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CONTENTS

An Improved Method for Debittering Apricot Kernels

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Manuscript Received: 19 December 1972

The process used at present for debittering apricot kernels is wasteful in terms of both time and water consumption. A new method is described, in which the peeled and coarsely ground kernels are soaked for 2 hr in slightly acid water (pH 6.5) at 55°C with nearly complete breakdown of the bitter principle, and the hydrolytic products—hydrocyanic acid and benzaldehyde—are removed by steam distillation. *Marzipan* made with these debittered kernels was found to be as good organoleptically as that made with sweet almonds.

Although almonds and apricots are closely related botanically—both belong to the same genus (*Prunus*)—and their kernels are morphologically and chemically similar[1], the former (as well as their products) are quite expensive, whereas the latter are relatively cheap and their kernels are mainly used—if at all—for oil extraction. The reason is that the kernels of many of the most important apricot varieties (like those of bitter almonds) contain, as bitter principle, appreciable amounts of the glucoside amygdalin which, on hydrolysis in the digestive system, releases hydrocyanic acid[2]. Unfortunately, the bitter taste is not a reliable deterrent against ingestion (especially by children), and cases of poisoning, some of them fatal, occur from time to time[3-6]. However, the kernels contain a built-in hydrolytic agent, and enzyme (or enzyme mixture) of the beta-glucosidase type known as *emulsin*,[2,7] which can be utilised for debittering them; the resulting safe product is a substitute for sweet almonds in *marzipan*, bakery products, etc.

The conventional debittering technique (which consists in soaking the coarsely-ground kernels for 24 to 48 hr, with frequent changes of the water), is wasteful in terms of both time and water consumption (especially where water is scarce), and appreciable quantities of water-soluble nutrients are lost in the process[7]. Apart from this, a pollution hazard is created through discharge of relatively large quantities of hydrocyanic acid into small streams. A further problem is another by-product—benzaldehyde. The latter, practically insoluble in water, dissolves in the kernel oil and is readily oxidised by air to form benzoic acid, whose presence is permitted by food regulations only in limited number of commodities, and even that at lower levels than in the present case. This study was undertaken with a view to developing an improved process, free of the above drawbacks.

Materials and Methods

Raw material: Apricot pits (of the principal local commercial variety 'Ra'anana', obtained from a canning plant) were dried in the sun for one week, run through a jaw crusher adjusted so as to break the shells only, and the kernels separated in 20 per cent brine (d= 1.12—1.14).

Processing studies: 1. Optimal conditions of pretreatment (soaking) to facilitate hand peeling of the skins from the kernel. 2. Optimal conditions for enzymatic hydrolysis of amygdalin (temperature and pH of the medium and duration of the hydrolysis), with one part of peeled and coarsely-ground kernels soaked in 5 parts of medium (tap water, pH adjusted with hydrochloric acid).

Removal of hydrocyanic acid and benzaldehyde: The hydrocyanic acid and benzaldehyde were removed by steam distillation (1 hr) and collected in a receiver containing an excess of sodium hydroxide solution. The residual amygdalin (which served as the efficiency criterion of the process) was determined as the amount of residual hydrocyanic acid recoverable from the debittered product (Tables 2-4). (Initial HCN content, 1800 ppm).

Assay of hydrocyanic acid: Two 4-5g samples of treated and untreated material (the former—with an admixture of 15 per cent sweet almonds, in order to restore the enzymatic activity destroyed by the steam distillation) were homogenised in 40 ml water, placed in tightly stoppered test tubes and kept in an incubator at 35°C for 24 hours (the optimum period

for complete breakdown of amygdalin, according to a preliminary test). Two aliquots—depending on the expected content—were taken from each sample for hydrocyanic acid determination by the spectrophotometric method of Russell and Wilkinson[8]. (Checked and found satisfactory in terms of accuracy and reproducibility. Recovery of cyanide added at different levels in the form of potassium cyanide to aliquots of ground apricot kernels was close to 100 per cent).

Preparation of marzipans and organoleptic evaluation: The *marzipan* variants were prepared from a mixture of 40 parts ground kernels and 60 parts sugar, plus (per kg mixture) one beaten egg white, 20 ml glycerol, 1 ml almond essence and 0.1 ml rose-water. The kernels used were as follows: A: 100 per cent sweet almonds (used as a standard for comparison); B: 92.5 per cent sweet almonds and 7.5 per cent untreated apricot kernels; C: 100 per cent optimally debittered apricot kernels; D: 92.5 per cent debittered and 7.5 per cent untreated apricot kernels. (The 7.5 per cent admixture in B and D is the equivalent, in amygdalin content, of the 5 per cent admixture of bitter almonds used by some manufacturers for flavouring).

The *marzipans* were evaluated organoleptically by a panel of ten, and the results subjected to analysis of variance.

Results and Discussion

Optimal pre-treatment: As seen from Table 1, the soaking time required for loosening the skins can be reduced considerably by raising the temperature of the water, and even more so by adding sodium hydroxide. The time saved by the latter treatment offsets both the cost of the sodium hydroxide and the further time required for subsequent washing, and the reduced absorption of water by the kernels in the shorter soaking period improves their grinding capacity.

Optimal temperature for amygdalin hydrolysis: Although previous experiments had shown that the efficiency of amygdalin breakdown increases with temperature, the 65°C limit was not exceeded, since above it most enzymes[9] (including the beta-glucosidases[10,11],) undergo partial or complete inactivation. Results (Table 2) showed relatively small differences in breakdown throughout the temperature range used, but as the optimum temperature for longer assays with beta-glucosidases is lower than that for short ones[10]—all subsequent series were conducted at 55°C.

Optimal pH for amygdalin hydrolysis: The pH range chosen was symmetrical about the natural level prevailing in homogenised apricot kernels. Results (Table 3) showed that although the differences in breakdown were again quite small, they were statistically significant (the least significant difference was found to be 7 ppm), and the pH for the next series was accordingly set at the optimum (6.5).

Optimal figure for amygdalin hydrolysis: Although results (Table 4) showed that 90 min would suffice to ensure a low residual hydrocyanic acid content, a 2 hr period is recommended as an extra safeguard.

Organoleptic evaluation: The *marzipan* preparation A, B, C and D were evaluated for taste, odour

TABLE 1. INFLUENCE OF TEMPERATURE AND SODIUM HYDROXIDE ON SOAKING TIME OF KERNEL FOR SKIN REMOVAL

Soaking medium	Temperature (°C)	Time required (min)
Tap water	25	150
,,	55	45
,,	60	30
NaOH solution 10%	55	10

TABLE 2. EFFICIENCY OF AMYGDALIN BREAKDOWN AT DIFFERENT TEMPERATURES

Temperature (°C)	Residual (ppm)	Amygdalin breakdown %
55	1395	22.5
60	1377	23.5
65	1352	24.9

(Medium—tap water, pH—7.0, duration—15 min)

TABLE 3. EFFICIENCY OF AMYGDALIN BREAKDOWN AT DIFFERENT pH LEVELS

pH	Residual HCN (ppm)	Amygdalin breakdown %
5.5	1403	22.1
6.0	1388	22.9
6.5	1370	23.9
7.0	1400	22.2

(Medium—tap water; temp.—55°C; duration—15 min)

TABLE 4. EFFICIENCY OF AMYGDALIN BREAKDOWN AT DIFFERENT DURATIONS

Time (min)	Residual HCN (ppm)	Amygdalin breakdown %
0	1800	nil
15	1370	23.9
30	965	45.3
45	595	66.9
60	295	83.6
90	102	94.3
120	18	99.0
150	12	99.3

(Medium—tap water, pH—6.5, temp.—55°C)

TABLE 5. MARZIPAN VARIANTS*—AVERAGE ORGANOLEPTIC SCORE AND HYDROCYANIC ACID CONTENT

Preparation	Taste	Odour	Texture	HCN (ppm)
A	6.1	6.7	6.6	nil
B	7.5	7.3	5.8	45.0
C	6.0	6.7	6.4	30.3
D	8.0	7.4	7.0	84.0

*Composition as in text.

and texture and scored on a scale of 1 to 10 for each parameter. Results are summarised in Table 5.

The statistical analysis showed that, so far as the organoleptic properties are concerned, the preparation made with the debittered kernels were at least as good as those made with sweet almonds (with or without flavouring).

In conclusion, the study showed that the proposed debittering technique is both efficient and economical. No sophisticated equipment is required, and the drawbacks in the conventional method are eliminated. Moreover, the hydrocyanic acid and benzaldehyde can be recovered from the distillate as by-products.

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Observations on the Sorption of Water Vapour by Rice and Sorghum

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The rate of sorption of water vapour by rice grain and sorghum at different relative humidities are studied. Equilibrium moisture content of these grains at various relative humidities are determined.

The time required for the moisture content of grains to come to equilibrium with any relative humidity to which it is exposed is not only of scientific interest, but also of great commercial importance. During storage, relative humidity and temperature of storage will have greater influence on the keeping quality of grains. Both the equilibrium moisture (M_E) content and the time required to attain it are important for investigations into nature of fungal and insect infestation. Water vapour sorption and equilibrium moisture content in wheat and wheat products have been studied by other workers[1,2]. Ayerst[3] employed a dew point apparatus for the determination of the water activity of stored foods, at two temperatures (25° and 35°C), over a range of moisture content. He examined two varieties of sorghum in addition to other foodstuffs. It was found that at a given water activity sorghum *Wiru* showed a lesser percentage of moisture content than sorghum *Bukura mateonba*. Pixton and Sylvia[4] have reported the time required for conditioning two varieties of wheat to equilibrium with specific RH at a constant temperature. They found that total time required for both varieties of wheat to reach complete equilibrium with controlling atmosphere, whether adsorbing or desorbing is approximately 30 days. Ninety per cent saturation is reached in shorter time in both varieties of wheat, when desorbing than when adsorbing.

This preliminary account describes the moisture content of rice and sorghum in equilibrium with

different relative humidities and the time required to condition them to that moisture content.

Materials and Methods

For desorption studies, rice (*Oryza sativa*) and sorghum (*Sorghum vulgare*) were initially conditioned to a constant moisture content by adding calculated amount of water to sorghum and storing in tightly covered containers at 3 to 4°C for over 10 days. The containers were shaken at intervals during storage. This facilitated to have uniform distribution of moisture in wet grains. For adsorption experiments the grains were similarly initially conditioned to a constant moisture content by prolonged drying in an air oven at 80°C till no further loss in weight was observed.

Accurately weighed sub-samples of sorghum and rice (approximately 5 g) from each conditioned bulk were exposed in desiccators to relative humidities from 30 to 100 per cent. The relative humidity inside the desiccators at room temperature (27 to 28°C) was controlled by employing saturated salt solution[5]. The corresponding RH of the atmosphere inside the desiccators was obtained from tables[5] for saturated salt solution. The grains were exposed in single layer in rectangular metallic boats with perforations on all sides. The boats were placed directly above the salt solution to avoid differences in relative humidity due to relative humidity-gradient.

The boats containing grains were weighed at an interval of 24 hours, till the weight was constant. The boats with grains were transferred back to desiccator without disturbing, after each weighing; and the weighing was continued for a further period of 10 to 15 days. It was found that there was no alteration in the final constant weight.

The initial moisture content of grains employed for sorption studies, initially conditioned, was determined by drying the grains at 105°C for 8 hours in an air oven. The final moisture content in equilibrium with a given RH (M_E) was calculated based on the final constant weight and the initial weight of the grain.

While weighing at an interval of 24 hours, care was taken to see that there was no loss or gain in the weight due to exposure (as far as practicable) to atmosphere, by covering the boats with a tared petridish.

Results and Discussion

Equilibrium moisture (M_E) contents of rice and sorghum are shown in Table 1, while Table 2 shows the time in days required for equilibration.

Table 1 shows that M_E of rice and sorghum by desorption process is generally more than that by adsorption process. This is in contrast to the observations of Coleman and Fellows[6] who found that moisture contents of all cereals in equilibrium with the same relative humidity were much the same. So the different samples of same grain in equilibrium with the same atmosphere do not necessarily have the same moisture content; in fact the difference appears to be surprisingly large in the range of 70 to 90 per cent relative humidity. This is particularly significant in the case of sorghum. Incidentally both M_E and its influence on the keeping quality of grains are of utmost importance in this range of relative humidity from the point of view of grain storage. Hysteresis effect may partly explain the reason for such differences[7]. As seen (Table 1) M_E of rice at a given relative humidity (below 90 per cent RH) is more than the corresponding value for sorghum. This may be partly due to structural differences and capacity of grains to hold the free water.

TABLE 1. MOISTURE CONTENTS (%) IN EQUILIBRIUM WITH SPECIFIC RELATIVE HUMIDITIES BOTH BY ADSORPTION AND DESORPTION AT ROOM TEMPERATURE (27 TO 28°C)

(Values are on wet basis)

Relative humidity %	Adsorption		Desorption	
	Rice	Sorghum	Rice	Sorghum
30	7.6	6.0	8.5	6.9
50	10.5	8.9	11.6	9.6
60	11.1	10.0	12.9	11.2
70	13.1	12.6	14.9	14.2
80	16.0	13.8	17.5	16.7
90	19.5	19.2	19.8	22.1
100	22.0	22.4	22.4	24.6

Table 2 shows that both in case of rice and sorghum, equilibration proceeds more slowly by adsorption than by desorption. Similar observations have been reported with two varieties of wheat by Pixton and Sylvia[4]. It is believed that the rate of adsorption is governed largely by the time taken for the moisture to diffuse up to the surface of the grains than the time required for the moisture to penetrate the kernel of the grains from its surface. Since the grains were spread in single layer to avoid the restriction for the

TABLE 2. DAYS REQUIRED TO ATTAIN EQUILIBRIUM MOISTURE CONTENT BY DESORPTION AND ADSORPTION

Relative humidity %	Adsorption		Desorption	
	Rice	Sorghum	Rice	Sorghum
30	18	27	6	8
50	15	16	7	7
60	13	14	7	7
70	13	12	5	7
80	13	12	5	7
90	6	9	2	5
100	4	7	2	5

water vapour to move to the surface of the grains from all the directions, time taken by the moisture to diffuse upto the surface of the grains has been minimised. On the other hand, as the equilibration proceeds to a constant moisture content by adsorption at any specific relative humidity, the rate of water vapour adsorption decreases, and the moisture content increases. This decrease during adsorption by biocolloids such as those occurring in the grains is due to weakening of the forces that hold the water system at high moisture content. While just the reverse works during equilibration by desorption. During the initial stages, the rate of desorption is fast as the moisture is held loosely by forces of capillary attraction. As the equilibration proceeds the desorption rate decreases. Presumably the forces due to molecular attraction play a vital role. Since more rigorous conditions are needed to remove water attached by hydrogen-bond, M_E of grains by desorption is generally more than that by adsorption. In the high humidity range, the rate of sorption of water vapour increases rapidly due to addition of moisture by capillary condensation.

