ISSN-0022-1155

JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

ASSOCIATION OF FOOD SCIENTISTS & TECHNOLOGISTS, INDIA

VOL. 20. NO. 3. MAY / JUNE 1983

ASSOCIATION OF FOOD SCIENTISTS AND TECHNOLOGISTS

(INDIA)

The Association is a professional and educational organization of Food Scientists and Technologists

AFFILIATED TO THE INSTITUTE OF FOOD TECHNOLOGISTS, USA

Objects:

1. To stimulate research on various aspects of Food Science and Technology.
2. To provide a forum for the exchange, discussion and dissemination of current developments in the field of Food Science and Technology.
3. To promote the profession of Food Science and Technology.

The ultimate object is to serve humanity through better food.

Major Activities:

1. Publication of Journal of Food Science and Technology (bi-monthly) and Indian Food Industry (IFI) (quarterly).
2. Arranging lectures and seminars for the benefit of members.
3. Holding symposia on different aspects of Food Science and Technology.

Membership:

Membership is open to graduates and diploma holders in Food Science and Technology, and to those engaged in the profession. Each member will receive a copy of the Journal of Food Science and Technology, published by the Association. The Chapters of the Association are situated at Bangalore, Bombay, Calcutta, Delhi, Hyderabad, Karnal, Ludhiana, Madras, Nagpur, Parbhani, Poona, Palayamkottai and Trivandrum.

Membership Fee		Admission Fee
Life Member	Rs 300	Rs 2
Life Member (Resident abroad)	$ 150	$ 1
Corporate Member	Rs 300	Rs 5
Member	Rs 20	Rs 2
Member (Resident abroad)	$ 10	$ 1
Affiliate Member	Rs 30	Rs 2
Student Member	Rs 10	Re 1

Annual Subscription for each Journal

Inland	Rs 100
Foreign:	
Surface Mail	$ 30
Air Mail	$ 50
For IFI	
Association members	
Indian	Rs. 20
Foreign	$ 6

For membership and other particulars kindly address

The Honorary Executive Secretary

Association of Food Scientists and Technologists, India

Central Food Technological Research Institute, Mysore-570 013, India

The Journal of Food Science and Technology is a bimonthly publication of the Association of Food Scientists and Technologists, India (AFST) issued in February, April, June, August, October and December.

Manuscripts for publication and books for reviewing in the Journal should be addressed to the Editor, Journal of Food Science and Technology, AFST, Central Food Technological Research Institute, Mysore-570013. The Editor reserves the privilege of editing the manuscript to make it suitable for publication in the Journal.

Correspondence regarding subscriptions and advertisements should be addressed to the Executive Secretary, AFST, Central Food Technological Research Institute, Mysore-570013, India. Payment may be made by cheque, draft, postal or money order in favour of Exec. Secretary, AFST.

JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

Volume 20 Number 3 May/June 1983

CONTENTS

Research Papers

Research Notes

RESEARCH PAPERS

Effect of Heat Processing on the Paste Viscosity of Cereal Flours

S. N. RAGHAVENDRA RAO, S. SREEDHARA MURTHY AND H. S. R. DESIKACHAR
Central Food Technological Research Institute, Mysore, India

Manuscript received 14 *October* 1981; *revised* 8 *November* 1982.

The effect of different forms of traditional heat processing of cereal grains on the paste viscosity of flours obtained from them was studied. All forms of heat processing generally increased the cold slurry viscosity but decreased the hot paste viscosity of the flours as compared with unheated control samples. Puffing and flaking produced greater reduction in hot paste viscosity, while parboiling and toasting effected smaller changes. The extent of viscosity change depended on the severity of heat treatment and the specific cereal grain treated. Malting considerably reduced the viscosity of all grains.

The effects of gelatinization of starch on its viscosity properties and modification of starch viscosity for industrial purposes are well known and commercially utilized[1-3]. Both the native and modified starches are being used in the food industry[4-6]. As there is little information on the effect of different traditional forms of heat processing applied to cereal grains on the viscosity properties of the resultant cereal products, it was proposed to study this aspect and compare it with the effect of malting, which is well-known to reduce the paste viscosity of the starch appreciably and which has recently been made use of for developing weaning foods with high caloric density and low paste viscosities[7]. The results of this study are described in this paper.

Materials and Methods

Paddy ('CH45)', wheat (Punjab'), sorghum ('CSH5'), ragi ('Poorna'), bajra (CB4') maize (hybrid) and Bengal gram were procured, cleaned and used. The following forms of heat processing were employed.

Parboiling: The grains were soaked in hot water at 60°C for 3 hr and after draining out the soak water steamed for 30 min and dried to 12-13 per cent moisture. The paddy was shelled to brown rice while the other grains were used as such.

Flaking: All the grains were soaked in cold water for 30 min, drained, steamed for half an hour at 15 psig and cooled to room temperature. They were later flaked in a heavy duty roller flaker (Kamas) adjusted to 3 mm clearance and dried to 11-12 per cent moisture. In case of sorghum, the steamed grain was dried in the shade for about one hour to condition it for flaking. The husk in the paddy was separated by aspiration.

Toasting: Samples of grains (5 Kg.) were loaded into an electrically heated rotating mechanical roaster, temperature was raised to 100°C, and maintained for 10 min and then cooled. Brown rice instead of paddy was used in this study.

Puffing: Samples of grains (1 Kg.) at their natural moisture content of 11-12 per cent were mixed with 2 kg of sand and heated to 260-280°C in a hand roaster (*Bhatti*) till the grains were just puffed. This took about 15-30 sec; the puffed grains were immediately removed from the pan and sieved off from the sand. In maize and wheat, puffing was very small and roasting was given for 60 and 40 sec respectively as further roasting caused browning without puffing.

Malting: The grains were soaked in cold water for 16 hr with two or three changes of soak water. After draining off the water the grains were spread on wet cloth and germinated for 24-30 hr keeping the grains moist (ragi and bajra for 24 hr). The germinated grains were dried with hot air at 60°C and gently toasted to a temperature of 80°C to develop the malt flavour[8].

All the processed grains including unheated control samples were ground in a plate grinder to pass through 44BS mesh sieve. In the case of paddy, the brown rice was used for grinding.

Determination of slurry viscosity: Twenty per cent slurry of the flour was prepared in cold water and viscosity measured using a Brookfield viscometer (model RV) at 100 r.p.m. using spindles appropriate to different viscosity ranges. For measuring hot paste viscosities, a 10 per cent slurry was raised to boiling with continuous stirring, boiled for 5 min, cooled to room temperature and then viscosity was determined as before. Twenty per cent slurry was too thick and hence 10 per cent slurry concentration was used for hot paste viscosity determination.

Results and Discussion

Data on the cold slurry and hot paste viscosities of the control and processed cereal flours are presented in Fig. 1 and 2 respectively. It will be seen from Fig. 1 that cold slurry viscosities of heat processed materials are far higher than those of the untreated control. The extent of increase in cold slurry viscosity appears to be related to the extent of heat damage or heat gelatinization undergone by the starch in the various materials. Generally, puffing which is achieved at very high temperature in sand medium produced maximum viscosity change. In maize, wheat and Bengal gram, however puffing was relatively small and the viscosity changes were not as marked as in other grains.

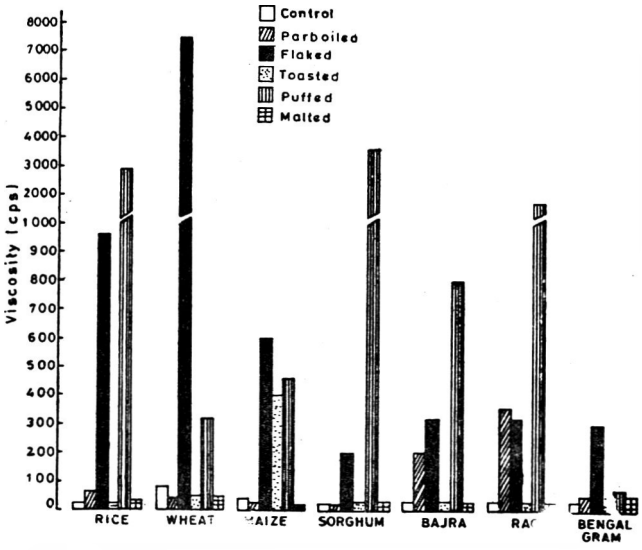


Fig. 1. Cold slurry viscosity of processed cereal flours.

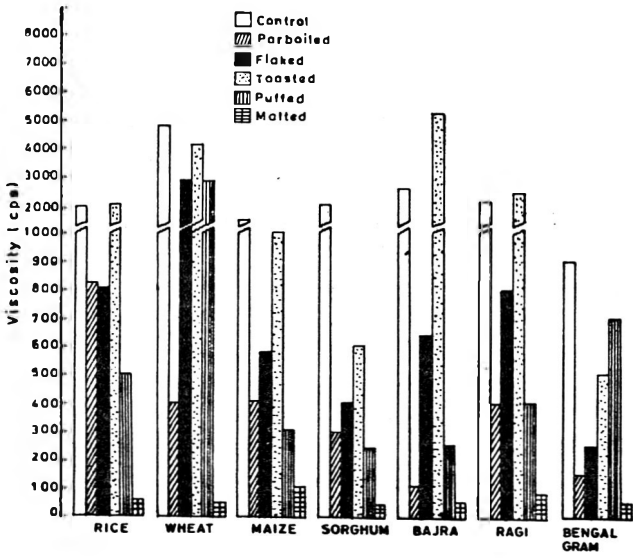


Fig. 2. Hot paste viscosity of processed cereal flours.

Flaking which involves steaming of grains followed by thinning between heavy flaking rollers also produced considerable viscosity change of the starch in all grains. Maximum change was found in wheat followed by rice, and maize. Changes in paste viscosities brought about by dry toasting as also parboiling were low as compared with the puffing or flaking treatments. Changes in Bengal gram (pulse) were comparatively less than that of the cereal grains. Effect of malting on the cold slurry viscosities of the slurries was very minor.

In contrast to the above, the effects of processing on the hot paste viscosity were maximum in malting as can be seen from Fig. 2. The elaboration of amylases during malting is responsible for the considerable fall in viscosity as compared with the control unmodified samples which had the highest hot paste viscosity in almost all cases. The variously heat modified grains exhibited lower hot paste viscosities as compared with the control untreated samples. The more severe the heat treatment, the lower was the hot paste viscosity as can be seen in rice, maize, sorghum and ragi which underwent good puffing, but exhibited low hot paste viscosities. Flaking also brought about a fall in viscosity as compared with the control. Dry toasting at 100°C had a very low effect in reducing hot paste viscosity as compared with the control and as compared with other heat treatment processes. In the case of bajra, toasting actually increased the hot paste viscosity. Parboiling reduced the viscosity to a small extent in all cases[9-14].

As the heat treatment given to all the grains was the same and may not be optimal or most appropriate to each particular grain, the extent of reduction in paste viscosity brought out by the heat treatments is not the same for all the grains. The results show that where reduced slurry viscosity is desired, as for instance, in the production of weaning foods with high caloric density, malting is the most appropriate method for reducing hot paste viscosity. Puffing and flaking are also suitable in this respect. Appropriate combination of puffed and or flaked materials with a little ot the malted product can also be expected to give a nutritious and acceptable product with low viscosity. Where a high hot paste viscosity is desired as a thickner for Indian soups (*Rasam* or *Sambar*), unheated cereal flours are suitable. If a high cold paste viscosity is required as in *Idli* or *Dosa*, batters with preheated cereal flours would be preferable.

References

1. Anker, C. A. and Geddes, W. F., Gelatinization studies upon wheat and ether starches with the Amylograph. *Cereal. Chem.*, 1944, **21**, 335.

2. Sanstedt, R. M. and Abbot, R. C., A comparison of methods for studying the course of starch gelatinization. *Cereal. Sci. Today*, 1964, **9**, 13.
3. Priestly, R. J., *Effects of Heating on food Stuffs*. Applied Science Publishers Ltd., London, 1979.
4. Ingleton, J. F., Starch and its use in sugar confectionery manufacture. *Confec. Prod.*, 1970, **36**, 631.
5. Wurtzbing, O. B. and Szymanski, C. D., Modified starches for the food industry. *J. Agric. Fd Chem.*, 1970, **18**, 997.
6. Radley, J. A., *Industrial uses of starch and its derivatives*, Applied Science Publishers Ltd., London, 1976.
7. Malleshi, N. G. and Desikachar, H. S. R., Formulation of a weaning food with low hot paste viscosity based on ragi (*Eleusine coracana*) and green gram (*Phaseolus radiatus*). *J. Fd Sci. Technol.*, 1979, **16**, 149.
8. Brandtzeag, B., Malleshi, N. G., Svanberg, U., Desikachar, H. S. R. and Mellander, O., Dietary bulk as a limiting factor for nutrient intake with special reference to the feeding of preschool children. Studies on malted flours from ragi, sorghum and green gram. *J. Trop. Pediat.* 1981, **27**, 184.
9. Priestly, R. J., Studies on parboiled rice part 2. Quantitative study of the effects of steaming on various properties of parboiled rice. *Fd Chem.*, 1976, **1**, 139.
10. Ferrel, R. E. and Pence, J. W., Use of amylograph to determine the extent of cooking in steamed rice. *Cereal Chem.*, 1964, **41**, 1.
11. Raghavendra Rao S. N., and Juliano, B. O., Effect of parboiling on some physico-chemical properties of rice. *J. Agric. Fd Chem.*, 1970, **18**, 289.
12. Arai, K., Raghavendra Rao, S. N. and Desikachar, H. S. R. Studies on the effect of parboiling on Japonica and Indian rice. *Jap. J. Trop. Agric.*, 1975, **19**, 71.
13. Ali, S. Z. and Bhattacharya, K. R., comparative properties of beaten rice and parboiled rice. *Lebensm-wiss. Technol.*, 1976, **9**, 11.
14. Ali, S. Z. and Bhattachrya, K. R. Pasting behaviour of parboiled rice. *J. Texture Studies*, 1980, **11**, 239.

Studies on Bebontot—A Traditional Balinese Pork Product

M. B. ARIHANTANA* AND K. A. BUCKLE
School of Food Technology, The University of New South Wales, Kensington, NSW 2033, Australia

Manuscript received 14 *July* 1982

The effects of pre-steaming of raw pork, the use of potassium sorbate to raw pork or to the plam sheath wrapping, and over wrappimg in polyethylene on the physical, chemical and organoleptic properties of bebontot, a traditional Balinese preserved pork product, were examined. The spices used did not act as preservatives, but increased the microbial load and also imparted desirable organoleptic properties. The addition of 0.1% potassium sorbate to raw pork, or pre-spraying the outer layer of the palm sheath wrapping with 0.3% potassium sorbate alone were not effective against subsequent mould growth during storage at 30°C. Bebontot with an initial water activity (a_w) of less than 0.77, both wrapped in polyethylene film or left unwrapped, did not develop oxidative rancidity after 3 week's storage. A storage life of 3 weeks at 30°C was obtained by a combination of the addition of 0.1% potassium sorbate to raw pork, pre-spraying the outer layer of the palm sheath with 0.3% potassium sorbate and wrapping the product in polyethylene. Organoleptic evaluation indicated no significant difference in taste between pre-steamed and uncooked bebontot before storage.

Bebontot is a traditional intermediate moisture pork product prepared in Bali, Indonesia by villagers for religious ceremonies and festivals. It is made from a mixture of lean and fat pork chopped into 1.5-2 cm cubes and mixed with fresh spices including turmeric, greater galangal (laos), ginger, garlic, chillies, pepper and salt. The mixture is wrapped in dried palm sheaths and dried in the sun for 4 to 5 days. The bebontot may be prepared from beef, but pork is more commonly used and is preferred. Bebontot spoils readily within a few days when stored at tropical temperatures, and for this reason it is usually prepared fresh. Any method aimed to extend the shelf life of bebontot should be simple, cheap and applicable at the village level. The aim of this investigation was to examine simple methods of extending the shelf life of bebontot by inhibiting spoilage by moulds and oxidative deterioration, and its acceptable organoleptic properties.

Materials and Methods

Materials: Lean and fat pork, salt, and spices fresh ginger, garlic, black pepper and long red chillies

* *Present address:* Department of Food Science and Technology, Udayana University, Denpasar, Bali, Indonesia.

were purchased from the local market. Fresh spices like greater galangal, turmeric and aromatic ginger were obtained from Bali, Indonesia, as were dried palm sheaths (0.5-1 mm thickness) normally used for bebontot production. Low density polyethylene sheeting (0.03 mm thickness) was obtained from Cello pak pty Ltd, Brookvale, NSW. Microbiological media was from Oxoid Pty Ltd, Carlton, NSW, all salts and chemicals were analytical reagent grade and water was glass distilled.

Bebontot preparation: Lean pork (150 g) and pork fat (50 g) were chopped into 1.5-2 cm cubes and mixed thoroughly with 14 g ground mixed spices containing (% w/w of the final product) laos (*Alpina galangal*), 1.6; salt, 1.5; turmeric, 1.2; red chillies, 1.2; garlic, 1.0; fresh ginger, 0.7; and aromatic ginger, 0.6. The mixture was placed onto a dried palm sheath (20×25 cm) and dehydrated for 6 hr at 35°C in a cross draugt cabinet dehydrator. The product during dehydration was hand turned every hour, then wrapped in a palm sheath which was tied at both ends with plastic string, and returned to the dehydrator until the desired moisture content was achieved or the product appeared acceptable in terms of consistency and texture (sample A).

Treatments applied to raw materials and bebontot: In addition to the above standard bebontot (sample A), the following samples were also prepared: lean and fat pork steamed for 30 min at 100°C, then processed as before (sample B), same as sample B except that the a_w was adjusted to about 0.77 by drying the bebontot in the dehydrator at 35°C; (sample C), potassium sorbate powder (0.1 per cent w/w) was thoroughly mixed with the raw pork, fat and spices and processed as before; (sample D) the outer layer of palm sheath was sprayed with 0.3 per cent potassium sorbate solution before being used to wrap standard bebontot samples (sample E). Some samples were over wrapped with polythene sheeting, and both wrapped and unwrapped bebontot were placed in desiccators over saturated potassium nitrate solution (relative humidity 93 per cent) and stored at 30°C for 3 weeks.

Analyses: Moisture content of raw pork, fresh bebontot and stored samples was determined by the air oven method[1] for 16-18 hr at 100-102°C. Equilibrium relative humidity (ERH) and thus a_w was determined under static air conditions in 120 ml glass jars fitted with rubber stoppers using a Vaisala Humicap HM II RH probe and meter calibrated with the following saturated salt solutions to give the a_w at 20°C as given in parentheses: LiCl (0.12), $MgCl_2$ (0.33), $Mg(NO_3)_2.6H_2O$ (0.52), $NaNO_2$ (0.66), NaCl (0.75), $(NH_4)_2SO_4$ (0.79), $BaCl_2$ (0.91) and K_2SO_4 (0.97)[2]. Samples were equilibrated over saturated salt solutions for 24 hr before readings were taken. Microbiological quality was assessed by determining the total aerobic plate count on serial dilutions of samples prepared according to Australian standard methods[3]. Oxidative rancidity of bebontot samples was assessed by measuring peroxide values[4] on fat extracted from ground samples with petroleum ether (b.p. 40-60°C). The extracts were filtered through Whatman No. 541 filter paper, then passed through a column of Brockman activity grade 1 aluminium oxide to separate the yellow colour of the turmeric[5]. The colourless solution was evaporated on a Buchi Rotavapor at a bath temperature of 45°C. Peroxide values were determined in duplicate on 5 g aliquots.

