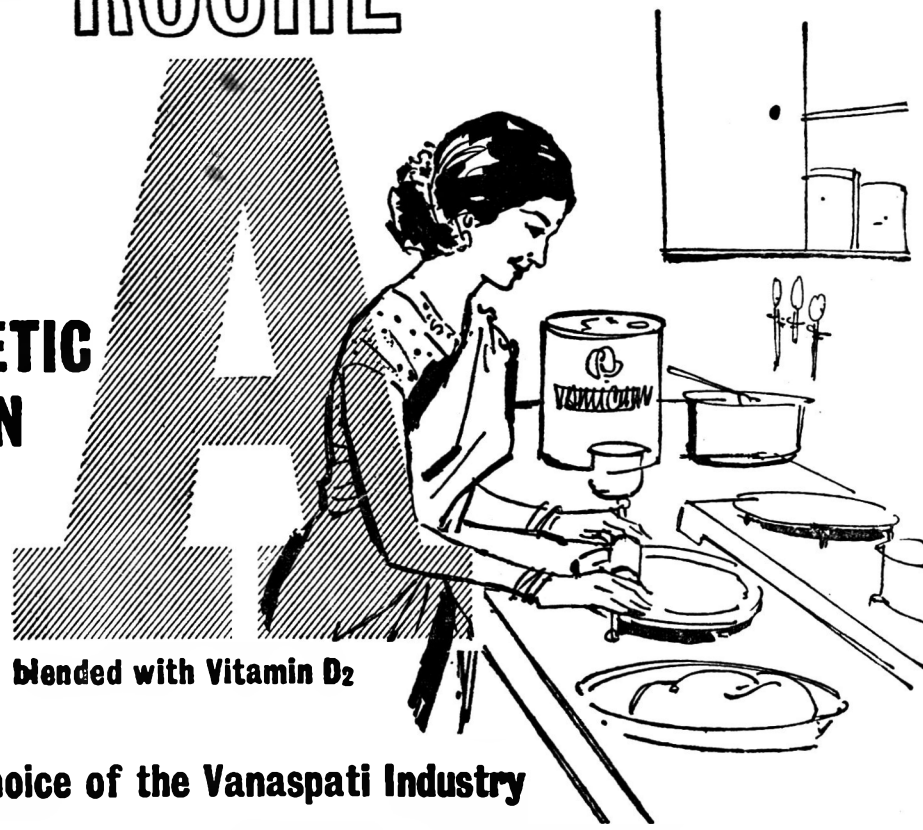

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   (*c*) *References to article in a book:* Joshi, S. V., in the Chemistry of Synthetic Dyes, by Venkataraman, K., Academic Press, Inc., New York, 1952, Vol. II, 966.

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

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