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Studies on Soybean Enriched Bread

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Fortified breads were prepared using 5, 10, 15 and 20 per cent semifatted soyflour (SSF). The quality scores of the bread considerably decreased with the incorporation of soyflour at all levels. Loaf volumes were also greatly diminished. It was found that by increasing the water content from 60 to 70 per cent and the yeast content from 2 to 3 per cent, the loaf volume was considerably increased in breads fortified with 10 per cent SSF or 10 per cent defatted soyflour (DSF). Loaf volume of 70 per cent water and 3 per cent yeast bread was not significantly different from that of the standard bread or 10 per cent SSF bread, while it was slightly less than that of the standard for 10 per cent DSF bread. The addition of 'Emplex' always gave the best breads.

Nutritionists have always been tempted to improve the protein quality of cereal based diet, by blending it with some quantity of soybean meal, a vegetable protein source of superior quality protein. Such attempts in respect of leavened bread, however, have met with failure because of adverse effects of soybean meal on the loaf quality[1,2,3]. Bayfield and Swanson[4] could alleviate the adverse effect of incorporation of soyflour in bread by increasing the bromate, and reducing the fermentation period. Glycolipids and sucroesters have been successfully used to protect the loaf volume from the adverse effect of soyflour fortification[5]. The glycolipids however are uneconomical while sucroesters are yet to be cleared for incorporation into food. Recently Tsen, Hoover and Phillips[6] and Tsen and Hoover[7] have shown that adding small amount of sodium stearoyl—2 lactylate and calcium stearoyl—2 lactylate could improve the loaf quality of soyflour containing breads and bring it in line with standard breads. These products however are not yet being manufactured in this country and therefore have to be imported. The

TABLE 1. COMPOSITION OF VARIOUS BREADS

Ingredients	Standard	Soybean breads 5%* SSF	10% SSF	15% SSF	20% SSF
Refined wheat flour (g)	100.0	95.0	90.0	85.0	80.0
Soybean flour (g)	0.0	5.0	10.0	15.0	20.0
Shortening (g)	5.0	5.0	5.0	5.0	5.0
Sugar (g)	8.0	8.0	8.0	8.0	8.0
Salt (g)	2.0	2.0	2.0	2.0	2.0
Yeast (g)	2.0	2.0	2.0	2.0	2.0
Water (g)	60.0	65.0	65.0	70.0	70.0
Protein %	11.0	13.0	14.3	15.4	17.6

*SSF=Semifatted soyflour.

TABLE 2. COMPOSITION OF PRINCIPLE INGREDIENTS USED IN THE STUDY

Ingredients	Moisture	Protein	Ash	Crude-lipid
Refined wheat flour	12.5	11.0	0.64	0.84
Semifatted soyflour	8.1	47.3	7.84	13.60
Defatted soyflour	8.0	50.2	6.58	0.00

object of the present study was to device other ways and means of improving the loaf quality of soyflour fortified breads.

Materials and Methods

The breads were prepared by straight dough method[8]. The recipe of the standard bread is furnished in Table 1.

Refined wheat flour and various types of soyflour used in the study were analysed for proximate constituents (Table 2) by AOAC methods[9].

In experiment 1, soyflour fortified breads were prepared by incorporating upto 20 per cent semifatted soyflour (SSF) in the recipe, in place of wheat flour (Table 1). This increased the protein content of the bread from 11.0 to 17.6 per cent. The soyflour fortified breads so prepared had very poor loaf qualities. Various modifications of the basic recipe were therefore attempted with the object of improving the loaf quality of soybean breads in subsequent experiments (Table 3). These studies were conducted using 10 per cent semifatted and defatted soyflour.

All the breads prepared were evaluated by a panel of five persons on the basis of cell formation, texture, colour, taste and odour. The maximum score of 10 was assigned to each of these criteria except the taste for which the maximum score was 20. The bread volume was measured by using mustard seeds.

TABLE 3. MODIFICATIONS IN THE RECIPE OF THE BREAD

Experiment 2

1. 60 per cent water (60w)
2. 70 per cent water (70w)
3. 80 per cent water (80w)

Subsequent experiments

1. 60 per cent water, 2 per cent yeast (60w, 2y)
2. 70 per cent water, 2 per cent yeast (70w, 2y)
3. 60 per cent water, 3 per cent yeast (60w, 3y)
4. 70 per cent water, 3 per cent yeast (70w, 3y)
5. 70 per cent water, 2 per cent yeast and 0.5 per cent 'Emplex'* (70w, 2y, E)
6. 70 per cent water, 3 per cent yeast and 0.5 per cent 'Emplex'* (70w, 3y, E)
7. Standard (no soyflour) (Std.)

'Emplex'—Sodium stearoyl—2 lactylate manufactured by Patco Products Div. of the C.J. Patterson Co. Broadway, Kansas City U.S.A.

In order to get statistically significant results each modification of the recipe was replicated several times. The data obtained was statistically analysed using Duncan's new multiple range test[10].

Results and Discussion

It is known that the loaf volume is determined by the volume of gas sealed in the bread and the elasticity of the dough which in its turn depends upon the quality of gluten and moisture content[8]. It is possible that when soyflour is incorporated in the bread at the cost of refined wheat flour the quantity of gluten with desirable elastic quality is decreased. The studies reported by Tsen, Hoover and Phillips[6] indicate that water requirements for dough making increases when soyflour is incorporated in the bread recipe. In experiment 2, therefore the quantity of water used for preparing dough was varied from 60 to 80 per cent. The dough obtained with 80 per cent water was very sticky and could not be made into a loaf. In subsequent experiments therefore 60 to 70 per cent water was used. The quantity of yeast used in the recipe was also increased to find out if it helped to improve the bread volume. Commercial dough conditioner 'Emplex' which has been shown to restore the loaf volume of the soyflour fortified bread[6], was used as one of the variations. The Emplex breads served as positive control[5]. In these studies each loaf was made using 50 g of refined flour or fortified flour. The studies showed that by increasing the water content of the SSF fortified bread to 70 per cent and keeping the yeast content at 3 per cent it was possible to completely overcome the adverse effect of soyflour on loaf volume (Table 4, Fig. 1). The quality score studies however indicated that only the 'Emplex' added breads were evaluated as equal

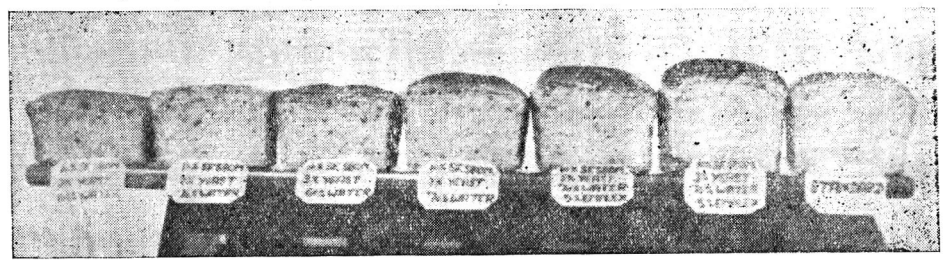

FIG. 1. Breads from semifatted soyflours.
Recipe from left to right: (1) 60w, 2y (2) 70w, 2y, E (3) 60w, 3y (4) 70w, 3y (5) 70w, 2y (6) 70w, 3y, E (7) Std.

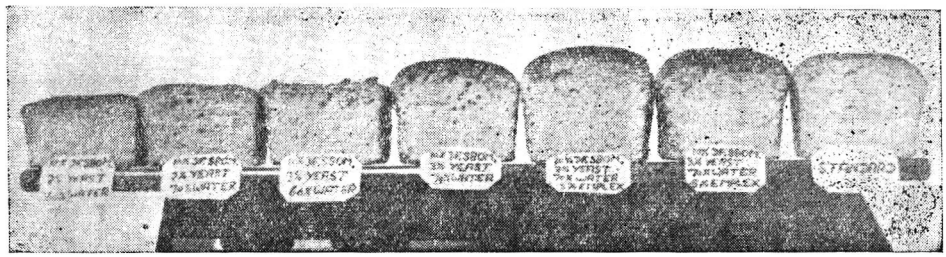

FIG. 2. Breads from defatted soyflours.
Recipe from left to right : (1) 60w, 2y (2) 70w, 2y (3) 60w, 3y (4) 70w, 3y (5) 70w, 2y, E (6) 70w, 3y, E (7) Std.

to the standard bread (Table 4). The panel could not be considered as biased against soyflour as it adjudged Emplex bread containing 10 per cent SSF as almost equal to standard bread. It would thus appear that apart from loaf volume, the Emplex improved other attributes of the 10 per cent SSF bread.

Studies similar to the above were repeated using defatted soyflour (DSF) instead of SSF for the fortification of the bread. As it was observed in the studies with SSF breads that the variations between replicates were very small, the number of replicates in the DSF bread study was reduced to two. It was noted that with each variation in DSF bread, the loaf volume changed (Table 5, Fig. 2). When DSF was used in fortification of the bread, the Emplex bread had significantly higher volumes than the other breads. This is in contrast with the results obtained with SSF breads. The SSF contained 13.6 per cent crude lipid, so the incorporation of SSF in a bread increased its lipid content by 1.28 per cent. It would thus appear that higher fat content in DSF bread would be necessary if the increase in water content to 70 per cent and yeast to 3 per cent is to produce as good a loaf as that of Emplex added bread. It would be interesting to verify this hypothesis.

The quality scores earned by 10 per cent DSF breads were very similar to those for the corresponding

TABLE 4. EFFECT OF CHANGES IN BREAD RECIPE ON THE BREADS CONTAINING 10 PER CENT SSF

Recipe*	Replicates	Volume (ml)	Specific volume**	Quality score
60w, 2y	6	241.7±3.7 a	3.33±1.3 a	36.45±1.50 a
70w, 2y	6	281.7±1.6 b	3.89±0.5 b	38.03±2.08 a
60w, 3y	6	316.7±3.1 c	4.35±0.5 c	40.10±1.60 a
70w, 3y	6	337.5±1.1 c	4.66±0.8 d	42.95±1.10 a
70w, 2y, E	4	337.5±1.3 c	4.75±0.01d	52.60±0.56 b
70w, 2y, E	4	343.7±5.5 c	4.82±0.1 d	55.35±0.98 b
Std.	6	334.1±3.5 c	4.82±0.01d	57.70±1.30 b

*See Table 3.

**Specific volume = $\frac{\text{Volume in ml}}{\text{Weight in g.}}$

Values bearing the same alphabet did not differ significantly (P=.05) from each other.

TABLE 5. EFFECT OF CHANGES IN BREAD RECIPE ON THE BREADS CONTAINING 10 PER CENT DSF*

Recipe**	Volume (ml)	Specific volume†	Quality score
60w, 2y	250.0±0.0 a	3.47±0.6 a	36.35±0.83 a
70w, 2y	282.5±2.5 b	3.91±.003 b	38.49±0.77 a
60w, 3y	302.5±2.5 c	4.19±.003 c	39.10±2.90 a
70w, 3y	342.5±2.5 d	4.75±.01 d	42.75±1.05 a
70w, 2y, E	355.0±0.0 e	5.06±.55 e	52.60±2.60 b
70w, 3y, E	362.5±2.5 e	5.07±.003 e	55.25±0.54 b
Std.	350.0±0.0 f	5.00±0.0 e	57.60±0.98 b

*DSF=Defatted soyflour

**See Table 3.

†Specific volume = $\frac{\text{Volume in ml.}}{\text{Weight in g.}}$

Values bearing the same alphabet did not differ significantly (P=.05) from each other.

variations in 10 per cent SSF breads. The Emplex breads were superior to other varieties in 10 per cent DSF bread, except the standard bread.

Acknowledgement

The authors are grateful to Dr S. W. William and Dr C. N. Hittle of the USAID, Jabalpur for the supply of soyflours, Emplex and active dry yeast.

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Studies on the Browning of Heat Processed *Chapaties* and Allied Products in Relation to their Chemical Constituents

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The degree of browning during heat sterilization of *chapaties* in particular and other allied products in general increased with the increase of processing time and temperature. This browning could be measured spectroscopically at 375 mμ. When *chapaties* were processed at 15 and 20 psi for 10 to 40 min, the rate of increase in browning was much higher than that processed at 10 psi. The level of both reducing and non-reducing sugars along with free amino nitrogen decreased as browning increased. Relationship between chemical constituents of *chapaties* processed at different time and temperatures, and browning is discussed.

The browning of certain foods, like *chapaties* and allied products, during baking, is recognised to impart attractiveness and to add a desirable undertone to the natural flavour. Recently, ready-to-eat foods like stuffed *parottas*, whole meal, etc. have been introduced in Service pack rations. These ready-to-eat foods were preserved by heat sterilization. During the course of studies on heat processing of stuffed *parottas* it was observed that brownness varied in degree when processed at different times and temperatures[1]. Though the initial brownness developed during baking of *chapaties* and other wheat products is desirable, the brownness produced during heat sterilization is not quite appealing. Sometimes the food items become too dark in colour, and nutritional values are lowered.

Very little information is available in the literature on the browning of *chapaties* occurring at high temperatures during sterilization. The paper reports the investigations on the rate of browning in *chapaties*, *parottas*, *puries* and steamed *chapaties*, developed during their heat sterilization at different times and temperatures. The relationship between their chemical constituents and brownness is also reported.

Materials and Methods

Chapaties, *parottas*, *puries* and steamed *chapaties* were made in two stages as indicated below:

(*a*) *Preparation of dough discs:* Dough was prepared by proper kneading of wheat flour (100 g) using 58 to 60 ml of water. Discs of 13 cm diameter were uniformly rolled using 25 g of the dough. 14 g of hydrogenated oil was added only to *parotta* dough.