TABLE 1. ANALYSES OF RAW PORK, SPICES AND BEBONTOT BEFORE STORAGE[a]

Sample	Moisture content (% wet wt. basis)	Water activity (a_w)	Total microbial count (colonies/g)	Drying time (hr)	
				Before wrapping in palm sheath	After wrapping in palm sheath
Raw pork	74.1	1.0[b]	5.5×10^5	—	—
Raw bebontot	—	0.94	1.1×10^7	—	—
Steamed pork[c]	56.9	0.93	0	—	—
Ground spices	—	—	7.5×10^5	—	—
Bebontot A*	39.4	0.81	6.4×10^8	3	21
Bebontot B*	39.0	0.85	2.9×10^8	2	19
Bebontot C*	33.9	0.77	1.7×10^8	1.5	32
Bebontot D*	44.1	0.86	2.9×10^8	4	28
Bebontot E*	22.7	0.74	8.1×10^8	6	41

a Means of triplicate determinations on two replications
b The raw pork was spoiled after 24 hr equilibration
c Steamed for 30 min at 100°C.
* See text for sample details.

Organoleptic evaluation: Organoleptic assessments were carried out on raw bebontot, and stored bebontot samples fried for 2 min in a polyunsaturated vegetable oil at 150°C. Student panelists from Asia and Australia and staff members assessed the products for aroma, colour, texture and overall acceptability using a scoring difference test[b] in which samples were given numerical values ranging from like extremely (8) to dislike extremely (1).

Results and Discussion

Table 1 gives results of analyses on raw pork, spices and bebontot samples before storage. Raw pork was quite heavily contaminated, but the total viable count

TABLE 2. PHYSICAL, CHEMICAL AND MICROBIOLOGICAL QUALITY OF BEBONTOT AFTER STORAGE AT 30°C AND RH>90%

Sample[a]	Storage time (weeks)	Moisture content (% wet wt. basis)	Water activity a_w	Total viable count (colonies/g)	Peroxide value (meq/kg fat)	Observations
A-wrapped[b]	1	33.6	0.80	2.6×10^8	2	Spicy odour; lean hard to firm, brown; fat firm, yellow
	2	34.7	0.81	2.0×10^8	4	As above
	3	30.9	0.83	2.1×10^{8c}	9	As above
A-unwrapped	1	31.9	0.81	2.6×10^{8c}	4	Spicy, slightly stale odour; lean and fat as above
	2	35.1	0.85	3.0×10^{8d}	14	Unpleasant odour; fat yellowish white
	3	35.0	0.88	2.7×10^{8e}	22	Unpleasant, rancid odour; lean brown to greyish-white
B-wrapped	1	36.8	0.88	2.4×10^8	2	Spicy odour; lean hard, brown; fat firm to soft, yellow
	2	35.3	0.86	1.7×10^8	6	As above
	3	25.3	0.85	1.4×10^{8c}	10	As above
B-unwrapped	1	34.5	0.79	3.5×10^{8c}	9	As above
	2	36.6	0.86	2.9×10^{8c}	18	As above
	3	31.6	0.88	2.4×10^{8d}	24	Unpleasant, rancid odour; lean hard dark brownish-white; fat firm to soft, yellowish-white
C-wrapped	1	27.4	0.85	3.6×10^8	2	As for B-wrapped
	2	22.2	0.80	1.9×10^8	7	As above
	3	28.1	0.84	1.2×10^8	10	As above
C-unwrapped	1	29.0	0.86	2.2×10^{8c}	8	As above
	2	28.9	0.86	3.1×10^{8d}	15	Spicy, slightly stale odour
	3	32.8	0.89	3.5×10^{8e}	17	Unpleasant odour; lean hard, brown to grey; fat firm to soft; yellowish-white
D-wrapped	1	40.8	0.93	1.7×10^8	2	As for B-unwrapped
	2	43.6	0.93	8×10^8	8	Slightly stale odour
	3	39.8	0.93	8.5×10^{8d}	18	Stale, unpleasnat odour
D-unwrapped	1	47.1	0.94	4.3×10^8	9	As for D-wrapped after storage for 1 week
	2	43.8	0.93	1.2×10^{9c}	15	Stale odour
	3	31.8	0.93	1.7×10^{9d}	23	Unpleasant, rancid odour; lean hard to firm, brownish-white; fat firm to soft; yellowish-white
E-wrapped	1	26.8	0.87	8.9×10^8	0	Spicy odour; lean hard to firm, brown; fat firm to soft, yellow
	2	33.2	0.87	8.0×10^8	2	As above
	3	27.2	0.89	3.5×10^8	2	As above
E-unwrapped	1	24.6	0.82	1.3×10^9	2	As above
	2	33.5	0.88	1.0×10^{9c}	4	As above
	3	32.7	0.91	1.3×10^{9d}	8	Slightly stale odour; lean hard to firm, brownish-white; fat firm to soft, yellowish-white

a See text for sample descriptions
b Wrapped in polyethylene film
c Mould growth on outer layer of palm sheath wrapper
d Mould growth on palm sheath and on bebontot
e Completely mouldy

increased significantly during the production of bebontot as a result of hand mixing and the incorporation of spices. Steaming the pork for 30 min destroyed all viable vegetative organisms and also reduced the moisture content considerably. The total drying time, i.e. sum of dehydration times of bebontot before and after wrapping in the palm sheath, was not directly related to the moisture content or a_w.

Sample B, in which the pork was pre-steamed, showed an a_w almost the same and a moisture content lower than sample D, yet it was dried for a total of 21 hr compared to 32 hr for sample D, the difference being due to the loss of moisture (ca. 17 per cent) which occurred during steaming. Steaming reduced the drying time of bebontot and marginally reduced the microbial load. The increase in microbial load of bebontot during drying is inevitable at the drying temperature used (35°C), which is typical of the conditions used in Bali for sun-drying this product.

Results of analyses on bebontot stored for 3 weeks at 30°C are shown in Table 2. The microbial counts of bebontot samples wrapped in polyethylene tended to decrease during 3 week's storage after an initial increase during the first week of storage, yet the microbial load of unwrapped bebontot D increased during the storage period to 1.7×10^9 cells/g. Bebontot was free of visible mould growth during 1 week storage, although mould was seen on the outside of the palm sheath wrapping. After 2 week's storage, moulds did not grow on bebontot samples wrapped in polyethylene. After 3 week's storage, all samples were either completely mouldy or showing mould growth on the surface of the pork pieces inside the palm sheath wrapper. Steaming of pork prior to bebontot production had little effect on subsequent bacterial growth, as did addition of potassium sorbate to bebontot or spraying the palm sheath with sorbate. The greatest influence on microbial growth was overwrapping the samples with polyethyelne film. The use of clean spices or storage at lower temperatures would considerably increase the storage life, but are unlikely to be practical solutions to villagers in places like Bali.

Oxidative rancidity increased with storage time and was considerably higher in samples not wrapped in polyethylene. It is obvious that polyethylene film, although not a film of low oxygen permeability, reduces oxygen access sufficiently to retard oxidative deterioration. Unpleasant odours were apparent at peroxide values of 10-15 meq/kg fat.

Organoleptic evaluation of uncooked normal (A) and pre-steamed (B) bebontot (Table 3) showed no significant difference in aroma and texture, but the colour of the two samples differed significantly. There was a significant difference in aroma and colour of fried, uncooked bebontot and fried, pre-steamed bebontot (Table 3), but the texture, flavour and overall acceptability of the two products was not significantly different. These results are not unexpected as the colour of uncooked bebontot was found by most panelists to be brighter than that of pre-steamed bebontot in which the darker colour, caused by protein denaturation, was retained after frying. During pre-steaming of the pork, fat melted and covered up some of the lean meat, and when mixed with ground spices, the bebontot was covered by fat and spices. When fried, the fat melted and spices were not retained, explaining the lack of aroma in the pre-steamed samples.

TABLE 3. T-TEST VALUES* OF ORGANOLEPTIC EVALUATION OF RAW AND FRIED UNCOOKED VS. PRE-STEAMED BEBONTOT SAMPLES

Parameter	Raw	Fried
Aroma	1.03	2.22**
Colour	2.76**	2.89**
Texture	1.02	0.47
Flavour	—	1.20
Overall acceptability	—	1.00

**Significantly different at 5% level

Although the present study was limited in scope, it showed that the simple process of overwrapping traditional bebontot with polyethylene film could provide a storage life of at least two weeks before rancid odours and mould growth rendered the product unacceptable. Other simple shelf-life extension treatments are currently being examined to improve further the storage life of this traditional Balinese food.

Acknowledgement

M. B. Arihantana thanks the Australian Government for the award of an Australian-Asian Universities' Cooperation Scheme Fellowship.

References

1. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, D. C., 12th Edn., Method 24.003, 1975, 417.
2. Rockland, L. B., Saturated salt solutions for static control of relative humidity between 5 and 40°C. *Anal. Chem.*, 1960, **32**, 1375.
3. *Methods for the Microbiological Examination of Food*,, Standards Association of Austrialia, North Sydney, N.S.W., Australian Standard 1766, Part 1, Section 2.2, 1975, 1.
4. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, D. C., 12th Edn, Methods 28.022, 28.023, 1975, 489.
5. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, D. C., 12th Edn., Methods 34.010, 34.011, 1975, 630.
6. Larmond, E., *Methods for Sensory Evaluation of Food*, Rev. Edn., Publication 1284, Canada Department of Agriculture, Ottawa, 1970.

Studies on the Processing of Culled Apples

GHULAM HASSAN SHAH AND B. S. BHATIA
Department of Food Science and Technology, Punjab Agricultural University, Ludhiana, India

Manuscript received 25 *August* 1982; *revised* 7 *June* 1983

Two mid-season ('Kesri' and 'Red Delicious') and two late maturing ('American' and 'Maharaji') varieties of apples were selected for preparing acceptable juice, jam and jelly from cull fruits. Products stored at ambient temperature and at 37°C were acceptable even after a storage period of 8 months. Juice from under-ripe 'Red Delicious' after adjusting sugar/acid ratio had maximum consumer's acceptance. Blending of 'Maharaji' and American' for juice making in the ratio of 1:1 was rated superior to 'Maharaji' and 'Red Delicious' blend near the stage of maturity. Jelly failed to set without addition of pectin. 'Maharaji' and 'American' blend in the ratio of 1:1 resulted in superior quality apple jelly after adding 0.7 per cent pectin. Reducing sugars increased and pectin content decreased during storage.

Apple is grown in India in Jammu and Kashmir and Himachal Pradesh. With an increase in acreage, the percentage of cull apples is increasing. In some varieties like 'Maharaji' and 'Ambri' the wastage due to preharvest drop alone is more than 18 per cent[1].

Among the various apple products apple juice, jam and jelly have an increasing demand in the market. The present investigations were conducted to standardize the techniques for processing of culled apples into acceptable juice, jam and jelly.

Materials and Methods

Two mid season '(Kesri and 'Red Delicious') and two late maturing ('Maharaji' and 'American') varieties were selected for the present studies. The preharvest drop and the other culled fruits of these varieties were collected in two lots from Kashmir valley at the end of August 1980 (mid season crop) and in the start of October 1980 (late season crop.) Mid season crop comprised of 'Maharaji, 'American', 'Red Delicious' and 'Kesri' varieties, whereas the late season crop consisted of 'Maharaji, American' and 'Red Delicious' varieties. Fruit was analysed for total soluble solids (TSS), pH, acidity, reducing and total sugars, tannins, and pectin besides its evaluation as table fruit by Hedonic Scaling[2]. Mid season crop was processed into juice alone, whereas the late season crop was for juice, jam and jelly.

Experimental preparation of juice: Fruits were crushed, washed, cored, trimmed and cut into pieces. These were dipped in water containing 100 p.p.m. of sulphur dioxide until crushed in apple grater. Sulphur dioxide at the rate of 100 p.p.m. was added to the fruit while crushing. The pulp was mixed with 0.5 per cent (w/v) pectolytic enzyme ("Tritone" enzyme obtained from CFTRI, Mysore) and left overnight. Juice was extracted from enzyme treated pulp in a hydraulic press using a pressure of 80-90 kg/sq. cm and filtered using filter paper pulp as filter aid. The acceptance of the juice was improved either by adjusting sugar/acid ratio alone or in combination with blending. Juice was heated to 70°C, filled hot into bottles of 200 ml capacity, sealed, processed for 20 min. at 80°C, cooled and stored at room temperature and at 37°C.

Experimental preparation of jam and jelly: After removing the injured portion and core, the fruits were cut into pieces and crushed in apple grater.

For the preparation of jam, water and sugar were added to the pulp in the ratio of 1:3, heated in a stainless steel kettle and citric acid was added at the rate of 1.75–2.00 g/kg of pulp when it was in the temperature range of 75-85°C. Heating was continued till the end point was reached which was observed at 103°C. The jam was cooled to 85°C and filled into wide mouthed sterilized glass jars of 400 g capacity. Aluminium lids (without rubber lining) were used for closing the jars.

To extract pectin for preparing jelly, water and pulp in the ratio of 1:2 were boiled for about 20 min and filtered through muslin cloth. A second extract was made similarly using water and pulp in the ratio of 1:4. Pectin extracts of each of 'Maharaji' and 'American' and 'Maharaji' and 'Red Delicious' were blended in the ratio of 1:1. and sugar was added at the rate of three fourth of extract volume (v/w). Pectin (medium set citrus pectin of 150 grade) at the rate of 0.70 per cent on the basis of extract was mixed with six times its weight of dry sugar and a paste was made with pectin extract having a temperature of 70°C. The paste was

TABLE 1. COMPOSITION OF DIFFERENT VARIETIES OF APPLES (MID SEASON AND LATE SEASON CROP)

Variety	TSS (%)		Acidity (% malic acid)		pH		Tannin (%)		Pectin (as cal. pectate %)		Ascorbic acid (mg%)	Sugar	
												Total (%)	Reducing (%)
	Mid	Late	Mid	Late	Mid	Late	Mid	Mid	Mid	Late	Late	Late	Late
American	6.0	13.5	0.10	0.19	3.85	4.20	0.08	0.07	0.36	1.23	3.75	11.34	8.68
Maharaji	6.5	13.0	0.40	0.56	3.25	3.35	0.08	0.15	0.42	0.80	4.44	8.68	8.27
Red Delicious	8.0	18.0	0.23	0.21	4.20	3.95	0.08	0.18	0.36	0.79	5.04	12.16	10.25
Kesri	10.0	—	0.43	—	3.67	—	0.11	—	0.68	—	—	—	—

added to the pectin extract, heated and filtered. Heating was again continued and to obtain proper pH for good jelly set, citric acid at the rate of 2g/litre of extract was added at a temperature of 103-104°C. End point was noted by sheet test and confirmed by clot formation of jelly in cold water. Jelly was cooled to 90°C and filled into wide mouthed glass jars of 400 g capacity.

Products were stored at ambient temperature and at 37°C after sealing and labelling. They were analysed for TSS, pH, acidity, ascorbic acid, reducing and total sugars by A.O.A.C. methods[3]. Pectin was estimated by Carre and Haynes method.[4] Organoleptic evaluation of the product was done by a panel of judges by Hedonic Scaling[2]. Data were analysed statistically using F-test[5].

Results and Discussions

Fruit used in the present stuides was declared unfit for fresh market by the judges mostly due to falling injury, underripeness, attack of pests/disease, etc. The chemical composition of the fruit is given in Table 1.

Juice: The juice recovery (unclarified) from the enzyme treated pulp is given in Table 2. Low juice yield in the mid-season crop may be due to the underripe fruit being used. The increased yield observed in the late season crop of all the varieties was clearly due to advanced stage of maturity.

TABLE 2. JUICE YIELD FROM DIFFERENT VARIETIES OF APPLES

Variety	% Juice yield in mid season crop		%Juice yield in late season crop	
	Fruit basis	Pulp basis	Fruit basis	Pulp basis
American	55.6	64.1	60.0	83.8
Maharaji	35.8	74.9	70.0	87.5
Red Delicious	57.0	79.3	71.4	91.5
Kesri	59.5	71.6	—	—

Straight juice was not preferred by the consumers because of unbalanced sugar/acid ratio. Blending and/or adjusting sugar/acid ratio resulted in superior fruit beverages which were ranked equal to or superior than two commercial samples, as shown in Table 3. Juices from preharvest drop of 'American' and 'Maharaji' at very early stages when the fruit was very much underripe is not acceptable unless it is blended and/or sugar/acid ratio adjusted. Blending of juices from 'Red Delicious' with 'Maharaji' and 'American' with 'Kesri' in the ratio of 1:1 for these very early stage fruits and adjusting the sugar/acid ratio is suitable for utilizing the fruit and preparing an acceptable product. However, juices from 'Red Delicious' and 'Kesri' obtained from fruits at such stage can also be converted to single variety acceptable juices by adjusting sugar/acid ratio, as observed in the present studies. By adopting these blending ratios on a commercial scale the prehervest

TABLE 3. COMPOSITION OF APPLE JUICE PROCESSED FROM MID-SEASON CROP

Variety/Blend	TSS (%)	pH	Acidity (as% malic acid)	Tannins (%)	Score out of 100
Modified sugar/acid ratio					
Red Delicious + Maharaji	15.75	3.32	0.60	0.08	71.66
American + Kesri	16.50	3.19	0.64	0.10	73.30
Red Delicious	16.00	3.31	0.56	0.08	81.60
Kesri	16.75	3.25	0.81	0.11	66.60
Sugar/acid ratio as such					
American	5.50	5.89	0.09	0.08	53.33
Kesri	10.00	3.67	0.37	0.11	66.60
Red Delicious	10.00	4.22	0.15	0.08	56.60

Score for commercial samples 1 and 2 are 70.0 and 63.33 respectively.

TABLE 4. COMPOSITION OF APPLE JUICE PROCESSED FROM LATE SEASON CROP

Variety/Blend	TSS (%)	pH	Acidity (% malic acid)	Tannins (%)	Score out of 100
Modified sugar/acid ratio					
Maharaji + American	12.25	3.60	0.58	0.08	77.00
Maharaji + Red Delicious	13.00	3.60	0.39	0.11	61.00
Sugar/acid ratio as such					
American	11.00	4.20	0.18	0.07	58.30
Maharaji	10.50	3.60	0.51	0.09	52.70
Red Delicious	16.00	4.20	0.21	0.09	62.80
Commercial sample	—	—	—	—	63.33

TABLE 5. COMPOSITION OF EXTRACTS OF CULLED APPLES USED FOR JELLY

Variety	TSS (%)	Pectin as Ca pectate (%)	pH	Acidity as malic acid (%)
American	8.00	0.39	4.40	0.14
Maharaji	7.00	0.37	3.50	0.48
Red Delicious	10.00	0.33	4.30	0.18

TABLE 6. YIELD OF JAM AND JELLY FROM DIFFERENT VARIETIES OF CULLED APPLES

Variety/Blend	Yield (%)
Jam	
American	84.2
Red Delicious	80.0
Maharaji	90.0
Jelly	
Maharaji + Red Delicious	54.3
Maharaji + American	72.8

drop of late maturing varieties like 'Maharaji' and 'American' can be utilized besides utilizing the culled ripe fruit of mid-season varieties like 'Red Delicious' and 'Kesri'. Juice from 'Maharaji' and 'American' varieties of fruits even 25-40 days prior to normal harvest is not very much acceptable unless blended suitably. Blending 'Maharaji' with 'Red Delicious' or 'American' in the ratio of 1:1 and adjusting their sugar/acid ratio resulted in juice of superior quality (Table 4). Dang *et al*[6]. also reported an increase in the acceptance of apple juice by blending different varieties.

pH decreased during storage of juice which may be due to change in acidity. Reducing sugars increased due to inversion of non-reducing to reducing sugars by hydrolysis during storage. The increase was more at 37°C than at ambient temperature. Change in organoleptic scores, during storage were statistically non-significant in all the cases except juice from mid-season crop stored at 37°C where it was highly significant. The product was rated almost equivalent to or better than two commercial samples even after 8 months storage.

Jam and Jelly: Good jelly set was obtained by incorporating 0.7 per cent pectin in the extract. Without addition of pectin, jelly failed to set. This was due to inadequacy of pectin in the extracts, which is evident from Table 5. By making a comparison of the pectin content in the fruit used (Table 1) and the extract obtained (Table 5), it is clear that all the pectin does not come out in the extract, but an appreciable percentage is left in the pomace, thus making the jelly set difficult without addition of pectin. Jelly failed to set at different levels of sugar, pH and calcium chloride without addition of pectin. Lal *et al.*[7] suggested a pectin content of 0.5 1.0 per cent in the extract for getting a good jelly set, which is in conformity to the present findings.

The end point in jam and jelly was recorded at a temperature of 102-103°C and 106-107°C respectively. Table 6 shows the yield of jam and jelly in the present investigation. The low yield of jelly in 'Maharaji' and 'Red Delicious' blend is probably due to low yield of pectin extract from 'Red Delicious' variety or it may be due to low percentage of pectin present in the original extract used.

TSS in jam decreased during storage, but there was no significant change in TSS of jelly. No significant change in pH and total sugars was recorded in both the products. Jelly stored at ambient temperature and jam stored at ambient and at 37°C showed an increase in acidity. Inversion of non-reducing to reducing sugars resulted in an increase of reducing sugars. Decrease in pectin content was recorded in jam at both the storage temperatures and at 37°C storage in jelly. Improvement in the texture of jam during storage was observed which may be due to change in pectin content. There was no significant change in flavour and appearance of the products during storage and they were highly acceptable even after 8 months storage at ambient temperature and at 37°C.

From the present investigation, it is concluded that culled apples can be utilized successfully for preparation of commercial products like juice, jam and jelly, by blending suitably.

References

1. Bhat, J. N., Singh, J. and Rashid, A., Control of preharvest drop in *Ambri* and *Maharaji* varieties of apples. *Hort. Res. Rep.*, 1978, **1**, 16.
2. Amerine, M. A., Rangborn, R. M. and Roessler, E. B., *Laboratory studies-types and Tests, Principles of Sensory Evaluation of Foods*, Academic Press, New York, 1965, 275-314.
3. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, D. C., 10th Ed., 1970.
4. Carre, M. H. and Hayness, D., The estimation of pectin as calcium pectate and the application of this method to the determination of soluble pectin in apples. *Biochem., J.*, 1922, **76**, 60.
5. Saxena, H. C., *Analysis of variance-Examples in Sytatistics*, Atma Ram and Sons, New Delhi, 2nd Ed. 1965.
6. Dang, R. L., Verma, S. K., Gaur, G. S. and Singh R. P. Studies on Kashmir apples. III. Varietal blends for the manufacture of apple juice. *Indian Fd Pckr*, 1979, **33**, 3.
7. Lal, G. Siddappa, G. S. and Tandon, C. L., *Preservation of Fruits and Vegetables*, Indian Council of Agric. Res. New Delhi, 1967.

Insecticidal Potential of Indigenous Plants: Comparative Efficacy of Some Indigenous Plant Products Against *Musca domestica* L.

S. M. Ahmed and Harish Chander

Discipline of Infestation Control and Pesticides Research, Central Food Technological Research Institute, Mysore-570 013, India

Manuscript received 25 *March* 1982; *revised* 23 *November* 1982

Of the seventeen plant materials tested against *Musca domestica* L., a few showed 50 to 100 per cent control of the fly population at both 30 and 15 per cent concentration levels, when eggs were seeded into the treated medium. When tested against third instar larvae, the powders of *Bougainvillea* sp., *Bassia longifolia*, *Fumaria indica*, *Caesalpinia bonduc* and *Embelia ribes* showed higher toxicity to larvae. Though powders of *Helleborus niger*, *Swertia chirata* and *Azadirachta indica* were effective even at lower concentrations against eggs and early instars, however, their effectiveness against well fed third instar larvae was very low. With regard to pupal mortality, *Carum roxburghianum*, *Embelia ribes*, *Saussurea lappa* and *Azadirachta indica* showed some promise. A few treatments also exhibited mild hormonal activity by prolonging the larval period.

The growing concern about protecting the environment, recognising the importance of ecological balance and evidences of changes in the surroundings by extensive and indiscriminate use of pesticides with persistant residues has emphasized the need to review our existing strategies for insect pest control. Among the several avenues explored for integrated insect pest control programmes, the use of plant insecticides being safe, easily biodegradable and practically innocuous to non-target species, has drwan attention all over the world. Apart from the known plant insecticides such as pyrethrins, rotenone, nicotine, etc., researchers have been exploring the possibility of using various other plant products to combat insect pests[1-3]. In the present investigation, seventeen indigenous plant products were assayed for their efficacy against the developing stages of *Musca domestica* L.

Materials and Methods

The plant materials (Table 1) were purchased or collected locally, dried at 40°C in a hot air drier and ground to 60 mesh in Raymond's hammer mill.

Housefly larvae were reared on a diet comprising of filter paper, corn starch, milk powder and yeast. For constant supply of eggs, the adult houseflies were fed on skimmed milk powder, sugar and yeast.

In the preliminary screening of the plant materials, the dried powders were incorporated at the rate of 30 and 15 per cent (w/w) into the culture medium described by Ahmed *et al.*[4] The treated medium, (10 g) was placed in glass jars (150×50 mm) and seeded with 100 eggs thoroughly washed with distilled water.

The promising plant materials from the preliminary screening were tested for their toxicity to well fed third instar larvae by mixing the powders at 40, 30, 2

TABLE 1. PARTICULARS OF PLANT MATERIAL UTILIZED IN THE STUDIES

Botanical name	Common name	Family	Part used
Curcuma amada Roxb.	Mango-ginger	Zingiberaceae	Rhizome
Artemisia absinthium Linn.	Worm wood	Compositae	Flower head
Butea frondosa Koen. ex Roxb.	Flame of the Forest	Papillionatae	Flower
Adhatoda vasika Nees.	Malabar nut	Acanthaceae	Leaf
Lantana camara Linn.	Wild sage	Verbenaceae	Leaf
Cleome viscosa Linn.	Dog mustard	Capparidaceae	Seed
Carum roxburghianum Benth & Hook.	Bishops' weed	Umbelliferae	Seed
Curcuma zedoaria Rose	Zedoary	Zingiberaceae	Rhizome
Caesalpinia bonduc Roxb.	Molluck Bean	Caesalpiniaceae	Fruit
Helleborus niger Linn.	Black hellebore	Ranunculaceae	Root
Swertia chirata Hain	Chiretta	Gentianaceae	Aerial parts
Bassia longifolia Linn.	Mahua	Sapotaceae	Seed
Azadirachta indica A. Juss.	Neem	Meliaceae	Leaf
Fumaria indica Linn.	Fumitory	Papaveraceae	Whole plant
Bougainvillea sp.	Bougainvillea	Nyctaginaceae	Bract
Embelia ribes Burm.	Bai Barang	Myrsinaceae	Seed
Saussurea lappa Clarke.	Kut root	Compositae	Root

and 10 per cent levels (w/w) intc the medium. Ten grams of the treated medium was kept in glass jars and 50 larvae were released in each treatment. Three, replications were maintained for each treatment along with equal number of untreated controls. All the bioassay studies were carried out at 27±2°C and 70-75 per cent R.H.

The observations recorded during the bioassay studies were, day of pupation, larval mortality, pupal weights and pupal mortality. For evaluation of the toxicity, the per cent larval and pupal mortalities were taken into consideration. The data on mortalities were corrected by Abbott's formula[5] and subjected to angular transformations[6], before carrying out statistical analysis. Comparison of toxicity of various plant materials at different levels of treatment was done separately by analysis of variance using Duncan's new multiple range test[7]. The toxicities of different concentrations within the plant material, were tested by Student's t-test and analysis of variance.

Results and Discussion

Results of the preliminary screening of seventeen plant products are presented in Table 2. Analysis of the data showed statistically significant differences among various plant materials at both the concentrations The powders of *S. lappa*, *E. ribes*, *Bougainvillea* sp. and *F. indica* at 30 per cent level gave a maximum of 90 per cent larval mortality, whereas, at 15 per cent level, the mortality ranged from 30.95 to 85.07 per cent. The next best were the powders of *C. viscosa*, *C. roxburghianum*, *C. zedoaria*, *C. bonduc*, *H. niger*, *S. chirata*, *B. longifolia* and *A. indica*. However, the powders of *I. camara*, *A. vasika*, *B. frondosa*, *A. absinthium* and *C. amada* gave less than 50 per cent mortality at both the concentrations tested. Majority of the plant products mentioned above, suppressed more than half the insect population at both the concentrations, acting either as ovicidal or larvicidal against early instars.

Analysis of the data (Table 3) revealed that in plant powders of *C. roxburghianum*, *S. lappa*, *C. zedoaria*, *A. indica* and *E. ribes*, the t-test was significant. However, in other treatments, there was no significant difference in larval mortality between the concentrations tested.

In some treatments, the time taken for pupation was prolonged by about 1-4 days, indicating a mild degree of juvenile hormone like activity (Table 2). The pupal size and weight in a few cases was drastically reduced as compared to their corresponding controls. This could be attributed to the occurrence of some water soluble antifeedant principles in such plants.

For the final evaluation, plant powders exhibiting more than 50 per cent larval mortality in the preliminary screening, were selected for testing their efficacy against third instar larvae of housefly. The results and tests of significance for different levels of treatment indicated significantly high differences among the

TALLE 2. EFFECT OF VARIOUS PLANT PRODUCTS ON THE DEVELOPMENT OF *MUSCA DOMESTICA* L.

Plant material	30% concn			15% concn			Control	
	Larval mortality* (%)	Day of pupation	Pupal wt. (mg)	Larval mortality* (%)	Day of pupation	Pupal wt. (mg)	Day of pupation	Pupal wt. (mg)
Curcuma amada	22.67^{a}	6.33	12.60	NR	6.67	17.43	7.00	18.60
Artemisia absinthium	31.57^{ab}	5.00	18.73	28.38^{a}	5.00	20.00	5.00	17.33
Butea frondosa	35.89^{bc}	6.00	19.60	NR	5.00	17.73	5.00	17.33
Adhatoda vasika	42.34^{c}	6.00	19.03	36.94^{abc}	5.33	19.70	5.00	19.20
Lantana camara	45.02^{cd}	7.00	18.53	43.23^{abcd}	7.00	16.53	5.00	17.53
Cleome viscosa	55.69^{de}	6.67	17.67	NR	6.00	20.40	6.00	17.67
Carum roxburghianum	63.59^{ef}	10.33	12.35	32.70^{ab}	8.00	16.01	6.00	22.92
Curcuma zedoaria	67.85^{efg}	5.67	22.93	25.26^{a}	5.00	22.40	5.00	18.40
Caesalpinia oonduc	67.91^{efg}	7.00	10.50	64.78^{ef}	7.00	15.89	6.33	18.53
Helleborus niger	68.80^{efg}	6.67	12.10	65.93^{ef}	6.67	12.13	6.33	17.10
Swertia chirata	70.03^{fg}	5.33	18.93	52.73^{cde}	5.00	21.49	5.00	21.51
Bassia longifolia	73.79^{fg}	8.00	11.20	47.09^{cde}	7.00	11.73	6.00	18.40
Azadirachta indica	77.61^{g}	7.00	6.10	60.66^{de}	6.00	11.80	5.00	16.20
Saussurea lappa	90.00^{h}	—	—	30.95^{ab}	5.67	17.06	5.00	18.06
Embelia ribes	90.00^{h}	—	—	62.79^{ef}	8.67	10.84	7.00	20.29
Bougainvillea sp.	90.00^{h}	—	—	80.97^{fg}	7.00	15.00	6.67	21.63
Fumaria indica	90.00^{h}	—	—	85.07^{g}	6.67	7.50	6.33	18.53
Statistical constant S.Em.±	4.09			5.87				

S=Significant ($P<0.05$). *Correctea values subjected to angular transformation.
Figures in a column with same superscript letter(s) do not differ significantly. N.R.=Not recorded

TABLE 3. LARVAL MORTALITY AT DIFFERENT CONCENTRATIONS OF PLANT PRODUCTS

Plant material	30% concn Mean±S.E.	15% Concn Mean±S.E.	Test of significance
Artemisia absinthium	31.57±1.87	28.38±3.58	N.S.
Adhatoda vasika	42.34±3.51	36.94±6.42	N.S.
Lantana camara	45.02±2.30	43.34±4.81	N.S.
Carum roxburghianum	63.59±5.44	32.70±1.71	S*
Curcuma zedoaria	67.85±3.22	25.26±3.55	S**
Caesalpinia bonduc	67.91±6.54	64.78±6.52	N.S.
Helleborus niger	68.80±3.64	65.93±0.18	N.S.
Swertia chirata	70.03±5.48	52.73±7.01	N.S.
Bassia longifolia	73.79±6.40	47.09±14.93	N.S.
Azadirachta indica	77.61±0.00	60.66±0.92	S**
Saussurea lappa	90.00±0.00	30.95±5.71	S
Embelia ribes	90.00±0.00	62.79±0.73	S**
Bougainvillea sp.	90.00±0.00	80.97±5.67	N.S.
Fumaria indica	90.00±0.00	85.07±2.50	N.S.

N.S. : Not significant ($p>0.05$)
S : Significant ($p<0.05$)
S* : Highly significant ($p<0.01$)
S** : Very highly significant ($p<0.001$)

various plant powders (Table 4). *Bougainvillea* sp., *F. indica*, *B. longifolia*, *C. bonduc* and *E. ribes* were found superior in toxicity compared to *S. lappa*, *A. indica*, *C. roxburghianum* and *A. vasika*. On the contrary, powders of *C. viscosa*, *H. niger*, *S. chirata* and *C. zedoaria*, which showed fairly high efficacy against eggs and early instars, were ineffective against the third instar larvae. The pupal moratlity in a few treatments indicated the presence of some biologically active principles, which may be responsible for inhibiting the complete pupation or affecting the normal metamorphosis.

Data on the comparison of various concentrations of a plant against third instar larvae revealed that in treatments of *B. longifolia*, *C. bonduc*, *E. ribes*, *A. indica*, *S. lappa* and *A. vasika*, a highly significant difference existed in the various levels tested (Table 5). While in the other plant materials there was no significant difference in the different levels within the same plant product.

In the present study, the treatments of *Bougainvillea* sp., *F. indica*, *B. longifolia*, *C. bonduc* and *E. ribes* have shown toxicity to well fed third instar larvae of housefly. The insecticidal potential of bracts of *Bougainvillea* sp. and seeds of *E. ribes* is substantiated by the findings

TABLE 4. COMPARATIVE EFFICACY OF PROMISING PLANTS AGAINST THIRD INSTAR LARVAE OF *MUSCA DOMESTICA* L.

Plant material	40% concn.			30% concn.			20% concn.			10% concn.			Control
	Larval mortality (%)	Pupal wt. (mg)	Pupal mortality (%)	Larval mortality (%)	Pupal wt. (mg)	Pupal mortality (%)	Larval mortality (%)	Pupal wt. (mg)	Pupal mortality (%)	Larval mortality (%)	Pupal wt. (mg)	Pupal mortality (%)	Pupal wt. (mg)
Bougainvillea sp.	**90.00^a	—	—	**90.00^a	—	—	**90.00^a	—	—	**90.00^a	—	—	21.40
Fumaria indica	90.00^a	—	—	90.00^a	—	—	90.00^a	—	—	82.38^{ab}	10.00	37.07	22.13
Bassia longifolia	90.00^a	—	—	90.00^a	—	—	90.00^a	—	—	80.55^b	16.00	42.25	23.20
Caesalpinia bonduc	90.00^a	—	—	90.00^a	—	—	24.10^c	12.93	29.00	8.83^d	15.33	23.33	17.60
Embelia ribes	84.45^a	5.50	52.06	71.11^b	5.58	47.61	63.14^b	5.60	36.22	19.34^c	14.93	0.00	20.33
Saussurea lappa	40.14^b	10.27	36.79	35.86^c	15.00	28.08	15.81^{de}	18.27	18.71	9.67^d	18.80	16.45	19.07
Azadirachta indica	39.98^b	7.53	27.45	30.39^c	8.26	32.74	20.84^{cd}	8.33	33.61	17.93^c	11.80	18.99	19.06
Carum roxburghianum	37.44^b	5.40	62.13	33.09^c	7.27	61.34	25.18^c	9.53	40.03	22.25^c	9.93	36.69	18.53
Adhatoda vasika	23.57^c	13.27	0.00	22.65^d	11.53	0.00	14.88^e	13.33	0.00	0.00	16.88	0.00	19.33
Curcuma zedoaria	9.18^d	18.67	0.00	9.18^e	18.26	0.00	6.19^f	19.60	0.00	0.00	20.53	0.00	20.20
Swertia chirata	0.00	17.80	0.00	0.00	19.00	0.00	0.00	19.20	0.00	0.00	19.60	0.00	19.60
Helleborus niger	0.00	16.53	0.00	0.00	18.00	0.00	0.00	18.40	0.00	0.00	20.73	0.00	23.46
Cleome viscosa	0.00	19.80	0.00	0.00	20.40	0.00	0.00	20.80	0.00	0.00	21.00	0.00	20.40
Significance	*			*			*			*			
S.Em±	3.43			2.80			1.78			2.60			

*Significant at 5% ($P<0.05$) level.

**Corrected values subjected to angular transformation. Treatments with no mortality were not included in the statistical analysis. Figures in a column with the same superscript letter(s) do not differ significanty.

of Rao[1] and Borle[8], wherein the authors have reported the toxicity of kerosene oil extract of *Bougainvillea* sp. to *Sitophilus oryzae* and petroleum ether extract of *E. ribes* to a number of insect-pests respectively. Reports are available regarding the repellent properties of *A. indica* leaves against *Ephestia cautella*[9] and *Tribolium castaneum*[2]. In the present study, the leaves of *A. indica* did not show any marked effectiveness as stomach or contact poison against third instar larvae of housefly, though against eggs and early instars the leaves did show some efficacy. Pandey *et al*[3]. have discussed the antifeedant, repellent and insecticidal properties of *L. camara* against *Athalia proxima*. However, it was not effective against eggs and early instars of housefly except that it prolonged the larval duration to some extent. *S. chirata* in the present study was practically ineffective against third instar larvae. However, Singh and Pandey[10] have reported the effectiveness of *S. chirata* powder on the growth and development of *Utethesia pulchella*. Majority of the plant products tested in the present work are medicinal,[11] hence extensive studies are being carried out to isolate and assay the active principles of such plants against insect pests of storage.

TABLE 5. COMPARISON OF DIFFERENT CONCENTRATION OF A FEW SELECTED PLANT POWDERS ON THE MORTALITY OF THIRD INSTAR LARVAE OF *MUSCA DOMESTICA* L.

Plant material	% mortality at the indicated concentrations					
	40%	30%	20%	10%	S.Em	CD at 5%
B. longifolia	90.00	90.00	90.00	80.55	0.56	1.82
F. indica	90.00	90.00	90.00	82.38	N.S.	—
C. bonduc	90.00	90.00	24.10	8.33	0.62	2.02
E. ribes	84.45	71.11	63.14	19.34	3.16	10.30
S. lappa	40.14	35.86	15.81	9.67	3.69	12.03
A. indica	39.98	30.39	20.84	17.93	2.44	7.96
C. roxburghianum	37.44	33.09	25.18	22.25	N.S.	—
A. vasika	23.57	22.65	14.89	0.0	1.80	6.02
C. zedoaria	9.18	9.18	6.19	0.0	N.S.	—

N.S.=not significant ($P<0.05$)

Values corrected and subjected to angular transformation

Acknowledgement

Authors wish to thank Dr. B. L. Amla and Mr. S. K. Majumder, of the Institute for providing necessary facilities and encouragement throughout the course of investigation.