(*b*) *Baking of chapaties, parottas, puries and steamed chapaties: Chapaties* were properly baked initially on hot plate (180-200°C) and then puffed on open coil (250°C). *Parottas* were baked on hot plate only, using 8 per cent of hydrogenated oil (dough weight basis). *Puries*

were deep fat fried in hydrogenated oil at 180—200°C whereas steamed *chapaties* were baked in an autoclave at atmospheric pressure for 10 min.

Packaging and sterilization: All the food items were packed singly first in MST cellophane and then in laminated pouch (60 g BC paper/0.02 mm aluminium foil/150 gauge polythene) having a vent plugged with cotton and finally heat sealed[2]. Before heat sealing both MST and foil laminated pouches were properly pressed by hand to expel most of the air. These pouches were sterilised in a conventional autoclave at 15 psi, for 10, 20, 30 and 40 min. *Chapaties* were processed also at 10 and 20 psi, for 10-40 min.

Extraction of brown colour: Both polar and non-polar solvents were tried for extraction of brown colour of *chapaties*. The extracts with dilute ethanol and isoamyl alcohol were distinctly yellow in colour, whereas those of water and chloroform were colourless. Dilute ethanol and isoamyl alcohol were selected as possible solvents for extraction. In both the solvents absorbancy increased as wave length decreased, when measured on a Bausch and Lomb Spectronic 20 colorimeter. Absorbancy was more in the extract of dilute alcohol than that of isoamyl alcohol at the same concentration. Dilute alcohol was finally selected as a solvent for extraction. In order to find out the optimum concentration of alcohol, various dilutions of alcohol were tried and 66 per cent concentration gave the best extraction in 60 min.

Using the above optimum conditions of extraction, 2.5, 5, 7.5 and 10 g of the sample were extracted and the colour at 375 mμ was measured. It was found to obey Bar's law.

Estimation of brownness: Five grams of powdered *chapaties, parottas, puries* and steamed *chapaties* were mashed with 10 to 20 ml of 66 per cent alcohol. The contents were transferred to a conical flask with 10-15 ml of dilute alcohol and the flask was kept in a rotary shaker for 1 hr. After the extraction it was made upto 50 ml along with the food item, and the supernatant solution was centrifuged. The absorbancy of the clear extract was measured at 375 mμ.

Chemical analysis: Moisture, fat, reducing and non-reducing sugars and free amino nitrogen were estimated in *chapaties* before and after processing at different times and temperatures by using standard methods[3].

Results and Discussion

Objective measurement of brownness: Subjective ranking according to colour intensity is difficult. So absorption spectroscopy was investigated as a possible objective measure of degree of brownness. Russel *et al*[4] have used a Beckmann Model DU—Spectrophotometer with a reflectance attachment for measuring brownness of bread crumb. The reflectance was measured at 600 mμ. Larsen *et al*[5] have utilised Hunter colour and colour difference meter for following the browning of bread crumb. The latter gave more accurate results. Ahmed *et al*[6] have used absorbance at 490/500 mμ for measuring progress of browning in bread crust and 278 mμ for the intermediate compounds formed in Maillard reaction in crust formation. Pearson *et al*[7] have used absorbance at 375 mμ for measuring brownness developed on heating fresh pork which showed a correlation of 0.95 with the objective colour measurements.

In our present studies the coloured extracts of *chapaties* and allied products in 66 per cent alcohol showed good absorbance at 375 mμ and since reading could be readily made with Bausch and Lomb Spectronic 20 colorimeter, this wave length was arbitrarily selected for measuring colour development. Colour readings made at 375 mμ were in accord with brownness judged visually. The absorbance of 66 per cent alcohol extract of fresh *chapaties* (5 g in 50 ml) was 0.35 ± 0.02 (mean of six batches in triplicate).

Comparative evaluation of brownness in chapaties, parottas, puries *and steamed* chapaties: The intensity of brownness varies in these four different food items prepared from wheat flour (*atta*). It can be observed from Table 1, that the absorbancy of *parottas* (0.4) was more than that of *chapaties*, *puries* and steamed *chapaties*. The absorbance of *puries* was slightly more than that of *chapaties* and steamed *chapaties*. This was in accordance with browning as judged visually. Increased browning produced in *parottas* may be due to the effect of hydrogenated oil to longer and intimate contact of the *parotta* with hot plate. With a view to find out the probable reason for increased brownness in *parottas*, *chapaties* were prepared with different levels of hydrogenated oil. From Table 2, it can be seen that there was no

TABLE 1. ABSORBANCE AS A MEASURE OF BROWNNESS IN CHAPATIES, PAROTTAS, PURIES AND STEAMED CHAPATIES

Food item	Moisture %	Fat %	Absorbance*
Chapaties	23.8	0.64	0.35
Parottas	26.5	13.39	0.41
Puries	27.6	15.36	0.38
Steamed *chapaties*	47.6	0.65	0.36

*At 375 mμ of 3.5 g food item (moisture and fat free basis) in 50 ml of 66 per cent alcoholic extract.

TABLE 2. EFFECT OF ADDED HYDROGENATED OIL TO THE DOUGH ON BROWNNESS OF BAKED CHAPATIES

	Observations made at hydrogenated oil levels of (%)			
	Nil	10	20	30
Moisture %	29.8	25.4	18.6	11.6
Fat %	0.64	8.23	15.89	21.27
Absorbance at 375 mμ	0.37	0.36	0.36	0.37

appreciable increase in absorbance with increase of hydrogenated oil. The oil in between the hot plate and the outer most layer of *parotta* acts as an oil bath. The quantum of heat thus supplied to the *parotta* will be more as compared to *chapati*. The amount of heat received at different microlayers of *parottas* will vary resulting in different degrees of brownness at various depths. Besides the brown compounds at the outermost layer of *parotta*, formed as a result of heterogeneous reactions, being lipid soluble, gradually migrate from outermost layers towards the centre.

When *chapaties* were baked by steam at atmospheric pressure for 10, 20 and 30 min, it was observed that there was no appreciable increase in browning both visually and by absorbance. This may be due to high moisture content (47 per cent) of steamed *chapaties*.

In order to study the effect of time and temperature on browning of *chapaties*, *parottas*, *puries* and steamed *chapaties*, and to ascertain whether the absorbance could be used as a measure of degree of brownness,

TABLE 3. ABSORBANCE OF CHAPATIES, PAROTTAS, PURIES AND STEAMED CHAPATIES PROCESSED AT 15 PSI FOR DIFFERENT PERIODS

Food item	Absorbance* at indicated periods (min)				
	Control	10	20	30	40
Chapaties	0.34	0.35	0.37	0.44	0.51
Parottas	0.41	0.42	0.44	0.48	0.54
Puries	0.37	0.39	0.43	0.48	0.53
Steamed *chapaties*	0.36	0.37	0.38	0.42	0.41

*At 375 mμ of 3.5 g food item in 50 ml of 66 per cent alcoholic extract.

the above food items were processed at 15 psi, for 10, 20, 30 and 40 min. It is observed from Table 3, that there is an increase in absorbance with the processing time which is in accord with brownness in *chapaties*, *parottas*, and *puries* as judged visually. But in the case of steamed *chapaties* no significant difference could be noticed which may be again due to high moisture content.

Brownness in relation to chemical constituents: Since the same trend was observed in respect of degree of browning in processed *chapaties*, *parottas* and *puries*, the study on brownness in relation to chemical constituents was restricted to *chapaties* only. *Chapaties* were processed at 10, 15 and 20 psi for 10, 20, 30 and 40 min and reducing sugar, non-reducing sugar, free amino nitrogen and brownness were estimated. The initial chemical composition of *chapaties* was: reducing sugars, 230—234 mg of maltose/10 g of sample, non-reducing sugars, 131-135 mg of sucrose/10 g sample and free amino nitrogen, 0.34-0.38 mg/2g

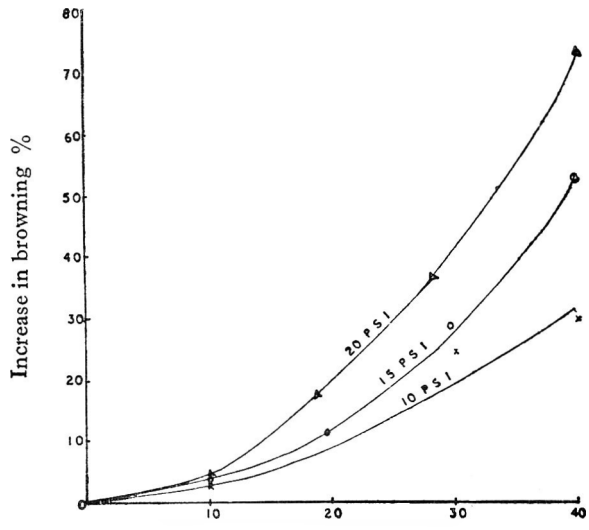

FIG. 1. Effect of time and temperature on browning of *chapaties*

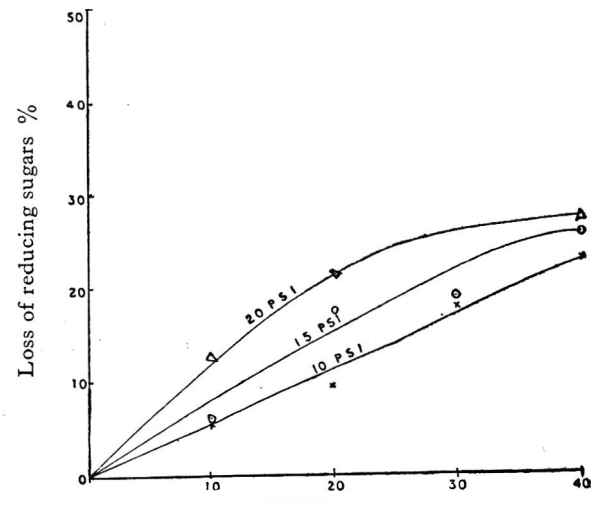

FIG. 2. Loss of reducing sugars during processing of *chapaties*

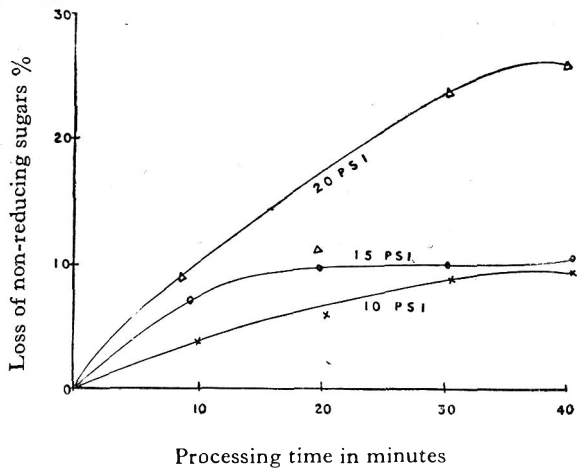

FIG. 3. Non-reducing sugars of processed *chapaties*

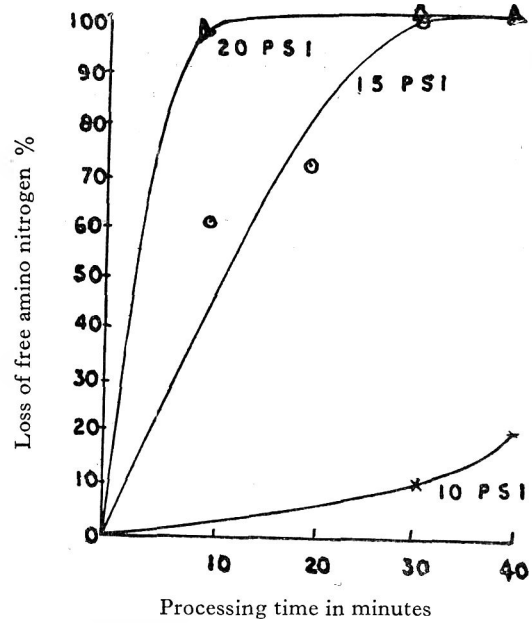

FIG. 4. Free amino nitrogen of processed *chapaties*

of sample. The results are expressed on moisture free basis.

It can be seen from Fig. 1 that there is no appreciable difference in brownness produced at different temperatures initially upto 10 min. On longer processing the rate of browning increased with increase of time at all the three temperatures. However, there was a steep rise in brownness of *chapaties* processed at 20 psi.

It is seen from Fig. 2, that there is gradual loss of reducing sugars in *chapaties* processed at 10 and 15 psi, for 10 to 40 min, whereas at 20 psi, the rate of loss of reducing sugars after 20 min decreased. This may be due to the hydrolysis of non-reducing sugars which is shown in Fig. 3. The rate of loss of non-reducing sugars at 20 psi, (26 per cent) is much more than that at 10 and 15 psi (10 per cent). There was gradual loss in free amino nitrogen content (Fig. 4) upto 21 per cent in *chapaties* processed at 10 psi, for 10 to 40 min, whereas no free amino nitrogen could be estimated after 30 and 10 min at 15 and 20 psi respectively.

From the data obtained it appears that in *chapaties* processed at 10 psi, upto 40 min, there is a direct relationship between the rate of browning as measured by absorption spectroscopy and the rate of decrease in reducing sugars, non-reducing sugars and free amino nitrogen whereas in *chapaties* processed at 15 psi, and 20 psi, no such relationship could be observed. At 15 psi, there was considerable loss of free amino nitrogen and its total destruction at 20 psi, after 10 min in excess of that required for 1:1 sugar amino acid reaction postulated by Hodge. Similar observation was made by Jones[8] on browning of cod muscle preparation. Morimoto[9] has also observed the decrease in free amino acid content of bread crust during baking. The browning of *chapaties* increased even in the absence of free amino acids. It could be due to the reaction of intermediate compounds formed during browning with the free amino groups of protein molecules. These results suggest that there are few, if any, intermediates containing primary amino groups present in the reaction mixture which do not preclude their participation in browning reaction pathways, but if such compounds are present they must be in small amounts and presumably very reactive. Another reason for more browning even in the absence of free amino acids may be due to the caramelization of sugar. To confirm this *chapaties* were prepared with sucrose (5 per cent on *atta* basis). These *chapaties* along with control were processed at 20 psi for 30 min. The absorbance was measured at 375 mμ and it was observed that there was an increase of 12.5 per cent in absorbance of *chapaties* with sugar.

The loss of sugars during browning reaction may not be of much importance, but the loss of free amino nitrogen cannot be overlooked. So, it is in this direction further work on studying the mechanism of browning and measures to check it is in progress.