References

1. Rao Seshagiri, D., Insecticidal potential of the corolla of flowers. *Indian J. Ent.*, 1955, **17**, 121.
2. Atwal, A. S. and Sandhu, G. S., Preliminary studies on the efficacy of some vegetable and inert dusts as grain protectants. *J. Res. Punjab Agric. Univ. Ludhiana*, 1970, **7**, 52.
3. Pandey, N. D., Mahaveer Singh and Tewari, G. C., Antifeedant, repellent and insecticidal properties of some indigenous plant materials against *Athalia lugens proxima*. *Indian J. Ent.*, 1977, **39**, 60.
4. Ahmed, S.M., Harish Chander and John Pereira. Insecticidal potential and biological activity of Indian indigenous plants against *Musca domestica*. *Int. Pest. Cont.*, 1981, **23**, 170.
5. Abbott, W. S., A method of computing the effectiveness of an insecticide. *J. Econ. Ent.*, 1925, **18**, 265.
6. Snedecor, G. W., *Statistical Methods*. Iowa State College Press, Ames, Iowa, USA, 1950, 449.
7. Duncan, D. B., Multiple range and multiple F-tests. *Biometrics*, 1955, **11**, 1.
8*. Borle, M. N., *Exploration of the insecticidal efficacy of some indigenous plant products*. 1966, Ph.D. Thesis, IARI, New Delhi-12.
9*. Fry, J. S. and Sons, Neem leaves as an insecticide. *Gold Coast Farmer*, 1938, **6**, 190.
10*. Singh, H. and Pandey, P. N., Effect of *Swertia chirata* on the development and growth of *Utethesia pulchella*. *Z. ang. Zool.*, 1979, **66**, 15.
11. Nadkarni, A. K., *Indian Materia Medica*, Popular Book Depot, *Vol.* 1. 1954.

*Original not seen.

Optimisation of Conditions for Malting of Sorghum

R. A. PATHIRANA, K. SIVAYOGASUNDARAM AND P. M. JAYATISSA

Industrial Microbiology, Ceylon Institute of Scientific and Industrial Research, P. O. Box 787, Colombo 7, Sri Lanka

Manuscript received 14 *December* 1981; *revised* 4 *October* 1982

Malting conditions for sorghum were determined using a local variety: IS 2941. The conditions studied were the steeping and germination times and the effect of heat treatment on malt quality. The parameters used to assess the malt quality were the malting loss, cold and hot water extracts, reducing sugar content of the extract, diastatic power and liquefying power. A steeping time of 18 hr and a germination time of 4-5 days were found to be optimum for malting. Due to the rapid inactivation of hydrolytic enzymes at high temperatures, kilning at moderate temperatures (around 100°C) for short periods (3-4 hr) is recommended.

Considerable work has already been done on malting of sorghum[1] (*Sorghum vulgare*). Its extensive use in the brewing of 'Kaffir Beer' in Africa is also well known. Although this cereal is not extensively cultivated in Sri Lanka at present, it has been shown that climatic and soil conditions of the dry zone are ideal for its cultivation on a commercial scale.

From the previous study[2], it was observed that yellow varieties of sorghum were superior to others for malting. Therefore, in the present study a yellow variety commonly grown in Sri Lanka, 'IS 2941', was selected to optimise conditions for malting. The quality of the final malt was assessed by amylolytic enzyme activities and the quantity of extract obtained.

Materials and Methods

Materials: Sorghum, variety 'IS 2941', was obtained from the Dry Zone Research Station, Department of Agriculture, Mahailluppallama, Sri Lanka.

Steeping and germination: Grains were steeped in running tap water at room temperature (approximately 30°C) for predetermined periods. The steeped grains were drained and germinated on cemented floors in layers of 5-8 cm thickness. Germination was carried out in darkness at room temperature. The grains were mixed regularly during germination and watering was done with a sprayer when the grains appeared to be dry. After germination for specified periods, the grains were dried in an oven at 45°C to a moisture content of approximately 10 per cent (w/w).

Grinding of malt: Malt was ground in a laboratory hammer mill and sieved through a test sieve of 710 μm aperture.

Heat treatment of malt: Malt was subjected to heat treatment in layers of 3-5 cm thickness for definite periods at predetermined temperatures. During the heat treatment the malt was mixed regularly.

Analytical methods: The cold extract, hot extract,

reducing sugars as 'maltose', diastatic power and liquefying power were determined according to the method described by Jayatissa *et al*[2].

In this study, three steeping periods comprising 8 18 and 32 hr were used. Grains steeped for different periods were germinated for 2-6 days. The quality of the malt thus obtained was assessed on the basis of the malting loss, cold and hot water extract, total reducing sugars as maltose in the hot water extract, diastatic power and the liquefying power (Table 1).

Results and Discussions

Effect of steeping time and germination time on malt quality: Malting losses were directly propotional to the number of days allowed for germination. In the case of different steeping periods, the relationship between the steeping period and malting loss was not clear. However, the results indicate that longer steeping periods lead to faster rates of germination and higher malting losses. Also as shown in our earlier study[2], these malting losses are much higher than those reported for barley. Cold water extracts of samples obtained by steeping for 8 hr were somewhat lower than those obtained by steeping for 18 and 32 hr. They ranged between 17 and 28 per cent over the period of germination of 2-6 days, while for samples obtained by steeping for 18 and 32 hr the values ranged from 21 to 32 and from 21 to 31 per cent respectively. These values indicate early modification of grain constituents in samples obtained by steeping for 18 and 32 hr. This fact is reflected in the hot water extract values of these samples also which were above 60 per cent (dry basis) on the second day of germination. Samples obtained by steeping for 18 hr gave the best hot water extract values, and by the 4th day of germination these values were much superior to those of the samples obtained by steeping for 8 or 32 hr. The very satisfactory extract values obtained on the 4th day of germination for samples obtained by steeping for 18 hr indicate that it may be possible to cut down the germination time to around 4 days with this variety of sorghum by using a steeping time of 18 hr and thereby reduce the malting loss to a minimum. The reducing sugar content (as maltose) in wort followed the same pattern as the hot water extract. Higher maltose contents (upto 89.3 per cent) were observed in samples obtained by steeping for 18 hr as compared with those of samples steeped for 8 and 32 hr which were somewhat lower.

Samples obtained by steeping for 32 and 18 hr indicated the early development of diastatic power with longer steeping periods. These samples gave diastatic powers of 46.3 and 36.6 KDU/g respectively on the second day of germination as compared with 13.8 KDU/g of samples obtained by steeping for only 8 hr. However, this difference narrowed down to a minimum as the germination progressed. As indicated in our earlier study, the highest values of diastatic power observed with local varieties of sorghum (around 60

TABLE 1. EFFECT OF STEEPING AND GERMINATION PERIODS ON MALT QUALITY OF IS 2941 VARIETY OF SORGHUM

Steeping period (hr)	Moisture at the end of steeping (%)	Germination period (days)	Malting loss*	Cold water extract*	Hot water extract*	Sugars as maltose*	Diastatic power (KDU/g)	Liquefying power (g starch/g malt/hr)
8	38.15	2	3.0	16.8	35.6	33.2	13.8	44.0
		3	4.8	18.9	53.5	53.2	33.8	55.0
		4	11.6	21.7	69.2	68.02	49.1	63.2
		5	15.9	25.6	82.1	79.1	52.2	66.0
		6	23.9	28.0	84.3	81.7	54.9	64.0
18	43.74	2	9.2	21.5	61.7	58.3	36.6	45.2
		3	12.9	22.0	75.7	75.0	56.5	55.0
		4	19.5	25.6	82.4	81.1	58.9	58.0
		5	23.3	24.2	87.7	86.7	54.9	60.0
		6	31.0	31.6	92.0	89.3	53.5	58.0
32	49.78	2	6.5	22.3	65.0	64.1	46.3	55.0
		3	10.2	24.6	67.5	66.2	45.7	56.3
		4	16.3	25.0	72.7	71.2	49.4	57.5
		5	23.5	24.9	77.6	77.0	48.5	61.3
		6	26.7	30.6	85.9	83.5	59.0	60.0

*(Values are percentage of malt on dry basis)

KDU/g) were much lower compared with those of barley. However, when compared with the best values reported for African varieties of sorghum[3], which were around 70-80 KDU/g, these values appeared somewhat satisfactory.

Liquefying powers of malts obtained by steeping grains for different periods did not show any clearcut relationship to the steeping period. The values obtained in this study (around 60-70 g starch/g malt/hr) were somewhat lower than the highest values obtained for Sri Lankan varieties in our earlier study[2] (around 70-80 g starch/g malt/hr).

From this study, it can be concluded that a steeping period slightly higher than 18 hr and a germination period of around 4-5 days would be optimum for the production of malt from sorghum variety 'IS 2941'.

Effect of heat treatment on malt quality: Kilning of malt at elevated temperatures is necessary to remove the raw flavour of green malt and also, to promote the chemical reactions responsible for the formation of flavour components which impart the characteristic flavour to malt. However, kilning also brings about a loss in the enzyme activities of malt, and if not minimized this may, give rise to problems during mashing. While kilning of sorghum malt, special consideration should be given to the loss in enzyme activity as the total enzyme activity in sorghum malt is considerably lower than that of barley malt. In this study, malt was subjected to heat treatment at 80, 100, 120 and 140°C for different periods. This was mainly to study the effect of high temperatures on the amylolytic enzymes of the malt. Before subjecting to heat treatment the green malt was dried at 45°C to a moisture content of less than 10 per cent (w/w) as higher moisture levels would accelerate the inactivation of enzyme at high temperatures. The main parameters used in the assessment of malt quality after heat treatment were the hot extract, total reducing sugars as maltose, diastatic power and the liquefying power (Table 2). The cold extract values decreased markedly with increase in the treatment temperature. A temperature of 80°C did not have any effect on the cold extract values of the malt even after treatment for 6 hr. On the other hand, at 140°C a marked drop in the cold extract values was observed. The effects of temperatures of 100 and 120°C were somewhat intermediate.

The hot water extract values also showed a marked decrease with increase of treatment temperature. While at 80°C there was no effect upto 6 hr of treatment, at 140°C there was a considerable drop in the hot extract values. This may be attributed to the inactivation of the hydrolytic enzymes, mainly amylases, at these higher temperatures. The effect of treatment at higher temperatures was more pronounced with respect to reducing sugar of the extract. This is indicative of the inactivation of saccharifying amylases (β-amylase) to a much greater extent than the liquefying amylases (α-amylase) at higher temperatures. The same effect is again reflected in the distatic power and liquefying power values. The marked decrease in the distatic power, which is a measure of the degree of maltose production (liquefaction & saccharification) is again indicative of the inactivation of β-amylase. The relatively lower decrease in the liquefying power shows that the α-amylase component

TABLE 2. EFFECT OF HEAT TREATMENT ON THE MALT QUALITY OF IS 2941 VARIETY OF SORGHUM

Treat. temp. (°C)	Treat. period (hr)	Moisture (% w/w)	Cold water extract*	Hot water extract*	Sugars as maltose*	Diastatic power (KDU/g)	Liquefying power (g starch/g malt/hr)
80	2	5.6	16.6	70.0	65.0	26.4	70.0
80	3	5.8	16.6	70.6	65.2	24.6	70.0
80	4	5.4	16.2	68.5	63.9	23.7	70.0
80	5	5.5	16.6	69.8	63.6	23.1	69.8
80	6	5.2	16.5	69.2	62.7	22.8	69.8
100	2	5.4	16.2	65.8	58.8	14.7	68.5
100	3	4.6	15.9	63.1	57.4	13.8	65.7
100	4	4.5	15.6	66.3	56.5	13.1	62.4
100	5	4.2	15.2	63.0	54.4	11.1	62.2
100	6	4.4	15.3	62.4	51.0	10.8	62.0
Control	—	9.9	16.6	73.4	67.7	28.1	70.0

*Values are percentage of malt on dry basis

is much more resistant to heat. Therefore, it appears that the extracts of malt treated at higher temperatures consist mainly of dextrins and oligosaccharides which contribute much less to reducing sugar content and also, to the fermentable sugars.

It could be concluded from the study that the saccharifying amylases of sorghum malt are highly susceptible to thermal inactivation. Accordingly, kilning has to be carried out under moderate temperatures.

References

1. Schwartz, H. M., Kaffirecorn malting and brewing studies. 1. The Kaffir beer brewing industry in South Africa. *J. Sci. Fd Agric.*, 1956, **7**, 101.
2. Jayatissa, P. M., Pathirana, R. A. and Sivayogasundaram, K., Malting quality of Sri Lankan varieties of sorghum. *J. Inst. Brew.*, 1980, **86**, 18.
3. Novellie, L., Kaffir corn malting and brewing studies. *xii* Variation of diastatic power with variety, season, matuirty and age of grain. *J. Sci. Fd Agric.*, 1962, **13**, 115.

A Mechanism for Breaking Egg and Separating Albumen

S. K. MAHAPATRA AND H. DAS
Department of Agricultural Engineering, Indian Institute of Technology, Kharagpur-721 302, India

Manuscript received 21 *June* 81; *revised* 21 *June* 1982

The egg breaker-separator developed has two components, viz. a 'Breaker Unit' and a 'Separator Unit'. The breaker unit breaks the egg and releases its liquid contents with yolk intact and the separator unit separates albumen from yolk. The breaker unit consists of a pair of chain and sprocket drives, juxtaposed on a horizontal plane. The chains are provided with half cups and each half cup with a spring loaded knife. A pair of half-cups facing each other forms a receptacle for a single egg. Egg gets cracked when the half-cups move against an overhead fixed plate. Cracked eggs are opened as the half-cups move apart on the sprockets. The contents of egg are directed to the separator unit which consists of sheet metal channel having a rectangular slot. Albumen gets drained through the slot and the yolk is left behind. The equipment could break and separate about 12 eggs per minute with a separating efficiency of 97 per cent.

The necessity to separate egg-yolk and albumen arises from the fact that, they differ considerably in their functional properties and find diverse uses in food and other industries. Egg-albumen, due to its good foaming ability, finds extensive applications in candy, and bakery industries for the production of light weight, spongy and soft products. Dehydrated egg-albumen is used in textile, photo, printing and pharmaceutical industries. These industries mainly use the adhesive property of the albumen. The egg-yolk has an excellent emulsifying property and it finds ready-made applications in cosmetics, soap, food and pharmaceutical industries. It also serves as a good medium for the preservation of bull-semen.

It requires about one minute to break on an average 15 eggs manually. If the contents are to be separated, then, 2 to 3 eggs can be broken and separated in one minute. Due to the slow rate of manual breaking and separating of eggs in the egg processing plant, there is the possibility of spoilage of egg-liquid before it is being processed. The paper describes a mechanism which can be used to build up a commerical machine for automatic breaking and separating of egg-liquids.

Weight of a chicken egg normally lies between 55 and 60g. Percentage weights of the three components of the egg are; shell 9 to 12 per cent, albumen 58 to 60 per cent and yolk 30 to 33 per cent.

Shape of an egg-shell approximates a prolate-spheroid[1]. A widely used shape index is the ratio of length of polar axis 'a' to diameter 'b' at the equator (Fig. 1). The ratio of a/b normally lies between 1.2 and 1.5. Equatorial diameter generally measures between 3.3 and 4.5 cm and the polar length between 4.0 and 5.5 cm.

When a shell-egg is placed on a flat surface (Fig. 1), the yolk is found to be slightly displaced from its central position towards the bottom of the shell, leaving a layer of albumen of approximately 1.2 cm thickness above it. Egg should, therefore, be broken from its top and a knife should not penetrate a depth greater than 1.2 cm.

The yolk inside a shell egg is surrounded by a thin proteinous layer called vitelline membrane (Fig. 1). For the process of separation of yolk and albumen, the

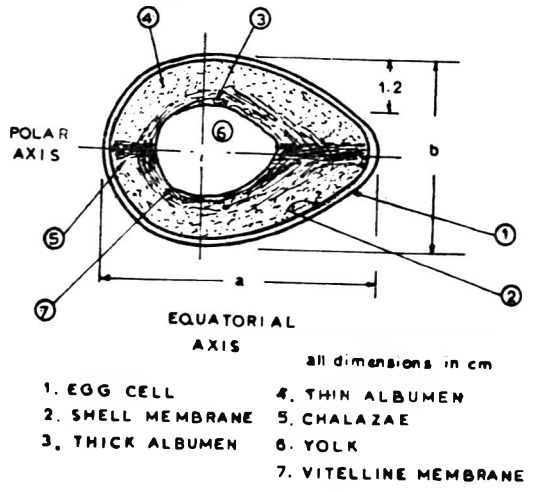


Fig. 1. Structure of an intact shell-egg

role of vitelline membrane is most crucial. If the membrane breaks it will be impossible to separate the yolk from the albumen.

When an egg is stored at a temperature of 10 to 12°C for a day or two, the vitelline membrane gets contracted from all sides, giving the yolk an appearance of a sphere. At this temperature, strength of this membrane has been found to be maximum. In a commercial egg processing plant where mechanical egg breaking and separating machines are employed, the temperature of egg and of breaking room should be maintained at 10 to 12°C[2].

Outside the vitelline membrane, there lies a layer of thick albumen and the yolk is centrally suspended by

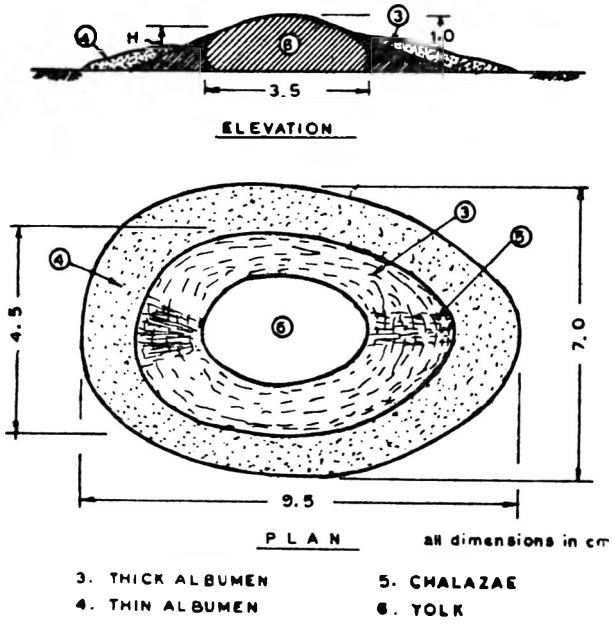


Fig. 2. Dimensions of spread of egg liquids when poured on a flat surface.

a set of two polar chalazae (Fig. 1). These chalazae provide an attachment between the vitelline membrane and the adjacent thick albumen.

When an egg is carefully broken and its liquid is poured on to a flat smooth surface, the position and geometry which the yolk and albumen take are shown in Fig. 2. The diameter of the yolk will then measure about 3.5 to 4 cm. On ageing, the height H of albumen gets reduced leading to more spreading of the contents. A method based on the measurement of the value of H is a measure of the quality of egg albumen. Haugh Unit is one such method which was originally developed by Raymond Haugh[3] and is expressed as

$$H.U. = 100 \log \left[H - \frac{\sqrt{G(30\ W^{0.37} - 100)}}{100} + 1.9 \right] \ldots (1)$$

where, H.U. is Haugh Unit, H is albumen height in mm, G is 32.2 and W is weight of shell egg in g. This method serves as an indirect way of measuring the egg quality.