Acknowledgement

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Factors Influencing Yellow Discolouration of White Pomfret *(Stromateus cinereus)*

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A method based on the complete extractability of pigment in 10 per cent NaOH was developed for assessing discolouration of white pomfret. This was computed by $\frac{T1-T2}{T3} \times 100$ where T1, T2 and T3 are per cent transmittance of the extracted pigment at 420, 400 and 350 mμ. Browning potential of alcohol soluble compounds was about 4 times more than that of total lipids but this decreased to nearly half i.e., 2 times in presence of externally added sugars (ribose or glucose). Dipping the fish in water as well as cooking treatments, suppressed the discolouration. However, this could be completely inhibited by vacuum packaging as well as by hydroxylamine. Effects of some food additives and chemicals on the discolouration have been discussed.

A new process termed as 'dehydro-irradiation' was developed in this laboratory[1-3], for enhancing the shelf life of shrimps for a period of 4 months at ambient temperature storage. This process incorporates principles of inactivation of enzymes by blanching fresh shrimps in brine solution, incorporation of sorbic acid for control of moulds, reduction in water activity of the product by partial dehydration to 35-40 per cent moisture and irradiation to control spoilage by bacteria. Two major characteristics of the final product are its high reconstitutability and built in safety factor against microbial hazards. Efforts are now being made to enlarge the scope of the dehydro-irradiation process to other fish varieties of economic significance. Studies with Bombay duck (*Harpodon nehereus*) indicated that semi-dried laminates with excellent quality features can be developed by this process[4].

White pomfret (*Stromateus cinereus*) with its high lipid content in the skin is prone to yellow discolouration by irradiation[5] as well as by prolonged frozen storage[6]. Development of yellow to brown discolouration in the fish is the major limiting factor which reduces markedly the acceptability of the product.

It was observed that measurement of the degree of discolouration of pomfret dried to 35-40 per cent moisture for shelf stabilisation by dehydro-irradiation process[7] by (*a*) per cent reflectance of the surface[8] and (*b*) by extraction of the pigment in polar solvent[5,9] or solubilization of the pigment by trypsin hydrolysis[10] were not suitable. Because of uneven nature of discolouration of the pomfret fillets, the reflectance method was not applicable and the other two methods extracted the colour only partially.

This paper describes a method based on extraction of pigments of the fish in 10 per cent NaOH, adopted previously by Sule and Chippalkatti[11], for extraction of colour from wool. As this method enables rapid screening of the effects of process variables, it may find more applications for development of combination treatments for dehydration of fishery products. Limitations as well as advantages of alkali extraction method have been described.

Methods

The pigments from both fresh and dehydrated pomfret were completely extractable in 10 per cent

sodium hydroxide, while at lower concentrations turbidity was noticed. Procedure for extraction of the pigments was as follows:

In view of the uneven nature of yellow discolouration of pomfret[6,12] a minimum of 50 g of sample was taken for this analysis. The fish was disintegrated into small lumps of ½ to 1 cm size and representative samples (5 g) from this lot were taken and soaked in 25 ml of 10 per cent sodium hydroxide. The time of extraction of the pigment varied from 7 to 16 hr depending upon the extent of discolouration of fish. Hence in all experiments, after soaking the sample in alkali for overnight, 100 ml of distilled water was added and filtered through Whatman filter paper No. 1. The extracted pigment was scanned for absorption maximum in the entire visible region using Beckman DU spectrophotometer. Extent of discolouration of the fish was assessed by the modified method of Toyomizu *et al*[9]. In this method, the discolouration rate of fish has been computed by using $\frac{T1 \times 100}{T2}$ where T1 and T2 are per cent transmittance at 410 and 450 mμ respectively. The modification of this method consisted in devising an appropriate arbitrary formula. For this purpose, per cent transmittance of the extracted pigment was taken at three arbitrary wavelengths viz. 350, 400 and 420 mμ from the straight line region of the absorption spectrum (Fig. 1). Browning of the fish was expressed as discolouration index or the number which was calculated by the arbitrary formula.

For establishing the validity of this method, discolouration indices of the samples were compared to visual colour grading. The scale of subjective colour rating ranged from 1 to 6: where 1 represents trace yellow, 2—slight yellow, 3—moderate yellow, 4—bright yellow, 5—intense yellow, and 6— brownish red.

For comparing discolouration of undehydrated and dehydrated pomfret, discolouration index was calculated on 5 g dry weight basis. In all these experiments, fresh fish samples without any visible discolouration were used to determine the degree of discolouration of extracted lipids during the extraction procedure of 7-16 hr. These extracts however did not show any absorption over the wavelengths examined.

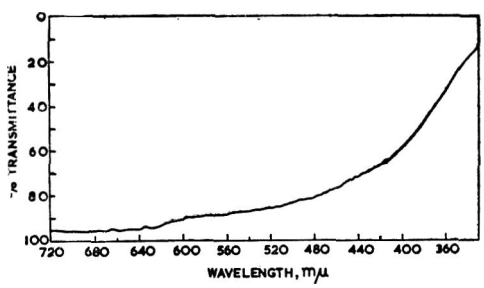

FIG. 1. Absorption spectrum of yellow pigment extracted from pomfret

Isolation of alcohol soluble and lipid components of pomfret: For studying the individual contribution of total lipids and alcohol soluble fraction of pomfret on the discolouration, these fractions were isolated by Bligh and Dyer's method[13]. This isolation resulted in three fractions comprising of extracted fish, chloroform (lipids) and methanol-water (sugar, amino acids and unknown compounds). Using these three fractions, besides glucose and ribose, eight other compositional variations were obtained (Table 1). Browning reactions of these mixtures were simulated by heating the samples at 60°C for 17 hr. Discolouration of these samples was determined as per the method described earlier.

TABLE 1. INFLUENCE OF COMPOSITIONAL VARIATIONS ON DISCOLOURATION* OF POMFRET

Variables	Discolouration index
Normal composition (R+C+M)	48
Alcohol solubles extracted (R+C)	11
Lipids extracted (R+M)	42
Alcohol solubles and lipids extracted (R)	8
Lipids extracted and D-glucose (1 per cent) added	233
Alcohol solubles extracted and D-glucose (1 per cent) added	123
Lipids extracted and ribose (0.2 per cent) added	203
Alcohol solubles extracted and ribose (0.2 per cent) added	91

*Browning reactions in the samples were simulated by heating at 60°C for 17 hr.

R=Extracted fish; C=Chloroform fraction; M=Methanol fraction.

Effects of process variables: For studying the effects of packaging, environment and temperature during storage, pomfret fillets were shelf stabilized by dehydro-irradiation process[7]. This consisted in cooking pomfret fillets in 20 per cent sodium chloride containing 0.1 per cent propyl paraben, for 5 min followed by partial dehydration to 35-40 per cent moisture at 60°C. Semi-dried pomfret was irradiated at 0.5 Mrad. Storage life of dehydro-irradiated pomfret was observed to be 4 months at room temperature (20-34°C).

Results

Extractability of the pigments: The main difficulty in the objective evaluation of discolouration of pomfret was lack of solubility of the colour pigments in many

solvents. It was observed that the pigments were insoluble in water and in many organic solvents like diethyl ether, pyridine, tetrahydrofuran, methanol and ethanol. Partial solubility of the pigments in other solvents was in the following decreasing order: glacial acetic acid, chloroform, benzene, petroleum ether and acetone. Solvent system consisting of acetone-hydrochloric acid-methanol (100:4:0.1), used by Koizumi and Matsura[14] for extraction of pigments of tuna, however, extracted the pigments but only of non-dehydrated pomfret[5].

Measurement of discolouration: Discolouration of pomfret samples having varying degree of browning reactions was assessed visually as well as by absorption spectroscopy. Fig. 2 shows the comparison of the two methods. Based on the readings of per cent transmittance (T) of the extracted pigment at 350, 400 and 420 mμ, three arbitrary formulae viz., A, B and C were computed. Discolouration indices of pomfret did not increase proportionately with respect to visual grading when formula A, $\left(\frac{400T - 350T}{420T} \times 100\right)$ and B, $\left(\frac{420T - 350T}{400T} \times 100\right)$ were used. However, formula C, $\left(\frac{420T - 400T}{350T} \times 100\right)$ gave good correlation. Thus, this formula was used for assessment of discolouration of pomfret.

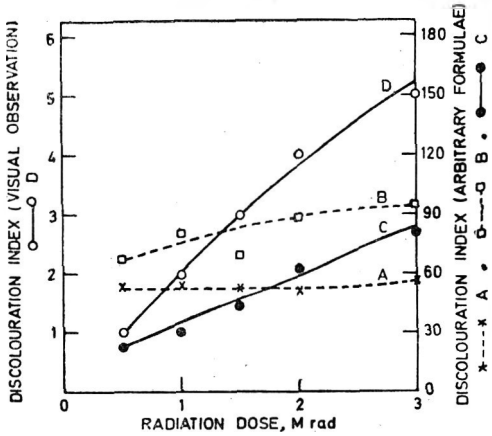

FIG. 2. Comparison of discolouration of pomfret assessed visually and by arbitrary formulae. Three formulae were :

A, $\left[\frac{400T-350T}{420T} \times 100\right]$;

B, $\left[\frac{420T-350T}{400T} \times 100\right]$ and

C, $\left[\frac{420T-400T}{350T} \times 100\right]$; where

T represents per cent transmittance at the wavelength shown by its prefix. Formula C and visual grading shows good correlation.

Effects of lipids and alcohol solubles: Table 1 shows the influence of total lipids and alcohol solubles on the discolouration of pomfret. Alcohol soluble compounds of fish contributed predominantly to formation of discolouration. Browning potential of these compounds was nearly 4 times more than that due to total lipids. However, in presence of externally added glucose or ribose, alcohol soluble compounds were about 2 times as effective as total lipids in causing discolouration of the fish. Discolouration indices of the samples containing 0.2 per cent ribose or 1 per cent glucose were almost identical when the samples were devoid of alcohol solubles or total lipids.

Physico-chemical treatments: Dip treatment of pomfret fillets in water decreased the discolouration index from 43 to 27 (Table 2). Discolouration index of the fillets decreased appreciably when the fillets were cooked in water or brine, this was perhaps, due to leaching of precursors responsible for browning reactions. Discolouration of the fillets remained unaffected by $FeSO_4$ and Na_2S. However, treatment of the fillets with ethylene diamine tetraacetic acid (EDTA), butylated hydroxytoluene (BHT), citric acid, potassium metabisulphite and sodium bisulphite retarded browning reactions while sorbic acid and $CuSO_4$ augmented discolouration. Hydroxylamine treatment inhibited the browning reactions.

TABLE 2. INFLUENCE OF PHYSICO-CHEMICAL FACTORS ON THE DISCOLOURATION OF POMFRET*

Treatments	Discolouration index
Physical	
1. Control	43
2. Dipping in water (30 min)	27
3. Cooking in water (100°C, 5 min)	13
4. Cooking in 20 per cent brine (100°C, 5 min)	14
Chemical	
1. Sorbic acid (0.5 per cent, 60 min, pH 6.8)	75
2. Copper (0.1 per cent, $CuSO_4$, 15 min).	150
3. Fe (0.1 per cent, $FeSO_4$, 30 min)	35
4. EDTA (0.5, 1 & 2 per cent respectively, 60 min)	14
5. Ascorbic acid (0.5 per cent, 15 min)	16
6. BHT (0.1 per cent, 60 min)	15
7. Citric acid (0.5 per cent, 30 min)	15
8. Pottassium metabisulphite (0.5 per cent) containing citric acid (0.2 per cent, 30 min)	13
9. Sodium bisulphite (0.5 per cent, 30 min)	15
10. Sodium sulphide (0.5 per cent, 30 min)	35
11. Hydroxylamine (0.5 per cent, 30 min)	6

*Discolouration of pomfret samples after the treatments was simulated by heating at 60°C for 7½ hr.

Fig. 3 shows the relationship between the residual amount of hydroxylamine and the browning reactions. Storage time had pronounced effect on the degree of browning of control as well as treated samples. Residual hydroxylamine content of the treated sample decreased sharply with increase in storage period. Depletion of hydroxylamine from the treated sample correlated with increased discolouration.

Storage temperature and packaging environment: Discolouration of pomfret was significantly affected by storage temperature (Fig. 4). Discolouration index of the samples increased gradually with storage period at ambient temperature (20-34°C). However, occurrence of browning reactions could be inhibited when the samples were stored at sub-room temperature (8°C).

Commercially available flexible packages were used for studying the effects of environment on the discolouration. Browning reaction of fish could be completely eliminated only under vacuum packaging (Fig. 5).

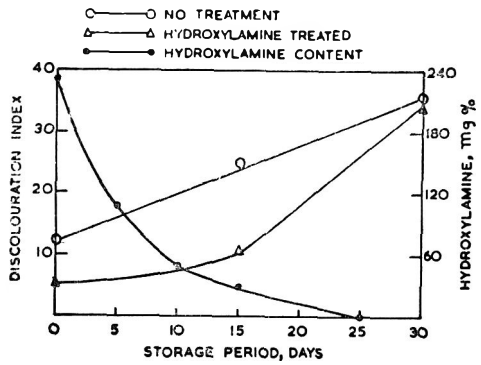

FIG. 3. Interrelationship between hydroxylamine content and discolouration index of shelf stabilized pomfret during storage. The fillets were dipped in 0.5% hydroxylamine for ½ an hour, prior to shelf stabilization by dehydro-irradiation process.

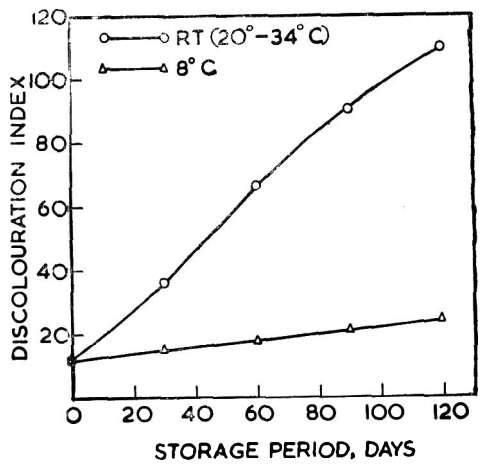

FIG. 4. Influence of storage temperature on the discolouration of shelf stabilized semi-dried pomfret.

Discussion

Chemical treatments: Non-enzymic browning reactions are influenced by a variety of factors[15,16]. The relationship between precursors and the pigment formed can be elucidated using specific chemical compounds. Inhibition of browning reactions of pomfret by hydroxylamine was possibly due to blocking of free aldehyde and carbonyl groups (Fig. 3 and Table 2). Nagaswa[17] and Toyomizu *et al*[18] have also reported the suppression of browning of fishery products by hydroxylamine. Though ribose was very effective precursor for browning of pomfret, ribose (free or bound) contents of fish did not show any relationship with the degree of discolouration. Ribose content of the muscle tissue was about 2 times that of skin but the tissue was less susceptible to discolouration than the skin. This reveals that besides usual amino-sugar type of Maillard reactions, other types of chemical reactions also contribute significantly to the discolouration. Kumta and Kamat[19] have demonstrated the participation of oxidized products of triglycerides and phospholipids in the browning reactions of pomfret.

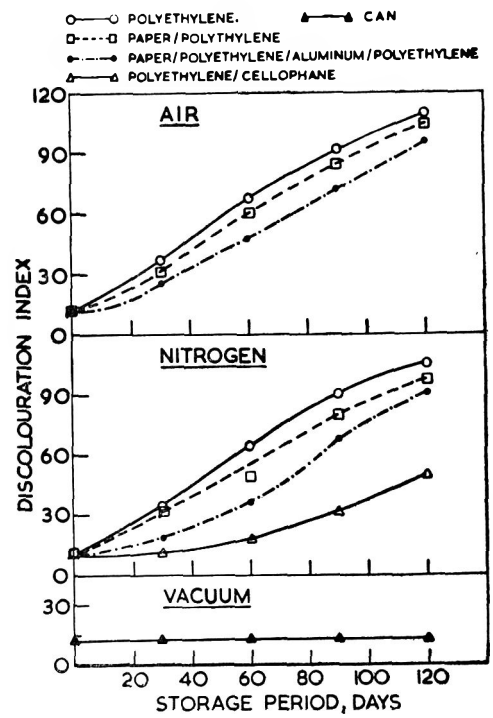

FIG. 5. Effect of packaging environment on the discolouration of shelf stabilized semi-dried pomfret.

Augmentation of the discolouration by copper sulphate can possibly be attributed to Cu^{++}ions which are known to catalyze the browning reactions in fishery products[20,21]. This suggests the need for using Cu^{++} free sodium chloride in the dehydro-irradiation of pomfret. Further, since sorbic acid induced discolouration in pomfret, another antifungal chemical viz., propyl parahydroxy benzoate was used for shelf stabilization of semi-dried pomfret[7].

Effect of packaging: While vacuum packaging of semi-dried pomfret resulted in inhibition of the discolouration and the presence of inert gas such as nitrogen inside the package did not control the browning reactions but as to the contrary caused increased discolouration during storage (Fig. 5). This was perhaps, due to poor gas barrier properties of polyethylene-cellophane laminated pouches under humid conditions resulting in the diffusion of atmospheric oxygen inside the pouch.

Discolouration index: Since the pigment of discoloured pomfret can be extracted in 10 per cent sodium hydroxide and this did not show any specific absorption maximum, therefore it is possible that this extracting procedure and method of assessment of discolouration may also be applicable to other fish varieties, especially where the pigment cannot be completely extracted in organic solvents or released by trypsin hydrolysis.

It may be noted that alkali extraction procedure solubilizes various types of pigments produced by different mechanisms. Hence, this method may not be applicable where mechanisms of discolouration and their pathways are being investigated. Nevertheless, the major advantage offered by this method is its usefulness in rapid screening of effects of the process variables which bring about discolouration in the fishery products. This approach has enabled successful development of dehydro-irradiation process for white pomfret[7].

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A NOTE ON THE FACTORS AFFECTING THE YIELD AND QUALITY OF *CHHANA*

The boiling of homogenized milk with 4.9 per cent fat provides highest yield and percentage recovery of total solids, fat and protein without affecting the quality of *Chhana* indicating its superiority over other treatment combinations. This set of condition therefore, appears to be the best and suitable for preparation of *Chhana* from Kankrej cow's milk.

Chhana is an important base milk product for many of the Indian sweets. However, attempts to improve the quality and yield of this product are very limited[1]. Therefore, it was felt worth investigating the effects of homogenization, temperature and levels of fat on the yield, composition and quality of *Chhana*.

Chhana was prepared from 500 ml batches of milk of Kankrej cows following the procedure of De and Ray[1] with certain modifications. The different treatments given to milk were (*i*) homogenization at 0 and 100 kg/sq. cm (*ii*) heat treatment at boiling and 82°C and (*iii*) fat content at 2.0, 3.6 and 4.9 per cent. These different treatments were given to milk in 12 possible combinations and 4 trials were conducted for each set of conditions. The estimations of total solids, proteins, lactose and ash in the samples of milk and whey were carried out by the methods recommended by AOAC[2].

The fat estimation was carried out following standard Gerber method. To assess the quality of product 7 member panel of judges was set and evaluation was done for colour, flavour and body and texture. The data were subjected to statistical analysis by analysis of variance and Bertlet's test of homogenity of error variance as given by Cochran and Cox[3].

The results of present study revealed that *Chhana* prepared from nonhomogenized milk having 4.9 per cent fat and heat treated to 82°C contained highest total solids (46.06 per cent) and fat (26.55 per cent) whereas the product prepared from homogenized milk with 2.0 per cent fat and heat-treated to boiling contained lowest total solids (38.71 per cent) and fat (12.92 per cent). Highest protein content (21.86 per cent) was observed in *chhana* prepared from nonhomogenized milk with 2.0 per cent fat which was heat-treated to boiling whereas lowest protein (13.36 per cent) was present in *chhana* prepared from homogenized milk with 4.9 per cent fat subjected to 82°C heat-treatment. The increased protein content in *chhana* with high temperature treatments of milk is expected because high fat and high temperature treatments of milk increase the formation of fat-protein complexes[4,5]. Highest lactose (3.93 per cent) was observed in *chhana* prepared after boiling the homogenized milk with 3.6 per cent fat and lowest (2.61 per cent) in the product prepared from nonhomogenized milk with 4.9 per cent fat heat treated to 82°C. Patton and Flipse[6] and Nielsen *et al*[7]., reported higher lactose content in protein fraction of heated milk than in proteins prepared from raw milk. *Chhana* from homogenized milk of 2 per cent fat heat treated to 82°C contained highest ash (2.14 per cent) as against the product prepared from nonhomogenized milk with 3.6 per cent fat boiled to 82°C which contained only 1.22 per cent ash.

Statistical analysis of data revealed significant variations in total solids, fat and lactose in all treatments and interactions. Significant effects of homogenization and percentage fat of milk on the percentage protein was observed. Ash content differed significantly due to different treatments and their interactions except homogenization × temperature and homogenization × temperature × fat interactions.

Highest yield (20.36 per cent) of *chhana* and recovery of total solids (61.44 per cent), fat (99.02 per cent) and proteins (93.64 per cent) were recorded in the product prepared from homogenized milk of 4.9 per cent fat and heat-treated to boiling. Statistically all treatments and their interactions showed significant variations on yield of *chhana* and percentage recovery of ash. The high yield of *chhana* and the percentage recovery of various constituents under these set of conditions may be explained on the basis of the observations made by Fox *et al*[4]. and Loewenstein[5] who reported that higher fat in milk and higher heating temperatures increase fat-protein complexes and hence the yield of the product. The quality of *chhana*, prepared under all the treatment combinations did not exhibit significant differences when judged by the panel of judges for the physical characteristics of *chhana* like colour, flavour, body and texture.

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10 November 1972

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CHANGES IN *AMLA* ON FERMENTATION IN BRINE

8 per cent salt preservation gave an acceptable product.

Amla, (*Emblica officinalis*) is found throughout India, in two varieties viz. smaller and bigger having $\frac{1}{2}$-$\frac{3}{4}$" and 1-1/$\frac{1}{4}$" diameters respectively. The average nutrient composition of *amla* pulp has been studied[1]. The fruit is rich in vitamin C, is sour and astringent and occasionally eaten raw. In combination with iron it is used as a remedy for anaemia, jaundice and dyspepsia[1]. Preservation of *amla* is usually in the form of a preserve by curing it in brine and pricking before making it into a preserve. Curing results in complete loss of the vitamin C while the non-cured fruit can retain it to a small extent after storage at room temperature for two years[2]. In the present work, retention of different constituents after fermentation of *amla* in brine was studied.

The immature, raw fruits of small variety ($\frac{1}{2}$" diameter) were washed sufficiently under running water and weighed. These were placed in clean, dry screw capped glass jars. Brine of appropriate strength viz. 8 and 10 per cent was sterilised at 15 lb for 15 min, cooled and poured into the jars upto the neck and the jars were closed. After every 2-3 days the brine samples were removed. The exact salt concentration was adjusted by adding calculated amount of pure salt. After the fermentation period was over, pasteurisation of the jars at 65-70°C for 1 hr was carried out and the *amlas* were stored as such in the same jars. With the brine samples removed at intervals conventional methods were used for the determination of pH, salt[3] and total acidity. Fermented *amlas* were also tested for moisture, ash, total acidity, volatile and non-volatile acids[4], reducing sugars[5] and ascorbic acid[6] contents.

As shown in Table 1, at both the salt concentrations tried, acidity increased from 0.77 to 1.44 and 0.63 to 1.39 respectively within 20 days of fermentation. Reducing sugars suffered a loss of almost 96 per cent and ascorbic acid 68 and 72 per cent in 8 and 10 per cent salt respectively as shown in Table 2. Volatile and non-volatile acids developed in both cases almost to comparable extents but more so in the 8 per cent sample. Evaluation for acceptability of the products suggested that the 8 per cent product had an acceptable fermented flavour associated with mild original flavour but the 10 per cent product had a slight off flavour. In both the products fruits were soft, increased in volume and a few had burst open. Taste was a balanced salty sour, while colour had changed to reddish brown in both the cases. There was no visible growth and turbidity in both the products. On the whole the 8 per cent product was better than the 10 per cent product and it was accepted very well after washing it in water to remove some of the salt.

TABLE 1. CHANGES IN ACIDITY, SALT CONCENTRATION AND PH DURING FERMENTATION* OF AMLA IN BRINE

Fermentation period in days	Fermentation in 8 per cent brine			Fermentation in 10 per cent brine		
	Acidity %	Salt %	pH %	Acidity %	Salt %	pH %
2	0.77	5.7	3.8	0.63	7.1	3.8
5	0.92	6.4	3.5	0.85	8.3	3.4
8	1.08	7.1	3.2	1.06	8.4	3.2
11	1.19	7.5	2.8	1.17	9.2	2.9
15	1.35	7.8	2.6	1.32	9.5	2.7
20	1.44	7.8	2.5	1.39	9.6	2.6

*Temperature of fermentation, 30-32°C.

TABLE 2. EFFECT OF FERMENTATION* ON NUTRIENTS OF AMLA

Constituents %	Initial	Fermented in 8% salt	Fermented in 10% salt
Moisture	86.9	88.0	88.4
Ash	0.68	0.57	0.54
Reducing sugars	7.40	0.32	0.30
Total acidity as lactic acid	0.34	1.44	1.39
Volatile acids as acetic acid	0.029	0.182	0.165
Non-volatile acids as lactic acid	0.29	1.167	1.143
Ascorbic acid	0.26	0.084	0.072

*Temperature of fermentation, 30-32°C; duration of fermentation, 20 days.

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7 December 1972

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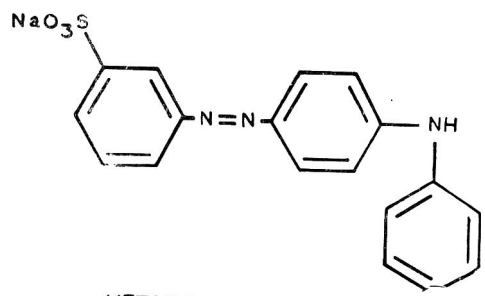
ANTI-TESTICULAR EFFECT OF METANIL YELLOW IN GUINEA PIG

Daily ingestion of 3 per cent Metanil yellow (a commonly used non-permitted food colour) for 90 days produces degenerative changes in the gametogenic elements of guinea pig testis. However, low doses (0.1 and 0.5 per cent) were safe till the end of 3 months.

Metanil yellow (monoazo; C.I. Acid yellow 36 (13065), is the sodium or calcium salt of [m (p-anilinophenyl) azo] benzene sulfonic acid.



METANIL YELLOW

It has been toxicologically classified under the category CII by the joint FAO/WHO Expert Committee on Food Additives meaning thereby, colours for which the available data are inadequate for evaluation and for which virtually no information on toxicity is available. According to U.S. Food and Drug Administration, this colour has been kept under the subhead Ext. D and C yellow Nos. 1 and 2 i.e. 'colour additives provisionally and presently subject to certification by the FDA and provisionally tested for use in externally applied drugs and cosmetics'.

The prevention of Food Adulteration Committee in India has not included metanil yellow in the list of permitted colours. However, a survey conducted by us has revealed that this is one of the most commonly used colours in various foodstuffs[1].

Although the long-term administration of dyes such as yellow AB and OB, at different levels in the diet, has been reported to cause varying degrees of degenerative changes in rat testis by Allmark *et al.*[2] and Hansen *et al.*[3], little attention has been paid to study the deleterious effects of metanil yellow on genital organs. The present study was, therefore, undertaken to investigate the effect of metanil yellow in guinea pig testis.

I.T.R.C. Colony bred adult male guinea pigs, average weight, 300 g, were used in this investigation. Animals were fed routine laboratory diet (Hind. Lever Ltd., India) and water *ad libitum* and were maintained under uniform husbandry conditions throughout the experimental period.

The animals were divided into four groups of ten each. The control group was maintained on routine laboratory diet. The other three groups were fed metanil yellow K (superior quality, from M/s Dadajee Dhakjee, Bombay, India) mixed in the diet at 0.1, 0.5 and 3 per cent levels respectively, daily for 90 days. On an average the animals consumed 50 g of the diet which was maintained even after the addition of metanil yellow.

Control and experimental animals were sacrificed 24 hours after the last feed. The testis were carefully dissected out and fixed in freshly prepared 10 per cent neutral formalin. Serial paraffin sections of 6μ thickness were stained with haematoxylin and eosin.