Fresh eggs collected from market were stored at a temperature of 7 to 12°C until they were used. Physical properties of eggs used in the experiments are as follows: Haugh unit, 64 ± 6; weight of shell egg 58 ± 2 g; weight of egg liquid 52 ± 2 g; diameter of yolk when poured on a flat surface, 3.4 ± 0.5 cm; and volume of albumen 42 ± 2 2 cm^3.

Breaker unit

The breaking mechanism works on the principle, that an egg when placed between two halves of an egg shaped cup and is broken from the top by a spring loaded knife attached to each cup, followed by splitting of two halves of the cup on a horizontal plane, will result in release of liquid contents of egg with yolk intact. The process can be made continuous by placing a series of half cups on two endless chain drives. Fig. 3 shows the designed mechanism. Two endless chains (8, 9) are mounted on sprockets (5, 6). Each chain is fixed with a half cup (1, 2). When the two half cups face each other they form a receptacle for holding a single egg. Portion LRN of the overhead fixed plate (13) is horizontal and the portion RK is curved upward. Vertical distance between the sprokets (3 or 4) and the horizontal portion LRN of the overhead fixed plate is kept equal to the equatorial diameter of an egg.

Two spring loaded knives (25) are attached to each cup (Fig. 3). The knives remain in upright position before the half cups enter under the curved portion RK of the overhead fixed plate. Fig. 4 show the details of the spring loaded knife before and after they have entered under the overhead fixed plate. As has been pointed out earlier, the knife should not penetrate

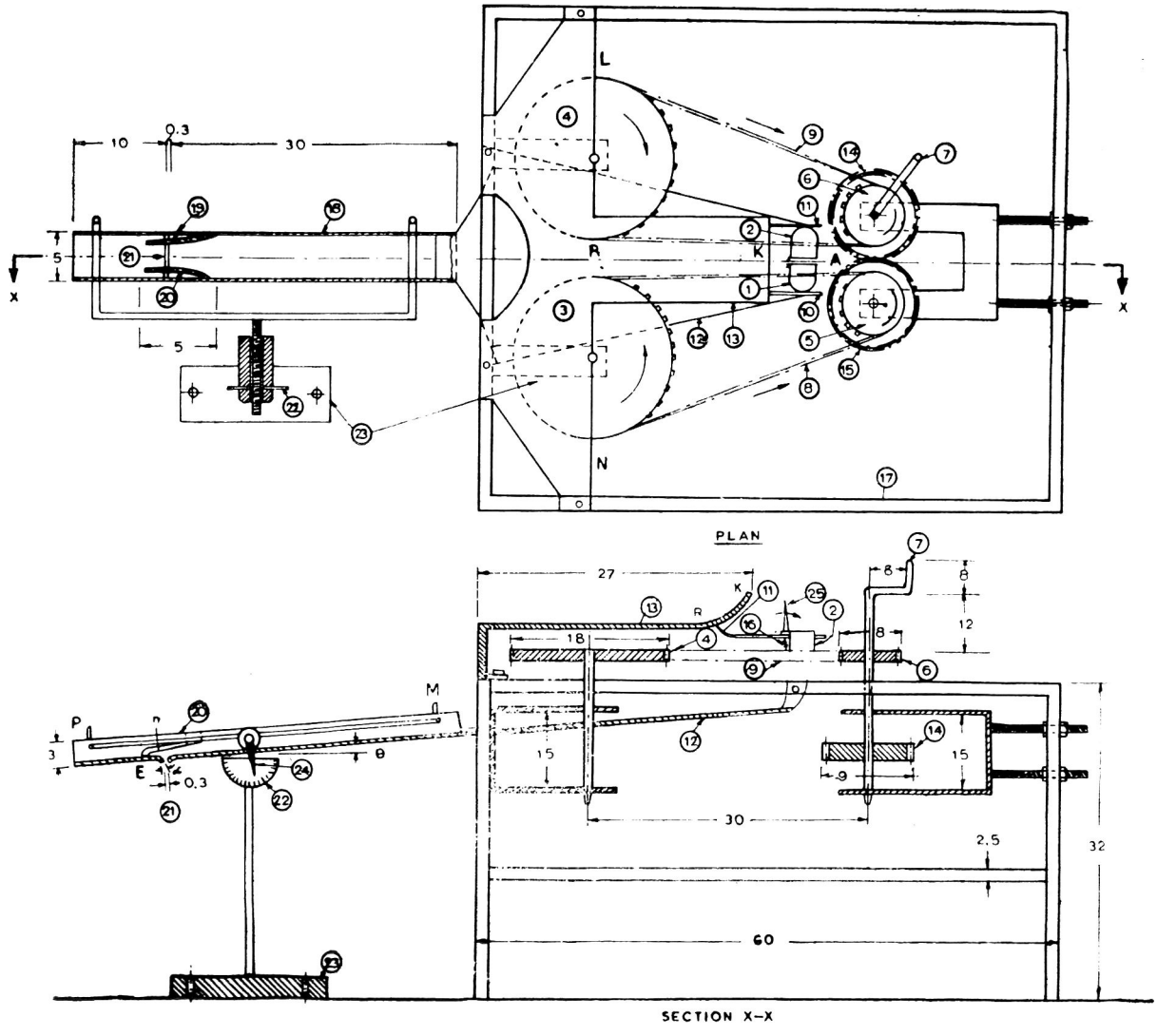


Fig. 3. Egg breaker separator

Scale 1:4. All dimensions in cm.

(1) Half cup with spring loaded knife (C. I.); (2) Half cup with spring loaded knife (G. I.); (3) (4) Head sprocket (M.S.); (5) (6) Tail sprocket (M.S.); (7) Drive handle (M.S.); (8) (9) Chain (Alloy steel); (10) (11) Guide rod (M.S.); (12) Egg liquid collection tray (Al sheet); (13) Overhead fixed plate (M.S.); (14) (15) Power transmission gear (C.I.); (16) Spring (Alloy steel); (17) Frame with breaker unit (M.S. Angle); (18) Inclined channel (Al); (19) (20) Albumen arrestor (Al); (21) Rectangular slot; (22) Channel angle meter (Plastic); (23) Frame of the separator unit (M.S.); (24) Pointer of 22 (M.S.); 25, Knife (G.I.).

C.I.=Cast iron; M.S.=Mild steel; G.I.=Galvanized iron; Al.=Aluminim.

inside an egg to a depth greater than 1.2 cm. The width of the knife is, therefore, kept at 1.2 cm. The knife remains in its down position until the half cups come out from underneath the overhead fixed plate L and N. Egg liquid is discharged at R and the empty shell at L and N. At A the half cups come again facing each other and the operation continues.

Bicycle crank sprockets of 18 cm diameter are used for the sprockets (3, 4). For other sprockets (5, 6) bicycle free-wheel sprockets of 8 cm diameter are used. To prevent the sagging of the chain, the centre to centre distance between the sprockets (3,5) is limited to 30 cm.

In order to keep the half cups intact without moving apart, two guide rods (10, 11) are provided (Fig. 3) which are fixed on to the frame. The horizontal distance between the two rods is such that the half cups remain tightly pressed together, as they move under the overhead fixed plate. The lower portion of the cups, touch each other, but a gap exists at the upper part of the cup through which the knives can get in.

Power to drive the mechanism was supplied to one of

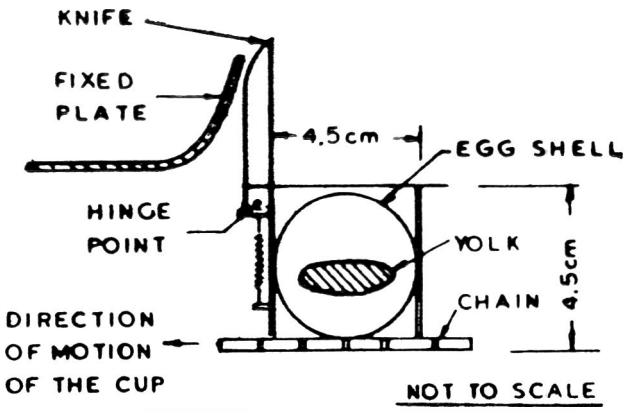


Fig. 4a. Details of spring loaded knife before its entrance under the fixed plate.

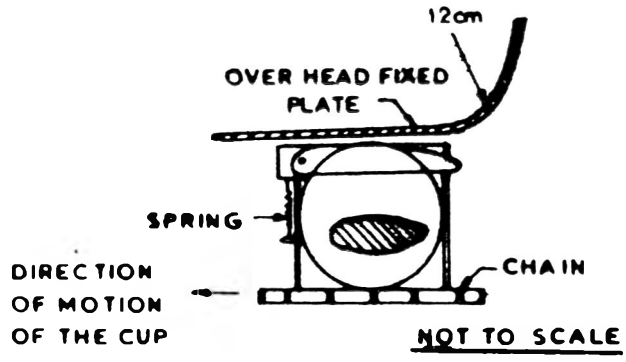


Fig. 4b. Details of spring loaded knife after its entrance under the fixed plate.

tail sprockets (5, 6) (Fig. 3). Both the sprockets are connected by two equal-sized gears (14, 15).

The optimum linear speed of the chain is found to be 6 cm/sec. Higher than this, speed ruptured the yolk, due to the jerk. If the speed is less, then the albumen slowly seeped out of the shell and this led to the settlement of yolk on the cracked edges of the shell. During the opening of the shell, the yolk thus settled, got punctured by the cracked edges of the shell.

As the length of the chain is 107 cm and a time of 5 sec is required for an effective separation of yolk from albumen in the separator Unit, a total of $107/(6\times5)\simeq3$ half cups could be mounted on each chain. In the present model, however, only one cup is fixed and the feeding of the eggs to the cup is done manually.

Separator Unit

During separation, vitelline membrance of the yolk is subjected to some amount of mechanical stress. To find out a suitable perforation which would impart least stress to this membrance, a range of circular holes and rectangular slots were tested for perfect separation.

A preliminary trial was made with a perforated inclined channel having circular holes of various diameters. Several combinations of inclination of channel bed and hole size could not bring about an effective separation. When trials were made on an inclined channel (18 in Fig. 3) with a rectangular slot (21), it was observed that one slot was sufficient to remove the whole of albumen. Observations were made at various channel inclinations θ (Fig 3), slot angles α, and slot widths

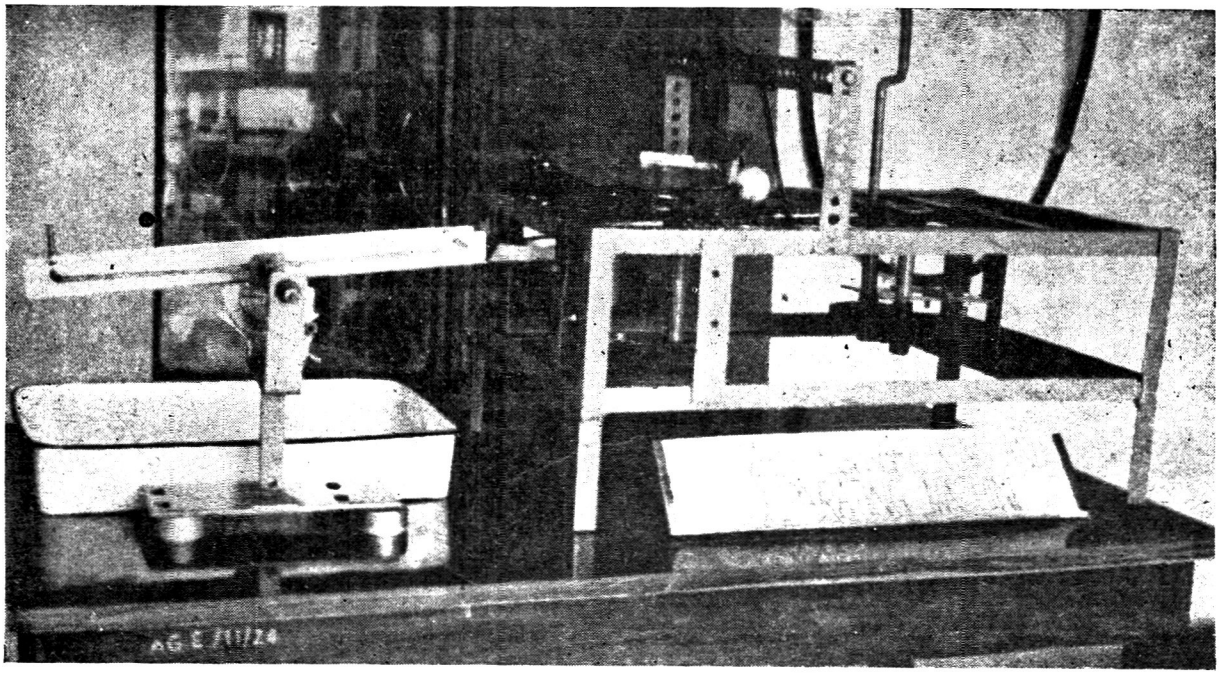


Fig. 5. Automatic Egg breaking and separating device

to find out the best combination which would give a quick separation of the albumen without distorting or rupturing the yolk.

It was found that when egg liquid was poured on a flat surface (Fig. 2), the thick albumen took an elliptical shape with a maximum width of 4.5 cm. Based on this, width of the channel bed is fixed at 5.0 cm.

The best shape of the slot is one which is able to retain the yolk for a maximum length of time and still is able to quickly discharge the albumen. Observations were made on the retention time of yolk on a horizontal channel having slot width d and slot angle α varying from 3 to 5 mm and 40 to 60° respectively. It was found that an unruptured yolk was able to stand on the slot with d=3 mm and α =60° for a period of more than 5 min. There was no difficulty for the albumen to get discharged through the slot of this size.

In order to have a small separation time, the channel inclination to the horizontal should be as large as possible. When the angle θ was more than 7°, both the yolk and the albumen jumped out of the slot without any separation. It was, however, observed that at room temperature (25-30°C) yolk became very supple and could even pass through a slot having a width of 0.3 cm. In order to avoid this problem, better results were obtained when inclination of the channel was increased from 7° to 9°.

The separation was achieved when the albumen drained out of the slot leaving the yolk behind. When the contents of another egg was poured at point M of the channel (Fig. 3), the liquid of the latter egg pushed the yolk which was previously standing on the slot to the point P downstream. The yolk of the latter egg again stood on the slot. A continuous separation of albumen from yolk could thus be achieved.

A further improvement on positive discharge of albumen is achieved by fixing a pair of metal strips (19, 20) over the slot as shown in Fig. 3. These metal strips are attached to the channel side walls, 3 cm ahead of the slot and extended 2 cm beyond the slot. At their point of fixture to the channel walls, the horizontal distance between them is equal to the width of the channel (i.e. 5 cm), but at the other ends the distance is slightly more than the most probable diameter of the yolk i.e. 3.5 cm. The strips are given a smooth curvature to attain a smooth entry of the yolk.

The gap 'n' between the channel bed and the metal strip is kept equal to the thickness of the advancing edge of the thick albumen (about 2 mm). The two points E at which the strips touch the channel bed arrested the advancing thick albumen and allowed it to be drained out through slot.

Performance of the Device

The developed model was tested for about 200 eggs and it worked very satisfactorily. As fresh egg was mainly used, there was no possibility of breaking a rotten egg. In a commercial plant, candling and other visual methods eliminate this problem before the egg is subjected to breaking operation. If any egg escapes these checks, manually scooping out the descending egg liquids as it moves on the inclined bed seems inevitable.

The efficiency of separation η may be defined as the percentage weight of albumen separated from the total weight of albumen fed into the separator unit.

$$\eta = \frac{W_2}{W - (W_1 + W_3)} \times 100 \quad \ldots.(1)$$

where,

η =efficiency of separation, per cent

W=weight of shell-egg

W_1=weight of empty shell and adhering film of albumen

W_2=weight of albumen separated by the separator

W_3=weight of yolk after washing it in water.

Values of different weights W, W_1, W_2 and W_3 were measured for two dozens of eggs and the separation efficiencies were calculated. Average value of separation efficiency was found out to be 97 ± 1.5 per cent.

Future Improvements: In order to convert the developed mechanism into a successful machine certain changes are required to be made. Providing more number of cups on the chain, use of stainless steel for some of the parts which come in contact with egg liquid and connecting a suitable power source to the machine are few such changes. Chain and sprocket may be made of food grade plastic to avoid contamination of egg liquid with lubricant as plastic chains do not require lubrication. A finger rotating below the bottom of slot of separator may possibly, shear out hanging albumen quickly and will enhance the speed of separation.

References

1. Voisey, I. W. and Hunt, J. R., Measurement of egg shell strength. *J. Texture Studies.*, 1975, **5**, 135.
2. Berquist, D. H., In *Encyclopedia of Chemical Technology*, Kirk-Othmer (Editor), John Wiley, New York, 1979.
3. Stadelman, W. J. and Coterili, O. J., *Egg Science and Technology*, AVI Publishing Co., Inc., Westport, Connecticutl U.S.A., 1968.
4. Mahapatra, S. K., A mechanism for breaking egg and separating albumen, unpublished M. Tech. Thesis, I. I. T. Kharagpur, 1981.

RESEARCH NOTES

EFFECT OF SURFACTANTS, FATTY ACIDS AND GLYCERIDES ON THE GELATINIZATION VISCOSITY OF *ATTA* (WHEAT FLOUR)

Peak gelatinization viscosity increased while amylose solubility decreased as a result of addition of fatty acids, mono—and di-glycerides and surfactants. Vegetable oils, tryglycerides, guar-gum, locust bean gum, carrageenan, carboxy-methyl cellulose, sorbitol, buty-land amyl-alcohols, however, showed no effect on the gelatinization behaviour of atta.

Surfactants either alone or with shortening are widely used for improving the texture and keeping quality of baked products. In this laboratory, addition of vanaspati, and mono-glycerides has been found beneficial in the retention of soft texture in preserved chapaties[1].

The beneficial effect of surfactants and lipids is believed to be due to their ability to form complexes with amylose[2]. However, published literature on the effect of surfactants and fatty acids on the gelatinization behaviour of starches are at variance. Mitchell and Zillman[3] and Medcalf *et al.*[4] have reported that fatty acids increased gelatinization viscosities, whereas Gray and Schoch[5] indicated that fatty acids reduced the maximum hot paste viscosity. On the other hand, Tenney *et al.*[6] reported that sodium-stearoyl-2-lactylate raised the hot paste viscosity of wheat starch, but reduced the viscosity of rice, tapioca and potato starches. Also, in most of the studies, pure starches rather than wheat flour have been used, though other components of flour especially lipids and proteins are known to interact with the surfactants and modify their overall effects on gelatinization[7]. The present paper describes the effects of some surfactants, fatty acids and their glycerides on the gelatinization behaviour of *atta* normally used for preparing chapties.

Brabender amylograph was used for determining peak gelatinization viscosity using 65 g of *atta* (14 per cent moisture) and 450 ml. water. Known quantities of additives were added to the *atta* before making slurry for transferring in amylograph bowl.

Soluble amylose was determined according to Yasunaga *et al.*[8] For studying the effect of surfactants on soluble amylose, slurries of *atta* (5 g in 30 ml water) both with and without additives were heated in boiling water for 15 min. with constant stirring. After cooling, 5 g samples were homogenised with 100 ml water and slurry centrifuged at 8000 p.p.m. for 10 min. Two ml aliquots of supernatant were treated with 98 ml of 0.004 per cent iodine solution and the blue colour developed was measured at 660 nm.

The effect of free fatty acids, glycerides and some vegetable oils on the peak gelatinization viscosity of atta is shown in Table 1. It is interesting to observe that all the fatty acids and mono-and di-glycerides significantly increased the peak gelatinization viscosity. But

TABLE 1. EFFECT OF ADDITIVES ON PEAK GELATINIZATION VISCOSITY OF *ATTA*

Additive	Gelatinization viscosity (B.U.)
None	540
Stearic acid (0.5%)	675
Palmitic acid (0.5%)	665
Myristic acid (0.5%)	670
Oleic acid (0.5%)	720
Linoleic acid (0.5%)	740
Sorbic acid (0.5%)	540
Tristearin (0.5%)	550
Tristearin (1.5%)	540
Tristearin (5%)	560
Triolein (0.5%)	540
Triolein (2.0%)	550
Distearin (2.0%)	640
Diolein (2.0%)	610
Safflower oil (0.5%)	540
Safflower oil (5.0%)	520
Groundnut oil (0.5%)	530
Groundnut oil (5.0%)	540
Vanaspati (0.5%)	530
Vanaspati (5.0%)	525
2-Amino-1-butanol (0.5%)	980
Sorbitan mono oleate (0.5%)	635
Sorbitan mono laurate (0.5%)	660
Polyoxyethylene sorbitan mono-laurate (0.5%)	765
Polyoxyethylene sorbitan mono-sterate (0.5%)	730
Polyoxyethylene sorbitan mono-oleate (0.5%)	750
Sodium stearoyl-2-lactylate	670
Glycerol monostearate (0.5%)	620
Sorbitol (0.5%)	560
Glycerol (0.5%)	530
n-Butanol (0.5%)	540
Isoamyl alcohol (0.5%)	550
Guar gum (0.5%)	550
Carrageenan (0.5%)	535
Carboxymethylcellulose (0.5%)	540

triglycerides and vegetable oils did not exert a significant effect even when incorporated at a level of 5 per cent. Orthoefer[9] has reported that addition of vegetable oils does not change the hot paste viscosity of waxy maize starch. Oleic and linoleic acids exhibited relatively greater effect than stearic, palmitic and myristic acids.

In the present study, all the emulsifiers tried increased the gelatinization viscosity of *atta*; the changes, however, were not related with their HLB (hydrophilic-lipophilic balance) index. The effect was highest in case of 2-amino-1-butanol followed by polyoxyethyelene sorbitan esters, sorbitan esters and glycerol esters. Sorbitol, glycerol, butyl-and amyl-alcohols, however, had no effect on gelatinization viscosity of *atta* though some of these alcohols have been reported to form complexes with amylose. Incorporation of these alcohols did not cause a significant decrease in the concentration of soluble amylose during gelatinization. On the other hand, addition of emulsifiers and free fatty acids significantly reduced the amylose solubility in water indicating their interaction with amylose molecules during gelatinization (Table 2). Decrease in amylose solubility, however, was not found to be quantitatively related with the increase in peak gelatinization viscosity. This may be due to differential stabilities of amylose-emulsifier complexes at peak gelatinization temperatures, though a direct proof of the same has yet to be obtained. Addition of vegetable oils, triglycerides and sorbic acid did not change significantly the amylose solubility. Collison[10], has reported that surfactant absorbs on the surface of the granules and thereby decreases the swelling power and gelatinization viscosity However, in the present study, all the surfactants have been found to increase the gelatinization viscosity. It is also interesting to observe that triglycerides and vegetable oils which are most likely to be absorbed on starch granule surface in an aqueous environment due to hydrophobic intereaction did not result in increased visocsity. It is most likely that increase in gelatinization viscosity by incorporation of emulsifiers may result from complexing of amylose and resultant inter-granular adhesion. Such interactions would be expected from substances having both hydrophilic and hydrophobic moities in the molecules which are present in fatty acids, monoglycerides and emulsifiers but not in triglycerides. It is also interesting to observe that guar gum, locust bean gum, carrageenan and carobxy-methyl cellulose neither increased the peak gelatinization viscosity nor the amylose solubility.

TABLE 2. EFFECT OF ADDITIVES ON SOLUBLE AMYLOSE IN HEATED SLURRY OF *ATTA*

Additives	% decrease
Polyoxyethylene sorbitan mono oleate (0.5%)	20
Sorbitan mono stearate (0.5%)	26
Polyoxyethylene sorbitan mono stearate (0.5%)	24
Sorbitan mono laurate (0.5%)	27
Sodium stearoyl-2-lactylate (0.5%)	55
2-Amino-1-butanol (0.5%)	40
Stearic acid (0.5%)	45
Palmitic acid (0.5%)	41
Myristic acid	48
Oleic acid	61
2-Amino-butanol (0.5%) Sorbic acid (0.25%)	18
2-Amino-1-butanol (0.5%) Sorbic acid (0.5%)	20
Sorbic acid (0.5%)	negligible

Our sincere thanks are due to Dr. T.R. Sharma, Director of the Laboratory, for providing facilities and for valuable suggestions.

Defence Food Research Laboratory S. S. ARYA
Jyothinagar, Mysore, India. M. C. NARASIMHA MURTHY
Received 15 *June* 1982
Revised 3 *December* 1982.

References

1. Arya, S. S., Vidyasagar, K. and Parihar, D. B., Preservation of chapaties. *Lebensm. Wiss. Technol.*, 1977, **10**, 208.
2. Schoch, T. J. and French, D., Studies on bread staling. I. The role of starch. *Cereal Chem.*, 1947, **24**, 231.
3. Mitchell, W. A. and Zillman, E., The effect of fatty acids on starch and flour viscosity. *Trans. Amer. Ass. Cereal Chem.*, 1951, **9**, 64.
4. Medcalf, D. G., Young, V. L. and Gilles, K. A., Wheat starches: Effects of polar and non-polar lipids fraction on pasting characteristics. *Cereal Chem.*, 1968, **45**, 889.
5. Gray, V. M. and Schoch, T. J., Effect of surfactants and fatty adjuncts on the swelling and solubilization of granular starches. *Starke*, 1962, **14**, 239.
6. Tenney, R. J., Ward, M. W. and Vanvactor, R. N., The effects of sodium stearoyl-2-lactylate on paste viscosity of food starches. Paper No. 266, A.O.C.S.—A.A.C.C. Joint Meeting, 1968.
7. Chung, O. K. and Tsen, C. C., Changes in lipid binding and protein extractability during dough mixing in presence of surfactants. *Cereal Chem.*, 1975, **52**, 549.
8. Yasunaga, T., Bushuk, W. and Irvine, G. N., Gelatinization of starch during bread making. *Cereal Chem.*, 1968, **45**, 269.
9. Orthoefer, F.T., Effect of type of fat on starch pastes containing glycerol-monostearate. *Cereal Chem.*, 1976, **53**, 561.
10. Collison, R., in the Starch and Its Derivatives, by Radley, J. A., (Ed) Chapman and Hall, London, 1968, 174.

CHEMICAL AND MICROBIOLOGICAL EVALUATION OF STORED GUAVA PULP IN PVC CONTAINERS

Guava pulp prepared from Cvs 'Allahabad Safeda' and Lucknow 49' was stored in 5 kg white PVC containers with 500, 750 and 1000 p.p.m. of added SO_2 at room temperature (26-30°C). The pulp was analysed for TSS, titrable acidity, pH, ascorbic acid, free SO_2, tannins and reducing sugars at 15-day intervals upto 60 days of storage. Increase in reducing sugars and decrease in Vitamin C, tannins and free SO_2 level were recorded. The fungi detected included *Aspergillus niger.*, *Alternaria* sp., *Candida* sp., *Helminthosporium* sp., and *Saccharomyces* sp. The study indicated that for shorter periods, (upto 60 days) of storage, 500 p.p.m SO_2 is sufficient to check the deterioration. For longer periods of storage, 1000 p.p.m. SO_2 is required. Guava juice prepared out of the stored pulp was of good quality.

Guava (*Psidium guajava* L.) is grown in many parts of India. It is generally consumed fresh and very little is used for processing. Kalra and Revathi[1] studied the storage of guava pulp containing SO_2 in glass, PVC and porcelain containers. Results of investigations carried out to preserve guava pulp with lower doses (500-1000 p.p.m.) of SO_2 in PVC containers at ambient temperature, are presented in this paper.

Ripe guava fruits, Cvs, 'Allahabad Safeda' and 'Lucknow-49 ' grown at the Experimental farm of Central Mango Research Station, Lucknow, were used. White PVC containers of 5-kg capacity with fit-in lids alongwith screw caps, procured from the local market, were used for storage of pulp. The guava pulp was prepared as described by Kalra and Revathi[1]. The pulp was heated to 75°C, cooled to 45-50°C and then mixed with potassium metabisulphite (KMS) before filling in to the containers. SO_2 at 500, 750 and 1000 p.p.m. was used. These were stored at room temperature (26-30°C) for sixty days and after that the pulp was utilized for preparation of juice. The treatments were replicated thrice. Titrable acidity, ascorbic acid, reducing sugars and free SO_2 were determined at 15-day intervals by AOAC[2] procedure. Tannins, pH and TSS were estimated as described by Kalra *et al*[3]. The pulp was dried to a constant weight at 60°C for moisture determination. Microbial load was estimated by serial dilution method using yeast extract-potato-dextrose agar (pH 4.5) for yeasts[4] and potato-dextrose-agar (pH 5.5) for moulds[5,6].

During 60 days of storage, there was no change in moisture content, but a slight decrease in TSS and an increase in titrable acidity of pulp was observed (Tables 1 and 2). Although, there was no apparent change in acidity of the stored pulp, the pH decreased at 60 days of storage in both the varieties. There was a gradual decrease in tannin content of both the cultivars, and the loss was least in 1000 p.p.m. SO_2 treatment (Tables 1 and 2). In both the cultivars there was a sudden increase

IIHR contribution No. 1321.

TABLE 1. CHEMICAL CHANGES IN GUAVA PULP DURING STORAGE OF ALLAHABAD SAFEDA (ON PULP BASIS)

Treatments	Storage in days					
	Fresh	0	15	30	45	60
	Moisture (Percent)					
T_1	85.26	87.02	86.07	86.68	86.34	86.60
T_2		87.14	85.97	86.54	86.72	86.86
T_3		86.74	85.88	86.55	86.42	86.82
	TSS (°Brix)					
T_1	9.57	9.30	8.96	8.49	8.15	8.09
T_2		9.30	8.31	8.36	8.15	7.81
T_3		9.30	8.61	8.23	7.75	7.67
	Acidity (% as citric acid)					
T_1	0.45	0.44	0.48	0.49	—	—
T_2		0.49	0.48	0.50	—	—
T_3		0.46	0.48	0.50	—	—
	pH					
T_1	4.08	4.05	4.14	4.15	4.04	3.79
T_2		4.04	4.20	4.15	4.09	3.77
T_3		4.13	4.16	4.18	4.10	3.84
	Reducing sugars (%)					
T_1	0.87	1.14	4.14	5.15	5.73	5.12
T_2		1.37	4.17	4.69	5.36	5.08
T_3		0.96	4.24	4.71	5.51	5.06
	Tannins (mg. %)					
T_1	486.48	382.74	338.41	289.67	272.95	274.64
T_2		414.20	371.45	291.91	268.92	278.98
T_3		415.51	379.08	335.55	288.65	282.45
	Ascorbic acid (mg%)					
T_1	63.65	41.84	32.37	27.37	23.14	18.97
T_2		43.40	31.95	27.16	23.84	17.44
T_3		40.71	31.95	25.98	22.48	16.57
	Available SO_2 (p.p.m)					
T_1	—	490.9	213.2	306.7	175.7	134.5
T_2		733.9	345.8	351.0	299.3	175.7
T_3		816.9	403.8	455.1	340.7	227.2

TABLE 2. CHEMICAL CHANGES IN GUAVA PULP DURING STORAGE CV. LUCKNOW-49 (ON PULP BASIS)

Treatments	Storage in days					
	Fresh	0	15	30	45	60
			Moisture (%)			
T_1	86.73	87.02	87.09	87.14	86.78	86.42
T_2		87.00	87.03	87.29	86.77	86.38
T_3		86.97	87.01	87.11	86.70	86.21
			TSS (°Brix)			
T_1	9.60	9.32	8.77	7.57	9.43	8.39
T_2		9.32	8.77	7.97	8.63	8.52
T_3		9.32	8.64	7.97	8.76	8.25
			Acidity (as% citric acid)			
T_1	0.45	0.42	0.43	0.44	0.42	0.42
T_2		0.45	0.45	0.45	0.42	0.44
T_3		0.45	0.44	0.44	0.45	0.45
			pH			
T_1	3.92	3.98	4.07	4.03	4.04	3.70
T_2		3.98	4.08	4.04	4.01	3.71
T_3		3.99	4.05	4.04	4.04	3.76
			Reducing sugars (%)			
T_1	1.18	1.38	4.73	4.63	5.51	5.58
T_2		1.24	4.55	4.64	5.65	5.74
T_3		1.10	4.57	4.61	5.46	5.42
			Tannins (mg. %)			
T_1	565.65	496.36	469.60	508.63	456.37	430.13
T_2		547.74	470.33	504.58	452.67	446.54
T_3		507.85	481.60	536.39	490.51	463.17
			Ascorbic acid (mg%)			
T_1	175.88	110.23	93.10	95.17	69.12	64.74
T_2		112.87	91.30	96.45	68.43	64.19
T_3		107.44	91.04	91.87	67.15	67.58
			Available SO_2 (p.p.m)			
T_1	—	490.9	485.9	443.7	438.7	335.7
T_2		733.9	663.7	624.1	500.5	376.9
T_3		816.9	816.9	621.1	685.9	603.5

in reducing sugars which continued till the end of storage (Tables 1 and 2). A similar rise in reducing sugars was observed by Kalra and Revathi[1] and it was more pronounced at 15 days of storage. It may be hypothesized that breakdown of some hemicelluloses and other soluble saccharides may contribute to the higher reducing sugars although such a mechanism is not known. However, this increase in reducing sugar content was not reflected in the TSS contents. It may be partially attributed to glucose, fructose, etc. showing proportionately lower values on the refractometer scale[7]. The ascorbic acid and free SO_2 contents reduced during storage (Tables 1 and 2). Even the higher concentrations of free SO_2 did not retard ascorbic acid degradation. Kalra and Revathi[1] also reported a decrease in the contents of ascorbic acid and free SO_2 during storage. The stability of ascorbic acid is adversely affected by higher temperatures[8]. Besides, the containers may not be completely air-tight.

The Yeast and mould count in fresh guava pulp was similar in the two cultivars (Table 3); it was negligible after heating. During storage, SO_2 treatment was quite effective in suppressing microbial population, the yeast growth increased to 37×10^2 and mould growth to 11×10^2 after 60 days in 500 p.p.m. SO_2 treatment in. 'Allahabad Safeda'. However, after 60 days of storage the yeast and mould population were only 1/5th and $\frac{1}{2}$,

TABLE 3. INFLUENCE OF SO_2 TREATMENTS ON YEAST AND MOULD POPULATION OF GUAVA PULP

Storage (Days)	Allahabad Safeda			Lucknow-49		
	500	750	1000	500	750	1000
			Yeasts ($\times10^2$/g pulp)			
15	0.05	ND	ND	0.13	0.20	ND
30	0.35	0.28	0.25	0.28	0.35	0.55
45	4.25	2.75	5.25	10.00	3.25	0.80
60	37.00	18.20	6.90	36.50	18.75	4.75
			Moulds ($\times10^2$/g pulp)			
15	0.20	0.35	0.01	0.15	0.20	0.30
30	0.25	0.40	0.45	0.58	0.30	0.20
45	1.75	1.50	0.50	0.68	0.35	0.10
60	10.80	12.50	0.68	3.00	1.85	1.00

Yeasts and moulds were not detected on O day.

ND=Not detected.

The yeast and mould counts ($\times10^2$/g pulp) in fresh fruit pulp of 'Allahabad Safeda' was 177.67 and 19.33 and in 'Lucknow-49' was 178.20 and 6.00 respectively.

respectively, of the amount present in the fresh pulp. This shows that the SO_2 treatment at the lowest level, of 500, p.p.m. was effective in controlling the growth of microorganisms. The fungi detected in the pulp included *Aspergillus niger*, *Alternaria* sp. *Helminthosporium* sp., *Candida* sp., *Kloeckera* sp., and *Saccharomyces*. The last fungus was more predominant towards the end of the storage period.

From the results, it may be inferred that the guava pulp could be stored without much deterioration in quality with 500 p.p.m of SO_2 for approximately two months. The juice having 12°Brix, 0.3 per cent acidity and 15 per cent pulp was prepared which was quite acceptable when judged on Hedonic scale. The juice was stored well in bottles upto one year at ambient temperature. In conclusion, guava fruit has good potential for processing because of its strong flavour and keeping quality.

Authors are thankful to H. Onkarayya, for critically reviewing the manuscript and to Shri H. C. Lohani, for assistance in chemical analysis. The financial assistance provided by USDA grant no. FG-In-561 (In-ARS-49) for this work is gratefully acknowledged.

Central Mango Research Station, Lucknow-226 006, India. D. K. TANDON
S. K. KALRA
National Research Centre on Groundnut, Junagadh, India. J. K. KULKARNI
Indian Institute of Horticultural Research Bangalore, India. K. L. CHADHA

Received 11 *January* 1982
Revised 18 *October* 1982

References

1. Kalra, S. K. and Revathi, G., Storage of guava pulp. *Indian Fd Pckr.*, 1981, **35**, 29.
2. *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington, D. C., 12th Edn., 1975.
3. Kalra, S. K., Singh, H. and Chadha, K. L., Evaluation of some mango cultivars on the basis of their biochemical compositions. *Indian J. Hort.*, 1981, **38**, 70.
4. Lodder, J., *The yeasts-A taxonomic study*, North-Holland Publishing Co., Amsterdam, 2nd Edition, 1970.
5. Speck, M. L., *Compendium of methods for the microbial examination of foods*, American Public Health Association Washington, D. C., 2nd Ed. 1978.
6. Subramanian, C. V., *Hyphomycetes*, Indian Council of Agricultural Research, New Delhi, 1971.
7. Bhasin, U. and Bhatia, B. S., Recent advances in technology of pickles, chutneys and sauces. *Indian Fd Pckr.*, 1981, **35**, 39.
8. Rathore, D. S., A possibility of inverse relationship between the ascorbic acid content of guava fruits and ripening temperatures. *Indian J. Hort.*, 1979, **36**, 128.

SYNERGISTIC ACTION OF GIBBERELLIN AND ETHREL ON THE INDUCEMENT OF SPROUTING IN POTATOES

Sprout induction in potatoes before planting is essential to ensure uniform sprouting and growth of potato in the field. The present investigation was carried out to study the Ethrel—Gibberellic acid interaction on sprout inducement. Dip treatments were given to dormant potato tubers with mixtures of Ethrel and Gibberellic acid; the relative con centration of each was varied keeping their total concentration constant at 100 p.p.m. A combination of these two chemicals was more effective than either of them applied alone, in sprout induction. The optimum proportion of Gibberellin to Ethrel is 60 to 40.

Induction of sprouting in potatoes before planting is necessary to regulate the seed rate and ensure sufficient number of plants. To induce uniform sprouting, different workers have suggested treatment of potato tubers with several chemicals[1-3]. Ethrel at 10 p.p.m. is reported to be as effective as 100 p.p.m. (Gibberellic acid) in inducing sprouting in potatoes[4]. Several workers have reported the interaction of growth promoters in different plants like bean, fenugreek, barley and capsicum[5-10]. The present investigation was undertaken to study interaction between gibberellic acid and ethrel for inducing sprouting.