The histological picture of the testis of the control, 0.1 and 0.5 per cent metanil yellow fed guinea pigs showed typical adult features with successive stages of transformation of the seminiferous epithelium into spermatozoa. The interstitium contained Leydig cells and fibroblast-like elements. The vascularity was normal (Fig. 1).

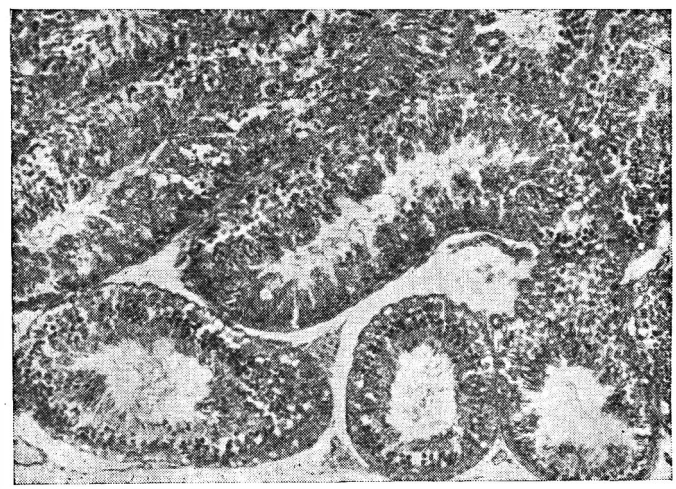


FIG. 1. Testis of a guinea pig. Note typical adult features showing vigorous spermatogenesis. HE × 160.

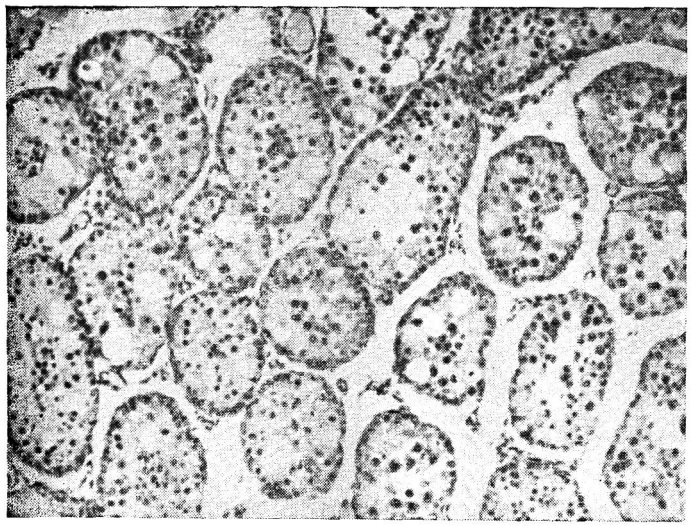


FIG. 2. Testis of a guinea pig treated orally with 3 per cent metanil yellow for 3 months. Note total necrosis of the seminiferous tubules and also sloughing off of seminiferous epithelial elements and giant cell formation. HE × 160.

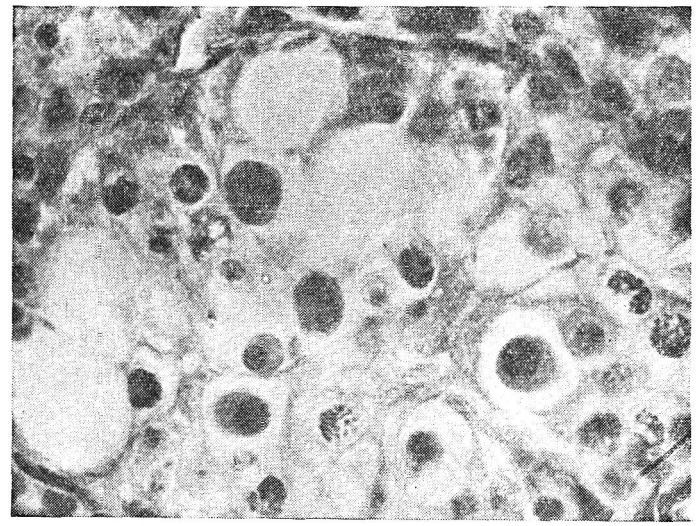


FIG. 3. Testis of a guinea pig treated orally with 3 per cent metanil yellow for 3 months. Note mono-, bi- and tetra-nucleate giant cells. HE × 700.

The testis of 3 per cent metanil yellow fed guinea pigs showed degenerative changes. The seminiferous tubules were reduced in diameter and spermatogenesis was notably affected; there were hardly any spermatozoa in the lumen of the tubules. In 30 to 50 per cent of the tubules, spermatogenesis was arrested at the primary spermatocyte or spermatogonial stage and there was extensive desquamation and sloughing off of the seminiferous epithelial elements. Mononucleate to tetranucleate giant cells were common and the tubules were devoid of lumen (Fig. 2 and 3). The Leydig cells were normal and functional but the blood vessels were engorged. Serous exudate was present in the interstitium in localized areas.

The results of the present preliminary study show that daily ingestion of a high dose (3 per cent) of a commonly used food colour metanil yellow, for 90 days produces degenerative changes in the guinea pig testis whereas low doses (0.1 and 0.5 per cent) were safe till the end of this study. It is interesting that the dye has a deleterious effect only on the gamete producing system and the hormone producing cells remained unaltered. Further studies are in progress.

The authors are grateful to Dr S. H. Zaidi, Director of the Centre for his keen interest in the work. Thanks are due to the Public Analyst, U.P., for his valuable help in the survey studies. Technical assistance of Messrs Mulkraj, V. G. Misra and G. B. Tewari is highly appreciated.

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Phosphates in Food Processing: An International Symposium on Phosphates in Food Processing held at the University of Guelph, Ontario, Canada. Edited by J. M. DEMAN, *et al.* The AVI Publishing Company, Inc. Westport, Connecticut, U.S.A., 1971, pp. 242. Price $ 21.

In recent years, the use of phosphates and polyphosphates in food processing industry is on the increase as a result of the profound effect on the functional properties of food products. In spite of the large amount of published information available on the chemistry of condensed phosphates and their effect on the food properties, a comprehensive review of the applications of phosphates, their interactions and effects has been lacking. As such this publication highlighting the proceedings of a symposium organised on the role of phosphates in food processing will prove very useful, more so because of the participation of the experts in the field. The proceedings have been suitably divided into four sections.

Section I opens with a chapter devoted to characterise the phosphates and polyphosphates from the view point of chemical structure and their physico-chemical properties such as texture, consistency, uniformity and appearance, etc. The main food applications such as bacteriocidal action, chemical leavening, cereal, dairy and animal products, etc. have also been described. In the second chapter, a detailed account of the nomenclature and manufacture of ortho-meta- and polyphosphates presently used in food industry and few other potential ones have been covered. In Chapter 3, are described different aspects of analysis of natural as well as added phosphates in foods. Different chromatographic methods have been detailed qualitatively and quantitatively.

Interactions between phosphates and individual food components form section II of the proceedings. Chapter 4 discusses in detail the interactions of milk proteins with phosphates. As phosphate addition increases, the water holding capacity of raw as well as cooked meats increases. They are extensively used in production of sausages, in curing of ham and for improving the rehydration properties of frozen meat. As such, chapter 5 is devoted to the interactions between phosphates and meat proteins with special reference to (*i*) general influence of ions on meat hydration, and (*ii*) interactions between phosphates and muscle proteins in salted as well as unsalted meat. Interactions between phosphates and plant proteins have been discussed in chapter 6 under the following heads:

(*i*) chemical interaction between phosphorus and peptides ;
(*ii*) protein, calcium and phytic acid interactions;
(*iii*) stability of phosphate ester bond in phosphate proteins;
(*iv*) comparative ratios of N/P in animal and plant phosphate proteins;
(*v*) physical effects of phosphorus and calcium on plant proteins ;
(*vi*) Inositol phosphatide—peptide complexes.

Interactions between phosphates and gelling and thickening agents have been discussed in detail in chapter 7. In recent years phosphates along with gelling and thickening agents have been in use to impart certain desirable characteristics to various food preparations such as ice-creams, fruit and vegetable industry, gelatin-based chiffon desserts, egg custard products, milk puddings, etc.

Section III is devoted to the most important aspect i.e. the use of phosphates in food products. In chapter 8 are described the modifications or the improvements which are achieved by use of starch phosphates and not the unmodified starches. Increased paste viscosity and clarity, reduced tendency to jellying, increased suitability to freezing and thawing, increased resistance of starch paste towards breakdown under stresses of shear, heat and acidity frequently encountered in food processing are some of the modifications or improvements in physical properties discussed. The advantages highlighted with the use of starch phosphates in food products are choice of consistency, better texture or mouth-feel and avoidance of separation of ingredients and convenient carriers of flavours. History, preparation and properties of interaction products of starch with phosphate, di-starch and many starch phosphate esters as well as their combination are also discussed. The commercial methods of preparation and their uses in foods have been stressed.

As the largest single use for phosphates is in the manufacture of pasteurised process cheese, all the

related aspects have been rightly covered in detail in chapter 9. The matter is covered under the following heads:

(*i*) types of phosphate (ortho- and condensed), emulsifying salts used in processed cheese;

(*ii*) the theory of emulsification: interactions of phosphate with calcium, protein and fat, the pH effects, the microscopic and histochemical evaluation of phosphates and emulsification;

(*iii*) methods of evaluating phosphates in process cheese: isolation and characterisation, physical measurements, melting, hardness, rheological properties, chemical measurements such as pH, water content, etc.;

(*iv*) effects of phosphates on physicochemical properties of process cheese;

(*v*) effects of phosphate types on quality attributes of process cheese like type and age of natural cheese, time and temperature of processing;

(*vi*) hydrolytic and biochemical stability of phosphates in process cheese;

(*vii*) phosphate defects like salt textures, darkening of wrappers in process cheese; and

(*viii*) comparison of phosphates with other process cheese emulsifiers.

The general concepts applicable to the use of polyphosphates—mainly sodium tri-polyphosphates in high-protein red meat, poultry and seafood processing are presented in chapter 10. In chapter 11, are covered the use of phosphates in fruit and vegetable industry as acidifier, preservative, alkalizer, gelling agent, sequestrant, buffer dispersent, precipitant, adsorber, vegetable tenderiser, etc.

As baking industry is perhaps the largest consumer of phosphates and leavening is the most important single application, various phosphates used in the leavening process, their properties and their applications as well as other functional use of phosphates in baked goods along with their nutritional aspects are discussed in chapter 12 on the use of phosphate in cereal and baking industry. It has been emphasised that the wide variety of phosphate complex provide broad range of reaction rates and reaction temperatures with baking soda. Such a range of properties has been instrumental in the development of new products and processes for conventional and convenience baked goods.

Section IV on 'Public health aspects of use of phosphates in foods' highlights occurrence, absorption, metabolism and excretion of phosphates, phosphates as food additives, their quality, health hazards and frauds, technological justification and as dietary factors.

On the whole, the proceedings encompassed in this single publication of AVI is a boon to a food scientist and technologist working in the fields of dairying, meat, poultry and seafood products, processing of plant proteins, fruit and vegetable industry as well as cereal and baking industry. As such it is needless to emphasise its prominent place on the book-shelf of a food scientist or technologist.

S. R. SHURPALEKAR

Technology of Wine Making: by N. A. AMERINE, H. W. BERG AND W. V. CRUESS, AVI Publishing Company, Inc. West Port, Connecticut, U.S.A. 3rd Edn. 1972, pp. 802. Price $ 28.

This is the third edition of the book under the present title but earlier to that the book was published under the name 'The Principles and Practices of Wine Making' with the sole authorship of Dr W. V. Cruess. In each edition steady improvement has been made in the book by incorporating ever increasing information in the scientific literature on the advances made in the fields of chemistry, microbiology and technology of wine making. In this latest edition the authors have made further modifications by eleminating some superfluous material and adding new ones to keep the book up to date. In the present edition major alterations have been made in two chapters viz. (1) molds and yeasts of grapes and wines and (2) legal restrictions on wine making. New classification of yeasts proposed by Lodder has been included alongwith recent changes in the State and Federal regulations in U.S.A. on the legality of wine making.

The book has been split up into 20 chapters as in the earlier editions. The authors have obviously felt no necessity to rearrange these titles as yet. The first three chapters deal with the wine regions of the world giving the history of wine making and the types of wines manufactured in each country; the composition of grapes and the physico-chemical changes occurring during the ripening in the important varieties of grapes and the types of American wines alongwith their composition. Chapter 4 deals with the occurrence, morphology and some other general properties of yeasts and molds which are considered vital in wine production. The chemistry of fermentation and certain other chemical aspects of yeast activity are presented in chapter 5 in addition to points of legal, biochemical and sensory importance pertinent to the

composition of wines. Chapter 6 gives the details of equipment used in winery operations, principles of their working and the over-all functioning of the winery. Individual chapters have been devoted to the production of different types of wines viz. red table wines, white table wines, sherry port and dessert wines, sparkling wines, vermouth and flavoured wines. Other fruit wines from apple, cherry, plum, pomegranate, pineapple, pear, oranges, grapefruit and various details about them are included in chapter 14. Diseases of wines both of non-bacterial and bacterial types have been elucidated in two separate chapters. Definitions of different types of brandies manufactured in U.S.A. and various details connected with them form the subject matter of chapter 17. Greater emphasis on details has been given on the types of products made in U.S.A. because the book has been mainly written to cater to the needs of that country. Analytical procedures for the evaluation of wines in the laboratory have been given in chapter 19 and the book ends with details on legal restrictions in wine making as prevalent in the United States.

Various other publications are available in the market on the individual types of wines and also on wines of different countries but in the present book the entire subject of wine making has been dealt with in a comprehensive way. The authors with their long experience in the field have presented various details in a simple and lucid style. The book is very well illustrated at various places which leaves a lasting impact of the subject on the minds of the readers. The book can be used as a text book for students undergoing training in fermentation technology. Besides it will also form a useful addition on the library shelves of different wineries as well as personal collections of others interested in the art of wine making.

A large number of references given in the bibliography at the end of each chapter are quite useful and the reader can consult the original papers if needed. Both the printing and the get up of the book are good.

J. C. ANAND

Poultry Breeding and Genetics: Seminar papers, 1972, pp. 123.

A compilation of papers presented by specialists during the Seminar on 'Poultry Genetics and Breeding' held at Centre of Excellence for Advanced Studies in Poultry Production, Indian Veterinary Research Institute, Izatnagar, U.P. during 19th-22nd of June 1972. The papers ranged from breeding for broiler or egg production, influence of poly morphism and heterosis on breeding, selection based on egg production, feed efficiency, egg mass, social dominance, resistance to diseases, genetic effects of spermatazoa to a paper on the 'Aseel' breed of game bird of A.P. region. The papers discuss and correlate the results of the controlled experiments conducted by the authors and the data published in scientific literature.

The collection of papers would be very helpful to scientific workers involved in Poultry breeding and genetics. The Seminar was organised by the Division of Poultry Research, Indian Veterinary Research Institute in collaboration with UNDP.

B. R. BALIGA

Commercial Chicken Production Manual: By MACK O. NORTH, The AVI Publishing Co., Inc., Westport, Connecticut, U.S.A., 1972, pp. 645, Price $ 31.00.

In the Manual the author has tried to bring together the information available on various aspects of poultry rearing keeping in view the decision one has to take under different situations of managerial stress in relation to productivity. Throughout the book he has emphasized the practical aspects of the problem and has taken great pains to shape the book as a service manual and reference guide for poultry growers. While doing so he has made an attempt to elaborate, how one should proceed in handling various situations connected with drop in egg production, low feed conversion, decline in hatchability, production of poor quality chicks, sudden change in weather and other stress problems seen in a commercial poultry flock.

The book contains in total 45 chapters including one dealing with tables and publications. The chapter titles are—(1) modern breeds of chicken (2) structure of the chicken (3) formation of the egg (4) development of the chick embryo (5) chick hatcheries (6) hatchery equipment (7) maintaining hatching egg quality (8) factors affecting hatchability (9) operating the hatchery (10) hatchery management (11) poultry housing (12) poultry house equipment (13) brooding management (14) growing management (15) laying management (16) breeding management (17) cage management (18) lighting management (19) force molting (20) broilers and roasters (21) poultry genetics (22) genetic management (23) production standards (24) record management (25) digestion and metabolism (26) major feed ingredients (27) vitamins and trace ingredients (28) feed fundamentals (29) nutritive requirements for growth (30) nutritive requirements for egg production (31) nutritive requirements for hatching egg production (32) analysis of feed stuffs (33) poultry

rations (34) feeding growing birds (35) feeding laying hens (36) feeding breeding birds (37) feeding broilers and roasters (38) bacteria, viruses, protozoa and fungi (39) developing immunity (40) drugs and antibiotics used in disease control (41) poultry diseases (42) parasites, insects, mites and rodents (43) disease prevention management (44) waste management and (45) Tables and publications.

The book contains many practical hints on various phases of management and is of great value for all those who are engaged in the practical field of poultry production.

P. C. PANDA

Principles of Enzymology for the Food Sciences: By JOHN R. WHITAKER, MARCEL DEKKER, Inc., New York, 1972, pp. 636. Price $ 26.50.

The book consists of 25 chapters plus an index. The first 14 chapters, (426 pages) deal with basic enzymology and the other 11 with enzymes on practical or potential importance in food science. The basic enzymological aspects such as kinetics, the active sites, and various factors which affect enzyme activity have been covered in an easily understandable conceptual manner but with the necessary elementary mathematics. The effects of various factors such as the inhibitors, pH and temperature, which affect the rate of reaction, have been lucidly dealt with in detail. A chapter on limited proteolysis of physiologically inactive proteins (zymogens, proinsulin, etc.) is quite interesting and so also the chapter on the functions of co-enzymes. Enzymes of practical value in food sciences have been discussed in more detail in chapters 15 to 25 (190 pages) with reference to their basic enzymological properties. The two most important groups are hydrolases and oxido-reductases. The enzymology of many of the important and well-known enzymes from these two groups have been dealt with in depth including the mechanism of action in some cases.

The book is a valuable aid to anyone (biochemist or food scientist) who wants to understand the basic principles of enzymology since these have been lucidly explained. In the latter part dealing with enzymes of interest in food sciences, it is our opinion that in addition to the useful basic information already present, some information on immobilised or insolubilised enzymes including their potentialities in industry and on the actual uses of the various enzymes of practical or potential value could have been included.

A very welcome feature is the inclusion of review-questions at the end of each chapter, which certainly help one in checking one's understanding of the text material. The get-up is excellent and so also the figures, illustrations, etc. It is hoped that the book will be warmly received and widely read.

M. R. RAGHAVENDRA RAO

Seminar on Processing, Preservation and Marketing of Poultry and Poultry Products

A six-day seminar on processing, preservation and marketing of poultry and poultry products was organised by the Centre of Excellence for Advanced Studies on Poultry Production at Indian Veterinary Research Institute (IVRI) Izatnagar between 28th Dec. 72 to 2nd Jan. 1973. Scientists from all over the country, representatives of Central Government, National and Agricultural Institutes and marketing organisations attended the symposium. Altogether 25 papers on various aspects of processing, preservation and marketing of poultry were presented.

Workshop on Plantation Crops

The second annual Workshop on All India Co-ordinated Plantation Crops Improvement Projects was held from 4th to 7th December, 1972 at the Tagore Centenary Theatre, Trivandrum. Over 150 delegates from all over the country attended the workshop.

National Symposium on Plantation Crops

The National Symposium on Plantation Crops organised by the Indian Society for Plantation Crops, Kasaragod, was held from 8th to 10th December, 1972 at Trivandrum. The Symposium was inaugurated by Sri C. Achutha Menon, the Hon'ble Chief Minister of Kerala. The Symposium was attended by 215 delegates and by over 150 invitees and observers. There were in all eight Sessions. While papers dealing with specific subjects were presented in six sessions, panel sessions were devoted for discussion on topics of general interest to Plantation Crops. Discussions on multiple cropping, hybrid vigour, concept of plant type, operational research, technological problems and economic research needs, with particular reference to plantation crops, were held.

A special lecture on 'Modern Trends in Agricultural Technology' was delivered by Dr M. S. Swaminathan.

Raman Spectra

Sadtler Research Laboratories, Inc., of Philadelphia, announces the publication of a new continuing collection of Raman Standard Reference Spectra. The initial publication consists of three volumes and contains Standard Raman and Infrared Grating Spectra of 1,200 compounds. The first 2,000 compounds in the collection will be systematically grouped into approximately fifty chemical classes. Many simple compounds are included in each chemical class to illustrate typical characteristics. Additional spectra will be published at the rate of 2,000 compounds per year and will be available on an annual subscription basis. The collection is comprehensively indexed to facilitate rapid retrival of spectral data.

1973 Subscriptions to Sadtler Standard Spectra Collections

Sadtler Research Laboratories, Inc., Philadelphia, U.S.A. announces publication of the 1973 subscriptions to Sadtler Standard Spectra collections. These subscriptions will supplement spectra previously published in the Sadtler Standard Infrared Prism, Infrared Grating, Nuclear Magnetic Resonance and Ultraviolet spectra collections.

The 1973 subscriptions include 2,000 IR Prism, 4,000 IR Grating, 2,666 NMR and 2,000 UV spectra. These spectra include many simple aliphatic, aromatic, alicyclic and heterocyclic compounds which have been selected from chemical catalogs such as Eastman, MCB, Aldrich, Fluka, Merck and other chemical manufacturing companies.

Each spectrum indicates the chemical name, molecular formula, structural formula, physical and optical constants (when available), source of sample, literature reference (when available), instrumentation and method of sample preparation. The Sadtler Total Spectra Index provides the most comprehensive indexing system available for published reference spectra.

The Diebold Group International, Inc.

The Diebold Group Inc., the management consulting firm, has joined The Diebold Group International, Inc. to extend its management practice to Asia, Africa, Australia, The Middle East and Latin America. The pattern of operation of The Diebold Group, Inc., founded in 1954, is to take as partners business and financial institutions deeply rooted in the communities to be served. Initially the four international financial institutions it has as its partners in the Diebold Group International are:

—Manufacturers Hanover Trust Company
—The Industrial Bank of Japan, Limited
—Crown Agents
—Australia and New Zealand Banking Group Limited

Earlier precedents were set by Diebold in forming its partnership with Rothschild Freres in France (1964) and Banco Espanol de Credito and Banco Vizcaya in Spain (1968).

The Diebold Group International, Inc. provides a full range of management consulting services in Diebold's traditional areas of business consulting such as marketing and organization, as well as new areas such as the applications of technology including agricultural management. In addition, the company conducts public administration consulting projects involving work directly for foreign governments and agencies, with emphasis on systems and procedures, organization, budget and finance matters, and economic planning. John Gratwick, former Managing Director, Urwick, Orr & Partners, Ltd., has been named Managing Director of the new company. He will make his offices at the new headquarters of the company in London.

First International Congress on Mercury

'The Instituto Technòlogico Metalùrgico' 'Emilio Jimeno' of the University of Barcelona, announces a—'First International Congress on Mercury' for September 2-7, 1973. Sessions as well as Symposia and Panel discussions will be held on history, geology and mining, extractive metallurgy, physical metallurgy and metallography, uses (pharmacy, metallurgical and agriculture), toxicity and miscellaneous. Sessions are planned to stress world resources, future of mercury and its wise use.

International Institute of Refrigeration

A meeting on Refrigerated Sea Transport and Refrigerating Machinery will be held from March 5 to 7, 1974, in Tokyo, under the auspices of Japanese Association of Refrigeration, Tokyo 160.

The topics to be handled are as follows: Refrigeration and Freezing of Fish on Board Ships, (1) chilling, (2) refrigeration, (3) freezing, (4) holding, (5) calculation and design of equipment, (6) regulation and automation, (7) operation of equipment, (8) insulation.

Indian Standards Institution

Following standards have been published:

IS:6559-1972	Code of Practice for Ante-mortem and Post-mortem Inspection of Poultry	Rs 6.00
IS:1035-1972	Methods of Sampling and Test for Bleaching Earths	Rs 6.00
Doc:AFDC15(1204) / Doc:AFDC15(1182)	Livestock Feeds (draft)	Free on request
IS:6591-1972	Rail Milk Tankers	Rs 5.00
IS:6387-1971	Vegetable Protein Infant Food with Milk	Rs 7.00
IS:2420-1971	Mackerel (*Rastrelliger* sp) Canned in Oil	Rs 3.00
IS:2421-1971	Sardines (*Sardinella* sp) Canned in Oil	Rs 3.00
IS:6544-1972	Wing Band for Poultry	Rs 3.00
IS:6545-1972	Leg Band for Poultry	Rs 3.00
IS:561-1972	BHC (HCH) Dusting Powders	Rs 8.50
IS:632-1972	BHC (HCH) Emulsifiable Concentrates	Rs 9.50
Doc:AFDC 31 (1207)	Ice-Cream Cones	Free on request
IS:1960-1961 Doc:AFDC 31 (1208)	Wheatmeal Bread	Free on request

Shri A. N. Sankaran, till recently Scientist in C.F.T.R.I., Mysore, retired from active service on 29th March 1973. While wishing him a peaceful retired life, the Association hopes that Shri Sankaran will continue to take active interest in the activities of the Association.

Shri M. R. Chandrasekhara, one of the life members of AFST, has taken up an assignment with Food Ministry to organise the Miltone Project. While in CFTRI, he had taken keen interest in the activities of the Association and in fact he was the Editor of this Journal for two successive terms. The Association is gratified to hear that Shri Chandrasekhara will be assisting the Journal in future also as one of the associate editors.

Prof. J. V. Bhat, one of our past presidents, was selected as Professor Emeritus by Indian Council of Agricultural Research, New Delhi, after his retirement from Indian Institute of Science, Bangalore.

Prof. A. Sreenivasan, one of the senior members of the Association, was awarded the 'Rafi Ahmed Kidwai Award' recently for his contribution in the field of post-harvest technology.

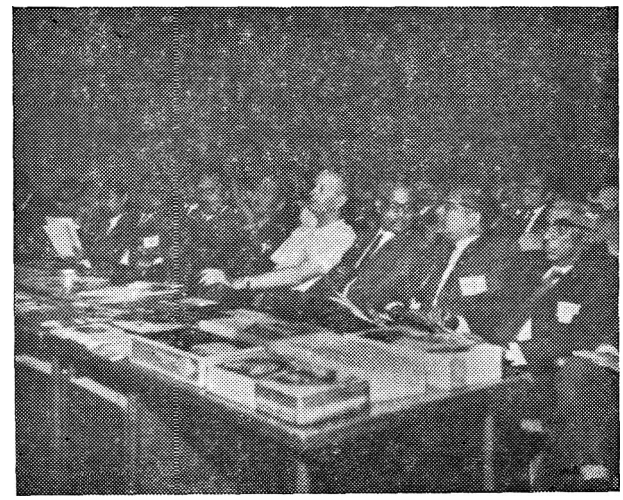
Mr K. Sen, Vice-Chancellor, Kalyani University inaugurating the Seminar on Frozen Food Industry, held on 3rd and 4th March, 1973 in Calcutta

Proceedings of the General Body Meeting of the Association of Food Scientists and Technologists (India) held at Calcutta on 4th March 1973

In the unavoidable absence of Dr Rege, President of AFST, Shri C. P. Natarajan, Vice-President of AFST (headquarters) occupied the chair and conducted the business of the meeting. The Chairman welcomed the members present for the AFST meeting and read Dr Rege's welcome address.

The Secretary, Dr M. A. Krishnaswamy then presented his report for 1972. He also presented the balance sheet for the year and budget proposals for 1973, on behalf of the Treasurer who was unable to attend the meeting.

The Gardners Award for the best research paper published in the Journal of Food Science and Technology during 1971 was presented to the research paper on 'Studies on packaging and storage of *atta* (wheat flour) under tropical conditions' by Arya S. S., Mohan M. S. and Nath H. of DFRL, Mysore. Dr H. Nath, received the award on behalf of the authors.



Participants in the Seminar

Dr H. Nath, the President for 1973 was then inducted into the chair by the Chairman, Shri C. P. Natarajan. The Chairman said that Dr Nath—who is the Director of DFRL is a familiar figure to all the food scientists and technologists both within and outside the country and thus did not require any introduction. It was indeed a privilege and a pleasure,

Annual General Body Meeting of AFST
From L to R—Mr. B. S. Narayana, President AFST (Eastern Regional Branch), Dr H. Nath, Mr C. P. Natarajan

the Chairman said, to induct such an eminent person as President of AFST. Dr Nath then took over the chairmanship and presented his address.