Potato tubers, about 4 weeks old from the time of harvest, were procured from the local market, washed in water and used in the experiment. Tubers free from any visible damage were selected and given dip treatments for 30 min in a mixed solution of gibberellic acid (GA_3) and Ethrel (2-ethylchlorosulphonic acid) (E_1 E_2, E_3, E_4, E_5 and E_6 in Table 1) by varying their relative concentrations keeping the total concentration at 100 p.p.m. The dip treatments of the 4 replicates was given successively in the 1 litre solution. Ethrel alone at 10 p.p.m was tried for comparison. Untreated tubers dipped in water served as control. Each treatment consisted of 4 replicates of 1 kg each. Tubers were surface dried and stored at ambient temperature and humidity (22 to 30°C; RH 50 to 80 per cent) in 0.2 per cent ventilated 200 gauge polyethylene bags. They were observed every week, for one month for (*a*) the number of sprouted tubers; (*b*) sprout number/tuber; (*c*) sprout length, and (*d*) sprout yield.

At the end of 4 weeks, sprouting was 100 per cent in treatments E_2, E_3, E_4 and E_5; 97.2 per cent in E_1 and 60 per cent in the control (Table 1) indicating earlier inducement by GA and E individually and also by their combination when compared with the control. The number of sprouts/tuber in combination treatments

TABLE 1. INTERACTION OF EXOGENOUS GIBBERELLIC ACID AND ETHREL ON SPROUTING, SPROUT GROWTH AND YIELD OF SPROUTS OF POTATOES DURING STORAGE AT AMBIENT CONDITIONS (22-30°C, RH 50-80%)

Treatment	Concns. (p.p.m) of		Sprout characteristics at the end of indicated weeks						Mean sprouts length/tuber (mm)*		Sprout wt./ 100 tubers(g)**	
			Sprouted tubers(%)*			Sprouts/tuber (no.)*						
	GA	E	2	3	4	2	3	4	2	3	4	4
E_1	100	0	82.56^b	85.0	97.2	2.9±2.2	3.2±1.2	4.4^b	3.8±1.1	5.2±0.7	4.7^a	8.12^b
E_2	75	25	92.5^c	100.0	100.0	4.0±0.9	5.4±0.6	6.4^c	4.0±1.4	6.0±1.4	6.0^b	15.8^c
E_3	50	50	90.2^c	95.0	100.0	4.8±1.9	5.8±0.8	5.9^d	4.7±1.4	5.4±2.5	7.5^c	13.3^{cd}
E_4	25	75	83.7^{bc}	90.8	100.0	3.9±1.2	4.2±1.7	5.5^d	3.2±1.4	4.5±0.3	4.5^d	8.2^{bd}
E_5	0	100	67.5^e	95.0	100.0	2.1±0.6	3.2±0.9	3.4^e	2.0±0.1	2.4±0.5	2.2^{be}	1.3^f
E_6	0	10	82.5^b	92.5	100.0	3.3±0.7	4.3±1.3	5.8^d	1.2±0.1	2.2±0.3	2.9^f	5.2^g
Control	0	0	30.0^a	40.0	60.0	0.7±0.6	1.0±0.3	1.6^a	1.1±0.8	1.8±0.4	1.7^g	0.1^a

Means with common superscript letter do not differ significantly ($P \leq 0.05$)

*no visible sprouting was observed at the end of first week

**At the end of 4 weeks of storage

(E_2, E_3 and E_4) was higher than either of them alone (E_1 and E_5). The combination treatments(E_2, E_3 and E_4) induced sprout length more vigoursly than E_1, E_5 and control. E_3 was found to induce sprout length to maximum extent than any other treatment.

The sprout yield for 100 tubers was comparatively more in combination treatments of GA and E (E_2, E_3 & E_4) than either of them alone and control. It was maximum in treatment E_2.

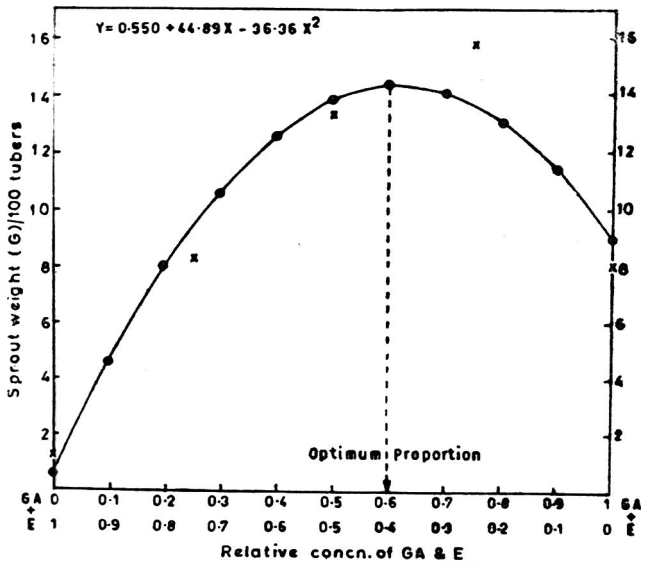


Fig. 1. Interaction of Gibberellin and Ethrel on the inducement of sprouting in potatoes. Weight of sprouts at the end of 4 weeks (×-experimental values). Curve based on calculated values employing the quadratic equation worked out, with optimal proportion at 60 : 40.

The optimal concentrations of GA and E required to produce the maximum yield of sprout weight was worked out statistically employing the quadratic equation and the calculated values were plotted against the experimental values. There is good correlation between the calculated and the experimental values. The relative proportion of GA to E for inducing maximum sprout growth was 60:40 (Fig. 1). The results obtained in the present investigation show clearly that there is synergistic interaction between GA and E on all the parameters observed with respect to sprouting.

The first author is grateful to Council of Scientific and Industrial Research, New Delhi for awarding fellowship.

Central Food Technological Research Institute, Mysore-570 013, Inda.

M. N. SHASHI REKHA
M. V. RAMA
P. NARASIMHAM

Received 29 *June* 1982
Revised 11 *November* 1982

References

1. Pushkarnath, *Potato in sub-tropics*, Orient Longman Ltd., 1976, 50.
2. Burton, W. B., *The Potato*, Chapman and Hall Ltd., London, 1948, 231.
3. Smith, O., *Potatoes production, storing aud processing*, The AVI Publishing Company Inc., West Port, Connecticut, II Ed., 1977, 57.
4. Rama, M. V. and Narasimham, P., A comparative study on the effect of giberellic acid, ethrel and ethylene chloride on potato sprouting. *J. Fd Sci. Technol.*, 1982, **19**, 144.
5. Hildbrand, J. and Dean B. B., Effect of ethrel on growth responses of Russet burbank and Kennebec potatoes. *Hortsci.*, 1969, **4**, 156.

6. Sarma, C. M., Interactions between Indole-3-acetic acid and Gibberellic acid on the expansion growth of leaf discs of bean. *Indian J. Pl. Physiol.*, 1979, **22**, 242.
7. Balasimha, D. and Tewari, M. V. Auxin-Cytokinin interaction on growth and auxin metabolism in fenugreek (*Trigonella foenum graecum* L.) *Indian J. Pl. Physiol.*, 1979, **22**, 3.
8. Rijven, A.H.G.C. and Prakash, V., Action of kinetin on cotyledons of fenugreek. *Pl. Physiol.*, 1971, **47**, 59.
9. Meleod, A. M. and Palmer, G. H., Interactions of indole-acetic acid and gibberellic acid in the synthesis of alpha-amylase by barley aleurone. *New Phytol.*, 1968, 72, 295.
10. Narasimham, P., Interactions effects of gibberellic and indole acetic acid and kinetin on the growth development of Capsicum Sp. seedlings, in relation to apical dominance. *Ans Phyisiol. Veg. Brux.*, 1972, **17**, 1.

EFFECT OF SCOURING AND CONDITIONING VARIABLES ON MILLING, RHEOLOGICAL AND BAKING PROPERTIES OF INDIAN WHEATS

The effect of varying moisture levels (14.5, 15.5 and 16.5 per cent), tempering times (24,48 and 72 hr), without and with scouring on milling, rheological and baking properties of 'WG 357' and 'WG 377' varieties of wheat, was investigated. Wheat conditioned to 16.5 per cent moisture produced flour with high damaged starch, finer granulation and higher water absorption as compared with the flours milled from wheat conditioned at 14.5 and 15.5 per cent moisture. Scouring prior to conditioning increased the yield of flour, but produced relatively coarser flour than the control samples. Moisture, scouring and duration of tempering had no effect on the extensibility characteristics of both the varieties, but farinograph water absorption was slightly decreased with scouring treatment.

There is an increasing use of indigenous wheats by the Indian flour milling and baking industries in different States[1]. Besides variety and environmental factors which affect the quality of flour, proper conditioning and milling[2] are of high importance for realizing full potential of any wheat. This investigation was, therefore, carried out using the commercially important wheats under cultivation.

Wheat varieties 'WG 357' and 'WG 377' were procured from the Punjab Agricultural University Experimental Farm. Fifty kg wheat from each variety was scoured to 0.5 per cent on commercial scourer (known as *roola*). Conditioning was done with moisture levels of 14.5, 15.5 and 16.5 per cent and the tempering periods were 24, 48 and 72 hr. Hundred grams of wheat was pearled on barley pearler for 45 sec and per cent overs were reported as pearling index. Five kg test samples were milled on the Buhler pneumatic laboratory mill (MLU-202); the flour yield was expressed on the basis of recovered products. The shorts were dusted through the Buhler Bran Finisher (MLU-302) to recover residual flour. The granulation of flour of each treatment was determined using sedimentometer[3]. Colour grade was determined using Kent-Jones and Martin colour grader, series III. Test weight, moisture, protein, ash, diastatic acivity and damaged starch contents were determined according to the AACC methods[4]. Brabender farinograph and extensograph were used to determine the difference in the rheological properties of dough using AACC procedures[4]. The 'Remix' procedure developed by Irvine and McMullan[5] was used for test baking.

From the results of test weight and composition in Table 1, it is seen that 'WG 357' had bolder grains than 'WG 377'. It contained 10.4 per cent protein compared to 9.2 per cent of 'WG 377'. The grains of 'WG 377', were harder as judged, based on pearling index. Scouring contributed to increased yields of flour of 'WG 357' (Table 2), but it was not very effective for 'WG 377'. 'WG 357' produced, on an average, 4.3 per cent first break flour when conditioned without scouring and 3.8 per cent when scoured. Similar results were reported by Finney *et al.*[6] using soft and hard varieties of wheat. Scouring did not show any effect on the yields of first reduction flour of 'WG 357'. However, in 'WG 377' the first reduction flour was increased by about 2 per cent. Scouring produced comparatively coarser flours than unscoured samples in both the varieties. In 'WG 357', variety,17-20 per cent of flour from different treatments, was coarser than 100 microns when milled without scouring as compared to 29.5-31.5 per cent flours obtained after scouring treatment. The flours below 50 microns was 13-15 per cent in unscoured wheats compared with 10-13 per cent obtained when scoured. 'WG 357' conditioned at 16.5 per cent moisture produced relatively finer flours. Yamazaki[7] also reported that higher moisture of tempering yielded finer flours than at lower moisture levels. It was interesting to note that in 'WG 377', 40 per cent of flour was above 100 microns in controls as compared to 46 per cent in scoured samples, however, there was little difference in the granulation of flour which was below 50 microns. For obtaining

TABLE 1. GRAIN CHARACTERISTICS OF 'WG 357' AND 'WG 377,' VARIETIES OF WHEAT

Variety	Moisture (%)	1000 kernel wt. (g)	Hectolitre wt. (kg)	Pearling index, overs (%)	Protein (N×5.7) (%)	Ash (%)
WG 357	10.1	47.5	78.0	56.5	10.4	1.51
WG 377	10.4	40.1	76.6	65.0	9.2	1.55

TABLE 2. EFFECT OF CONDITIONING VARIABLES ON PHYSICO-CHEMICAL PROPERTIES OF FLOURS OF 'WG 357' AND 'WG 377' VARIETIES OF WHEAT

Conditioning											
Moisture (%)	Duration (hr)	Flour yield (%)		Ash (%)		Diastatic acitivity*		Damaged starch (%)		Farinograph water absorption (%)	
		C	S	C	S	C	S	C	S	C	S
						WG 357					
14.5	24	72.1	76.5	0.53	0.57	308	302	9.7	10.4	62.0	56.9
14.5	48	73.8	77.9	0.52	0.52	305	313	9.9	10.3	63.0	59.0
14.5	72	73.6	76.4	0.52	0.56	317	325	10.6	10.7	63.3	59.8
15.5	24	74.4	76.3	0.52	0.52	323	284	9.6	10.4	62.0	59.9
15.5	48	74.1	77.1	0.50	0.60	307	337	10.2	10.8	62.2	59.0
15.5	72	73.4	75.9	0.51	0.56	313	336	10.5	11.1	62.8	60.6
16.5	24	73.8	76.9	0.48	0.55	316	323	10.2	10.8	62.8	60.3
16.5	48	73.4	77.5	0.48	0.56	298	276	10.3	11.1	62.2	59.7
16.5	72	72.5	76.5	0.47	0.60	297	327	9.9	10.8	63.0	61.5
						WG 377					
14.5	24	65.0	68.2	0.59	0.62	383	406	11.4	12.5	65.9	61.4
14.5	48	67.5	67.7	0.57	0.63	400	401	11.6	12.3	67.0	63.1
14.5	72	65.2	56.8	0.58	0.59	389	391	11.4	12.5	65.7	62.5
15.5	24	66.6	68.8	0.58	0.62	414	413	12.0	12.6	67.0	61.3
15.5	48	67.9	67.5	0.59	0.60	419	417	12.0	13.1	65.9	62.2
15.5	72	65.4	68.6	0.60	0.62	389	412	11.4	13.3	65.9	62.5
16.5	24	66.0	69.2	0.57	0.60	400	400	11.8	12.7	66.9	63.5
16.5	48	67.2	69.7	0.59	0.58	403	417	12.2	12.8	66.2	63.0
16.5	72	66.7	68.1	0.58	0.63	385	408	11.6	13.6	66.5	64.2

*mg maltose/10g. C=Control, S=Scoured

fine flour of this variety, conditioning to 15.5 per cent moisture was essential. Typical granulation curves of 'WG 357' and 'WG 377' along with Canadian baker's flour are illustrated in Fig. 1.

Scouring, conditioning moisture and rest times produced negligible effect on the protein content of flours.

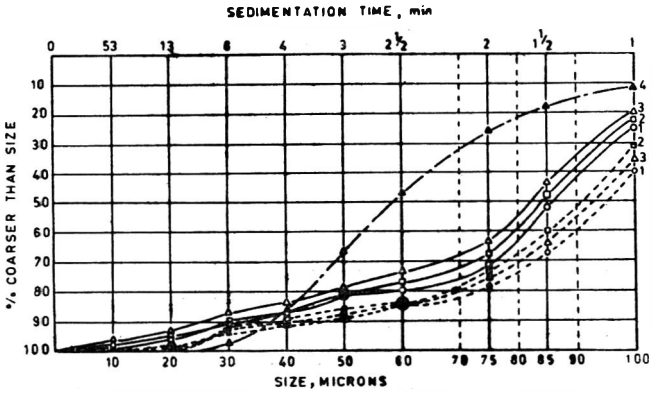


Fig. 1. Granulation of flours as influenced by conditioning variables

———WG 357, - - - - - WG 377, Curves 1, 2 and 3 are at 14.5, 15.5 and 16.5% moisture levels and curve 4 is of Typical Baker's Flour

There was a decrease of 0.9-1.4 per cent protein after milling of 'WG 357' as compared to 0.6-1.0 per cent in 'WG 377'. Siebel *et al*[8]., compared the protein content of wheat with that of short patent flour and reported a decrease of 0.9-1.5 per cent in the protein content of flours. Conditioning variables in general had no effect on the ash content of flours, though ash was more in flours of scoured wheats. Finney *et al.*[6] obtained lower ash content in flours of US wheats. However, the extraction rates of the flours were also lower than those obtained in the present investigation as a result of longer milling system including the bran finisher. The higher extraction rates of the flours as a result of scouring, seem to be the possible reason of high ash contents in those samples.

Conditioning at 15.5 per cent moisture produced flours with slightly higher diastatic values than that of 14.5 and 16.5 per cent conditioned wheats, probably due to the difference in damaged starch content. McCormic[9], Kozmin[10] and Sosedov *et al*[11]., reported lower diastatic values with increased tempering periods. Losev[12] and Anderson[13] reported a decrease in diastatic activity with increase in moisture content for a particular duration of conditioning. There were high posi-

tive correlations between diastatic acivity and damaged starch (0.96 for control and 0.92 for scoured) and between damaged starch and farinograph water absorptions(0.85 for control and 0.94 for scoured) of both the varieties. Similar correlations were also reported by Tara and Bains[14]. The amount of damaged starch present when compared with particle size distribution discussed earlier, revealed that inspite of high damaged starch in these wheats, the flour was relatively granular.

The absorption of 'WG 357' flours from unscoured wheat varied from 62.0-63.3 per cent as compared to 57.0-61.3 per cent when scoured. The corresponding values for 'WG 377' flours being 59.9-67.0 per cent and 61.3-64.2 per cent respectively. Tempering at higher moisture produced flours with higher absorption as compared to conditioning at lower moisture levels. Duration of tempering had practically no effect on the absorption. Scouring treatment had little affect on DDT. Likewise, there was no effect of conditioning variables on stability and mixing tolerance. Wichser and Shellenberger[15] studied the effect of tempering moisture and time on various flour properties and reported no difference in the farinograph curve characteristics. Moisture level and duration of tempering had no effect on the extensograph curve characteristics. but scouring treatment produced significant changes in the resistance to extension and extensibility of the doughs (Table 3). High ratio figures were obtained when the doughs were stretched immediately after shaping. Bains and Irvine[16] obtained high ratio figures for a number of NP wheats as well as 'C 591' grown at different places.

The baking absorptions were found to be much below the farinograph water absorption. Considerably reduced baking absorption as compared to farinograph water absorptions were also employed by Bains and Irvine[16] to ensure proper handling of the doughs of Indian wheats milled on the Allis Chalmers experimental mill. Scouring treatment had significant effect on the loaf volumes of breads, being higher in control samples than in scoured ones. Moisture of tempering and rest times had no effect on the loaf volume of breads.

TABLE 3. EFFECT OF CONDITIONING VARIABLES ON THE LOAF VOLUME AND EXTENSOGRAPH[1] CURVE CHARACTERISTICS (ANALYSIS OF VARIANCE)

	Loaf vol.	Curve area	Extensibility	Resistance to extension
Varieties	27.63**	0.07	1.34	2.13
Scouring	39.98**	1.69	7.24*	10.80**
Moisture	0.51	1.87	2.69	0.28
Tempering times	1.30	2.00	0.22	0.67

[1]After 135 min relaxation of the dough

*Significant at 5% level

**Significant at 1% level.

Department of Food Science and Technology, Punjab Agricultural University, Ludhiana-141 004, India.