Dr M. A. Krishnaswamy, Hon. Exe. Secretary, announced the results of election for different offices. The Secretary pointed out that as per the resolution of General Body Meeting of 1971, postal ballot system of elections was introduced for the first time. The meeting approved the following election results:

Headquarters (Mysore)

President Elect:
Dr T. N. Ramachandra Rao

Vice-President:
Dr V. Sreenivasamurthy

Hon. Executive Secretary:
Dr A. G. Mathew

Hon. Joint Secretary:
Dr V. H. Potty

Hon. Treasurer:
Sri M. V. Sastry

Councillor:
Sri P. S. Balakrishnan

Eastern Branch

Vice-President:
Mr K. C. Dé

Councillor:
Mr P. K. Bose

Northern Branch

Vice-President:
Dr A. G. Naik Kurade

Councillor:
Dr Hari Bhagwan

Western Branch

No nomination received

Dr M. A. Krishnaswamy then proposed a vote of thanks to the office-bearers of the Eastern Branch for their hospitality in hosting the General Body Meeting. He pointed out that this was the second time that General Body Meeting was held outside headquarters and AFST was proud of its branches hosting such meetings as well as seminars like the one that preceded the General Body Meeting.

Extract from Annual Report of AFST presented by the Hon. Executive Secretary for the year 1972, at the General Body Meeting held at Calcutta on 4th March, 1973

1. Membership of A.F.S.T.

The total strength of membership of the Association during the period under review was 738 out of which 31 were Life Members and 19 Corporate Members as against a total of 677 members during the previous year. The memberships of regional branches particularly Western and Northern have increased significantly.

2. Subscribers to Journal of Food Science and Technology

Subscribers to the Journal were 354 out of which 152 were Indian and 202 foreign as against a total of 360 during 1971. Revenue from advertisements in the Journal has slightly improved over the previous year. However, there is great need as well as scope for securing a larger number of advertisements from the industries in order to promote useful liaison between industries and science and to sustain and upgrade the Journal. It is necessary that the headquarters as well as the regional branches should make vigorous efforts to strengthen the financial position of the Association by securing more and more advertisements for the Journal.

3. Activities of the Association during the year 1972

During 1972, a Symposium on 'Alcoholic Beverage Industries in India: Present Status and Future Prospects' was held at CFTRI, Mysore on 2nd and 3rd, November 1972. This Symposium was sponsored jointly by AFST and CFTRI, Mysore. Over 150 delegates representing research laboratories, universities, industries and administrative wings of different governments involved in implementation of policies on alcoholic beverage industries, effectively participated in the Symposium. The Symposium made a number of recommendations on various aspects concerning this industry. It has tried to lay down a list of priorities for the development of the industry on sound technological footing. The set of recommendations made have been forwarded to all the delegates of the Symposium and to the various administrative agencies involved in implementation of policies affecting the alcoholic beverage industry. The Association is publishing the entire proceedings of this symposium and it is hoped to release it for circulation among members of AFST and delegates at an early date. Also, it was unanimously recommended to form an Association of 'Fermented Beverage Industries' to look after development of this industry in the country.

Over 10 technical lectures were organised under the auspices of the AFST (Headquarters) at CFTRI, Mysore during the period, the subjects covered related to food toxicology, marketing of food products, quality control in food industry, measuring quality and maturity of fruits and vegetables and allied topics.

Eastern Zone of AFST, held its General Body Meeting on 1st July 1972 when Dr S. Varadarajan, Research Director of Hindustan Lever Ltd., Bombay, spoke on the role of food technology in nutrition. Dr S. M. Sarkar, Director of Bose Institute was the chief guest. The Eastern branch arranged for a seminar on 'Frozen Food Industry in India' on 3rd and 4th of March 1973, and hosted the Annual General Body Meeting of AFST.

Central Zone arranged a seminar on Poultry Genetics and Breeding at Izatnagar on 19th June 1972 with Dr P. Bhattacharya, Member of the National Commission on Agriculture, in the chair.

Western Zone organised a technical seminar on Beverages on 15th and 16th April 1972, at the Institute of Catering Technology and Applied Nutrition, Bombay. The AFST General Body Meeting for 1971 was hosted during the period by the Western Branch.

Northern Zone under the auspices of Northern Zone Sri Chitra Mitra of Indian Market Research Bureau, Calcutta, delivered a lecture on Consumer Acceptability of Soybean Products in Indian Preparations.

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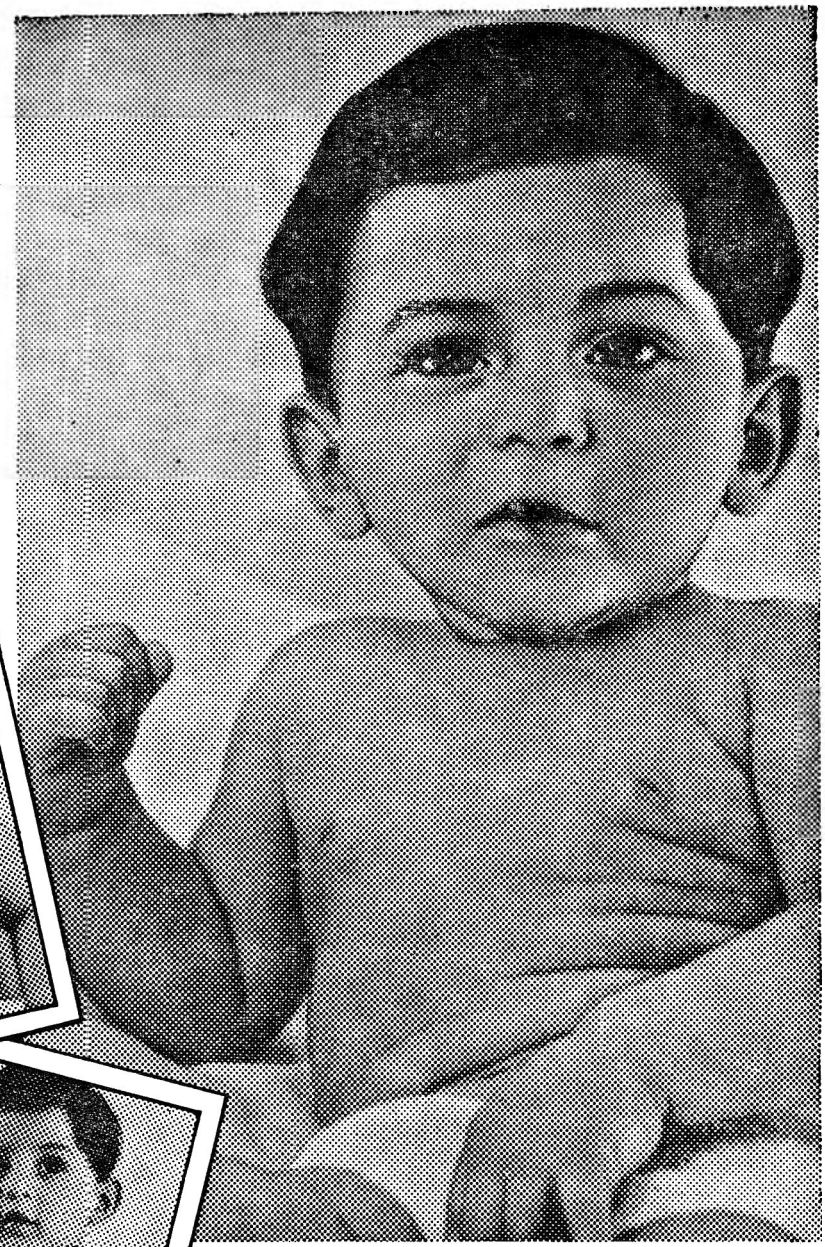

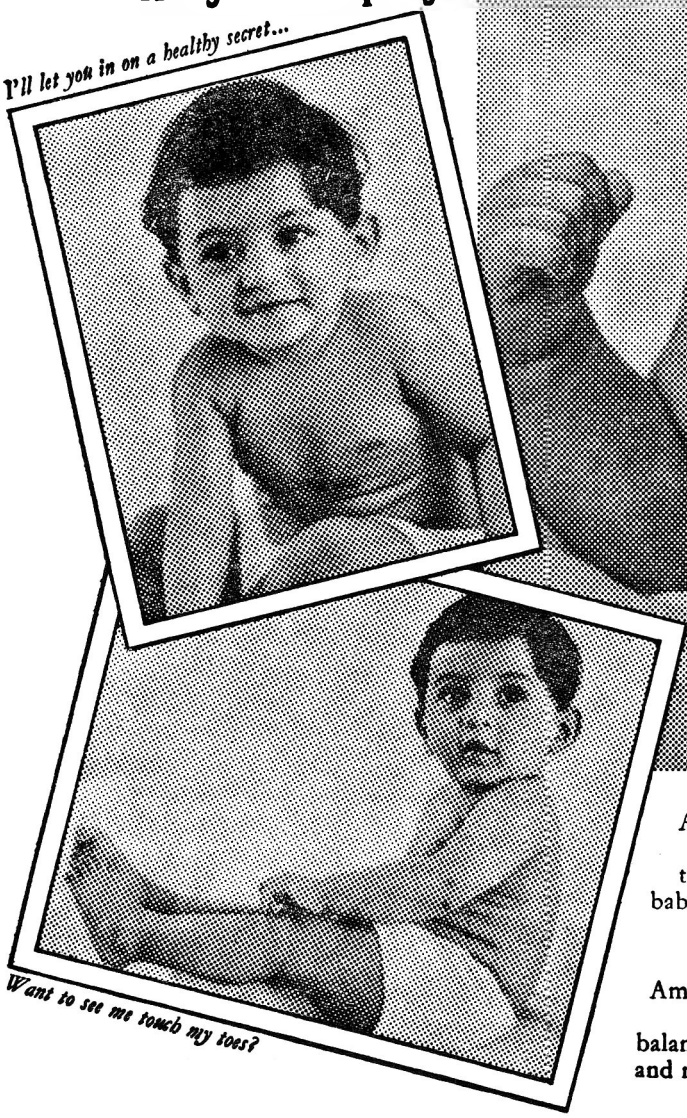

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INSTRUCTIONS TO CONTRIBUTORS

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

2. Short communications in the nature of letters to the editor should clearly indicate the scope of the investigation and the salient features of the results.

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

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

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

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

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

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

In the text, the references should be indicated by numbers placed above the line (superior). They should be numbered and included at the end of the article in serial order.

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

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

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

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

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

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

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

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Proceedings of the Workshop held at C.F.T.R.I., Mysore
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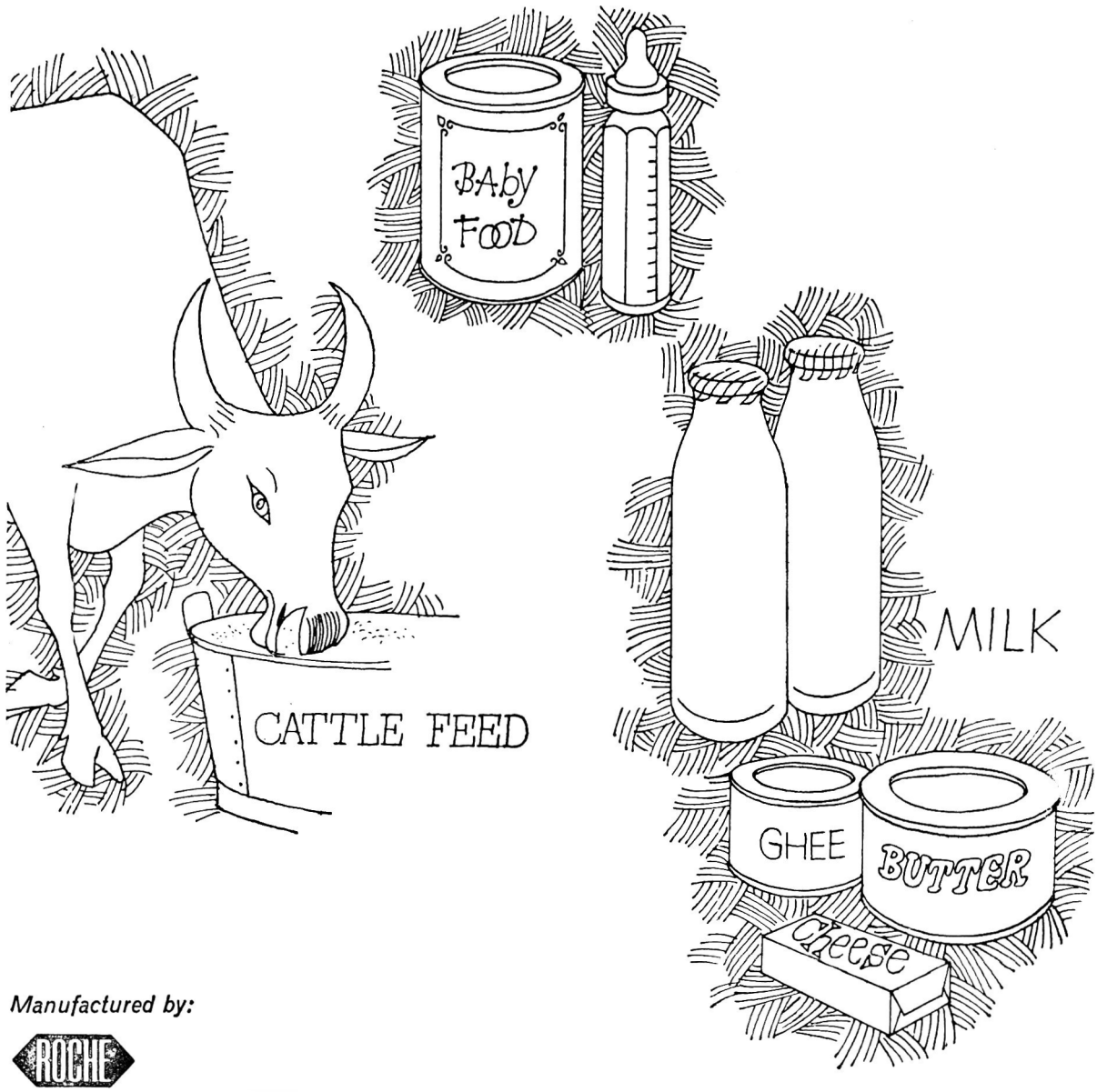

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