H. P. S. NAGI
G. S. BAINS

Received 15 *June* 1981
Revised 14 *September* 1982

References

1. *Bakery Industry in India*, The Institute of Economics and Marketing Research, New Delhi, 1974.
2. Kent-Jones, D.W. and Amos, A. J., *Modern Cereal Chemistry*, Food Trade Press, London, 1967.
3. *Cereal Laboratory Methods*, Henry Simon Ltd., Stockport, England, 1976.
4. *Cereal Laboratory Methods*, American Association of Cereal Chemists, Inc., St. Paul, Minn., U.S.A., 1972.
5. Irvine, G. N. and McMullan, M. E., The 'remix' baking test. *Cereal Chem.*, 1960, **37**1 603.
6. Finney, P. L., Bains, G. S. Heseney, R. C. and Lineback, D. R., Quality of Indian Wheats. *Cereal Sci. Today*, 1973, **18**, 392.
7. Yamazaki, W. T., Flour granularity and cookie quality. I. Effect of Wheat variety on sieve fraction properties. *Cereal Chem.*, 1959, **36**, 42.
8. Siebel, W., Springer, F. and Zwingelberg, H., Vergeich duetschen und auslandischen Qualitatsweizenj unter besonderer Berucksich tigung der Eizeugergemeinschaften. *Muhle*, 1969, **14**, 106.
9. McCormic, R. E. *Effect of length of tempering period on the process of milling*. 1930, M.Sc. Thesis, Kansas State College, Manhattan.
10. Kozmin, N. P., Critical contribution to the biochemistry of the conditioning. *Muhle*, 1933, **70**, 159.
11. Sosedov, N. I., Shvetsov, V. A., Vaskar, A. B. and Drozdove, Z. B., Biochemical process in wheat conditioning. *Acad. Sci. Bull., U.S.S.R.*, 1939, **6**, 873.
12. Losev, N., Modification of grain during conditioning. J. *ges. getreide.*, 1936, **23**, 185.
13. Anderson, J. E., What water does to wheat in tempering. *Assoc. Oper. Millers Bull.*, 1937, 794.
14. Tara, K. A., Finney, P. L. and Bains, G.S., Damaged. starch and protein contents in relation to water absorption of flours of Indian wheats. *Starke*, 1972, **24**, 342.
15. Wichser, F. W. and Shellenberger, J. A., Relationship of physical factors to the granulation of flour. *Northwest Miller.*, 1949, 238.
16. Bains, G. S. and Irvine, G.N., Studies on the quality of some improved Indian wheats. *J. Sci. Fd Agric.*, 1956, **16**, 526

CARBOHYDRATE COMPOSITION OF MUSTARD (*BRASSICA JUNCEA*) SEED MEAL

The carbohydrates of brown mustard (*B. juncea*) were fractioned and estimated. Compared to rape seed and turnip rape, mustard seed contains significantly larger amounts of hemicelluloses, but lesser amount of pectic substances, hot water soluble polysaccharides and celluloses. The 80% aqueous ethanol soluble free sugars were separated and estimated by paper chromatography. Among free sugars, sucrose was considerably less where as raffinose, glucose and fructose were more in mustard.

Mustard seed meal is a rich potential source of good quality protein[1]. The meal contains more than 35 per cent carbohydrates. A proper knowledge of the carbohydrate composition is of much interest from the nutritional angle since attempts are being made to process the meal as edible protein concentrate[2]. Some information on the carbohydrates present in the meals of rapeseed (*Brassica napus*) and turnip rape (*Brassica campestris*) varieties is available.[3-8] Since no detailed information is available on the carbohybrates of mustard, the present investigation was undertaken.

Mustard seeds (var. 'Varuna RT 59') were obtained from U.P. Institute of Agricultural Sciences, Kanpur. They were dehulled by splitting in a plate mill and separating the hulls by air classification. The meals were defatted by extraction with hexane in a soxhlet extractor. The defatted kernels were ground in a laboratory blender and passed through 60 mesh sieve (B.S.).

The meal (20 g) was extracted with 150 ml of 80 per cent aqueous ethanol (v/v) for 6 hr. Two more extractions were carried out to complete the extraction of free sugars. The combined extracts were deionized using Dowex 50 (H^+) and concentrated to 50 ml in a rotary evaporator. The free sugars were spotted on Whatman No. 1 filter paper and separated by descending paper chromatographic technique using n-butanol-acetic acid-water (4:1:5 v/v) and the separated spots were sprayed with ammonical silver nitrate solution to detect the sugars.[9] Quantitative separation and estimation of sugars was done by preparative paper chromatography[10], using standard sugars.

The ethanol insoluble material was extracted with 100 ml hot water for 4 hr. The extraction was repeated twice to completely extract the hot water soluble polysaccharides. The combined extracts were concentrated to 100 ml and the carbohydrates were precipitated by the addition of 4 volumes of ethanol and the precipitate separated by centrifugation at 400 r.p.m. The hot water insoluble residue was further extracted with 150 ml of 0.5 per cent (w/v) ammonium oxalate for 4 hr. After two more extractions, the combined extracts were concentrated to 100 ml and the pectic substances were precipitated by the addtion of 2 volumes of ethanol and separated by centrifuging at 4000 r.p.m. The oxalate insoluble residue was extracted with 10 per cent (w/v) sodium hydroxide in a nitrogen atmosphere[11]. The extraction was repeated twice and the combined extracts were acidified with 50 per cent acetic acid when hemicellulose A fraction precipitated out and it was separated by centrifugation. Three volumes of ethanol was added to the supernatant to precipitate hemicellulose B which was separated by centrifuging at 4000 r.p.m. The supernatant was concentrated and lyophilized to obtain hemicellulose C.

A portion of alkali-insoluble residue was digested with 72 per cent (v/v) sulphuric acid for one hr at ice cold temperature and diluted with distlled water to obtain a 2N solution and was hydrolysed for 5 hr on a boilding water bath. It was then filtered and the filtrate was neutralized with $BaCO_3$ and the cellulose thus degraded was estimated as glucose. The undigested residue was dried and weighed as lignin. The several fractions were quantitatively estimated by using phenol-sulphuric acid reagent by measuring the yellow-orange colour at 490 nm[12]. The nitrogen content was determined by microkjeldahl method[13].

The quantities of different carbohydrate fractions present in mustard and turnip rape meals are given in Table 1. Considerable differences are observed in respect of pectic substances and hemicelluloses. In

TABLE 1. CARBOHYDRATE CONSTITUENTS OF MEALS FROM MUSTARD AND TURNIP RAPE

Solvents	Carbohydrates	Carbohydrate content (% on dry basis)	
		Mustard	Turnip rape
80% aqueous ethanol	Free sugars (deionized)	12.60	10.0
Hot water	Soluble polysaccharides	2.20	4.5
Hot ammonium oxalate	Pectic substances	6.50	14.5
Sodium hydroxide	Hemicelluloses	8.07	—
(10%)		4.55	3.0
		trace	—
72% H_2SO_4	Celluloses	2.80	7.0
Insoluble residue	Lignin	trace	—
	(Total	36.72	39.0

TABLE 2. 80% ETHANOL SOLUBLE MONO AND OLIGOSACCHARIDES

Sugars	Sugar content (% on dry basis)		
	Mustard *B. juncea**	Rapeseed *B. napus*	Turnip rape *B. campestris*
Stachyose	2.11	1.43–3.04	2.39–2.43
Raffinose	1.23	0.29–0.33	0.31–0.34
Melibiose	0.68	—	—
Sucrose	1.68	6.51–8.26	6.77–7.49
Galactose	1.80	—	—
Glucose	0.96	0.10–0.24	0.32–0.40
Fructose	2.11	0.10–0.27	0.24–0.51
Unidentified	2.01	—	—

*Estimations were carried out in duplicate

turnip rape, the pectic substances form the major fraction, (14.5 per cent), while in mustard meal, it is only 6.5 per cent. In contrast, mustard meal has 14.6 per cent hemicelluloses compared to 3 per cent in turnip rape.

Table 2 gives data on the contents of mono-and oligosaccharides in mustard, turnip rape and rapeseed. One major difference is, with regard to sucrose which is present to the extent of 1.68 per cent in mustard, wheareas rapeseed and turnip rape have more than 4 times this quantity. Further, mustard seed meal contains more of reducing sugars compared to the other two Brassica species. These differences in the nature and quantities of the carbohydrate constituents are likely to affect the functional properties of the protein concentrates from these different species.

Protein Technology Discipline,
Central Food Technological
Research Institute,
Mysore-570 013, India.

T. C. SINDHU KANYA
M. KANTHARAJ URS

Received 6 *May* 1982
Revised 9 *December* 1982

References

1. Kantharaj Urs, M. and Kowsalya, Studies on preparation of edible grade meal from mustard seeds. PAG Compendium Y3.4/2-C-1293 Vol. C-2, 1969.
2. Ohlson, R., Rapeseed protein concentrate for human consumption. PAG Bulletin, 73, No. 3, 1973.
3. Theander, O. and Aman, P., Low molecular carbohydrates in rapeseed and turnip rapeseed meal. *Swedish J. Agric.*, 1976, **5**, 81.
4. Theander, O. and Aman, P., Fractionation and characterization of polysaccharides in rapeseed meal. *Swedish J. Agric.*, 1977, **7**, 69.
5. Theander, O. and Aman, P., Fractionation and characterisation of alkali-soluble polysaccharides in rapeseed meal. *Swedish J. Agric.*, 1978, **8**, 3.
6. Siddiqui, I. R., Wood, P. J. and Khanzoda, G., Low molecular weight carbohydrate from rapeseed. *J. Sci. Fd Agric.*, 1973, **24**, 1427.
7. Siddiqui, I. R. and Wood, P. J., Carbohydrates of rapeseed: a review, *J. Sci. Fd Agric.*, 1977, **28**, 530.
8. Siddiqui, I. R. and Wood, P. J., Structural investigation of sodium hydroxide soluble repeseed polysaccharides. V. Fucoamyloids. *Carbohy. Res.*, 1977, **53**, 85.
9. Patridge, S. M., Filter paper partition chromatography of sugars. *Biochem. J.*, 1948, **42**, 238.
10. Whistler, R. L. and BeMiller, J. N., *Methods in Carbohydrate Chemistry*, Whistler, R. L., (Ed.) Academic Press, New York, 1962, 395.
11. Whistler, R. L. and Feather, M. S., Hemicellulose extraction from annual plants with alkaline solution. *Methods in Carbohydrate Chemistry*. 5. Whistler R. L., (Ed.) 1965, 144.
12. Dubois, M., Gillies, K. P., Hamilton, J. K., Rebers, P. A. and Smith, F., Colourimetric method for determination of sugars and related sugars. *Anal. Chem.*, 1956, **28**, 350.
13. *Official Methods of Analysis*, Association of Official Analytical Chemists, 13th Ed., Washington, D. C. 1980.

GELATINIZATION OF WEANING FOOD INGREDIENTS BY DIFFERENT PROCESSING CONDITIONS

Weaning food ingredients were roller dried and viscosity of the reconstituted materials measured as the index of degree of gelatinization. Roasted ingredients gelatinized to a lesser extent, compared to unroasted materials. There was considerable gelatinization when the composite blend of ingredients was directly dried on the roller drier. However, pretreatments (different types of cooking of the blend) prior to roller drying considerably reduced the degree of gelatinization.

The importance of special protein foods for the weaned child has now been well recognised[1]. In India and many other countries, several types of weaning foods are being manufactured[2]. The raw materials required for the preparation of weaning foods are cerals, pulses and edible grade oilseed cakes. The aim has been to mutually supplement the vegetable proteins so as to obtain a balanced amino acid pattern.

In weaning foods, gelatinization of starch is an important functional characteristic for the formation of a smooth porridge. In this investigation, the effect of processing on the degree of gelatinization of weaning food ingredients, and also the composite blend has been studied having the visocisty of the reconstituted roller dried material as the index of degree of gelatinization.

Good quality Bengal gram dhal, green gram dhal and wheat were obtained from the local market. Edible

groundnut cake was obtained from M/s Rangavilas Ginning and oil Mills Co., Coimbatore. Some quantity of the raw materials was also roasted (120°C for 20 min) in an electrical roaster to get the desired aroma. The roasted and unroasted raw materials were powdered in a flour mill and sieved through 40 mesh sieve for use.

The individual ingredients (roasted and unroasted) were mixed with water in the ratio of 1:5 and the slurry was roller dried (Buffalovac atmospheric double drum drier, 6″ diameter and 8″ long, revolving at 8 r.p.m at 3 kg/cm^2 steam pressure).

A weaning food formulation consisting of 25 parts of wheat flour, 15 parts of Bengalgram flour and 35 parts of defatted groundnut flour, with added vitmains and minerals was standardized by Chandrasekhara *et al.*[3] The weaning food was prepared by precooking and subsequent roller drying. The protein efficiency ratio of the food was 2.3 and it had a similar amino acid composition as that of FAO reference pattern. Hence, the blend of the above composition was selected for the study. The raw blend was mixed in water (1:5) and the dispersion obtained roller-dried. The raw blend was also subjected to one of the following treatments prior to roller drying. (*i*) cooking in a kettle for 10 min; (*ii*) steaming at atmospheric pressure for 10 min.; (*iii*) autoclaving at 1 kg/cm^2 pressure for 5 min. and (*iv*) steam sparging for 10 min.

The roller dried samples were reconstituted in 5 times water at 60°C, cooled to room temperature (27°C) and the viscosity of the gruels was measured by using a Brookfield synchroelectric viscometer. The viscosity of the dispersions comprising of the raw ingredients was also determined. Owing to the non-Newtonian behaviour of the reconstituted products (gelatinized dispersions), the viscosity data are reported as "Apparent viscosity" for the spindle and speed designation.

Direct roller drying of the dispersions of ingredients resulted in the gelatinization of starch (Table 1). This was true for all the ingredients except groundnut flour which had high protein content. When materials containing starch are cooked above a critical temperature, the intermolecular hydrogen bonds are ruptured and the hydroxyl groups are exposed to the solvent (aqueous) medium[4]. Water can combine with the hydroxyl groups and thus the material swells. This phenomenon is called the gelatinization of starch. However, the materials such as wheat flour, Bengal gram flour and groundnut flour contain proteins in addition to starch and other carbohydrates. On heating, proteins can interact with the carbohydrate constituent of the flour and they may also denature. These complex reactions may have an effect on the swelling characteristics of the material.

TABLE 1. EFFECT OF PROCESSING ON THE VISCOSITY OF GELATINIZED INGREDIENTS

Ingredients	Protein content (%)	Apparent viscosity (Centipoise)		
		Dispersion without roller drying	Roller dried, unroasted, reconstituted as gruel	Roller dried, roasted, reconstituted as gruel
Wheat flour	10.5	62(1)	1190(4)	85(3)
Green gram flour	22.0	16(1)	280(4)	60(3)
Bengal gram flour	22.5	31(1)	118(2)	83(2)
Groundnut flour	50.0	140(3)	28(1)	30(2)

Figures in parenthesis indicate the spindle used for measurement of viscosity at rotational speed of 30 r.p.m.

The viscosity of the reconstituted gruel of roller dried wheat flour was higher than that of the other ingredients (Table 1). This is due to the higher starch content of wheat flour. The gruel viscosity of the direct roller dried materials when compared to the viscosity of the raw dispersion was quite high to indicate that direct roller drying caused considerable gelatinization of the starches of cereal and pulse flours.

Roasting of the ingredients has resulted in the reduction of the gruel viscosity of the roller dried product considerably and consequently the extent of gelatinization. The effect was more marked with wheat flour due to the high starch content. In the case of groundnut flour, there was no change. This may be due to the lower starch content of groundnut flour. The finding that roasting caused decrease in gelatinization is rather interesting. Any heat treatment may be expected to increase the extent of cooking. However, dry cooking, as in roasting, may lead to complex reactions between the various constituents and thus affect gelatinization. The high protein content appeared to provide protection against this effect, as has been observed in the case of groundnut flour.

The highest viscosity (consequently maximum gelatinization) was obtained with the weaning food blend, which had been prepared by direct rollers drying, without any pretreatment (Table 2).

Pretreatments considerably reduced the viscosity. The reduction in gruel viscosity may be due to lower swelling capacity of starch granules resulting during precooking and roller drying compared to direct roller drying. Possibly, during the pretreatments starch granules present in the weaning food blend get highly associated due to some interaction among the ingredi-

TABLE 2. EFFECT OE PROCESSING ON THE VISCOSITY OF GELATINIZED BLEND OF WEANING FOOD

Pretreatment of blend slurry prior to roller drying	Apparent viscosity (Centipoise)
Blend dispersion (without pretreatment and roller drying)	12(1)
Direct roller drying	730(2)
Cooking for 10 min.	130(2)
Steaming at atmospheric pressure for 10 min	88(2)
Autoclaving at 1 kg/cm^2 pressure for 5 min.	92(2)
Steam sparging for 10 min.	165(2)

Figures in parenthesis indicate the spindle used for measurement of viscosity at rotational speed 30 r.p.m.

ents and they are unable to swell to the same extent as the starches in the unassociated form. A similar finding on the reduction in the viscosity of the starches due to prolonged steaming has been reported by other workers[5,6].

It is concluded from the above studies, that the weaning food prepared by direct roller drying possessed the required characteristics namely, smooth porridge formation, with the desired gruel visocisty on reconstitution in hot water.

Discipline of Protein Technology,
Central Food Technological Research
Institute, Mysore-570 013, India.

H. N. CHANDRASEKHARA
G. RAMANATHAM

Received 3 *July* 1981
Revised 26 *November* 1982

References

1. Max Milner, PAG recommendation for the promotion of processed protein foods for vulnerable groups, *PAG Bull.*, 1972, **2**, 10.
2. Swaminathan, M., Supplementary foods based on oilseeds for infants and children. *Biochem. Rev.*, 1974, **XLV**, 3.
3. Chandrasekhara, M. R., Madhava Krishniah, M., Chandra sekhara, H. N. and Shurpalekar, S. R., Preparative trials on roller dried weaning foods. *J. Fd Sci. Technol.*, 1967, **4**, 116.
4. Radley, J. A., *Starch and Its Derivatives*, Chapman and Hill, 4th Ed. London, 1968.
5. Peplinski, A. J. and Pfeifer, V. F., Gelatinization of corn and sorghum grits by steam cooking. *Cereal Sci. Today.*, 1970, **15**, 144.
6. Sair, L., Heat moisture treatment of starch. *Cereal Chem.*, 1967, **44**, 8.

SEDIMENTATION AND EXTENSOGRAPH CHARACTERISTICS OF SOME WHEATS IN RELATION TO GLUTEN COMPOSITION

Micro-sedimentation values and extensograph characteristics of the flours and doughs of eleven wheat varieties were studied. The results have shown that the quantities of gliadin (GD) and glutenin (GTN) correlate negatively, and the quantity of residue protein (RP) and the ratio of the quantities of residue protein to gliadin plus glutenin (RP/GD+GTN) correlate positively with micro-sedimentation and extensograph characteristics of flours and doughs. Best correlation was shown with the quantity of residue protein.

In an earlier paper[1], we had reported that of the wheat flour proteins, only gliadin, glutenin and residue protein, correlate with farinograph dough development time (DDT) and dough stability (DS). The quantities of gliadin (GD), glutenin (GTN) and residue protein (RP) were found to correlate individually as well as in combination in the form of the ratio residue protein over gliadin plus glutenin. In addition to farinograph, sedimentation values of wheat flours and extensograph charactetistics of their doughs are also used for judging wheat flour quality[2]. This note reports the relationship between gluten composition and the micro-sedimentation values (MSV) and extensograph areas (EA) of the flours and doughs of wheat varieties 'Sonalika', 'UP 283', 'HD 2189', 'UP-K1', 'C 306', 'HD 1949', 'Kalyansona', 'HD 4530', 'Hy 65', 'K 65' and 'K 68'.

The sources of wheat varieties and the procedures for the preparation of wheat flour have been reported earlier[1]. Approved methods of the AACC[3] were used for determining micro-sedimentation value, and extensograph (Brabender Model EXE K/6) characteristics.

Table 1 gives the values for correlation coefficients (r) calculated from the quantities of GD, GTN and RP and the values of the ratio RP/GD+GTN in the above wheat varieties and the microsedimentation values of their flour and the extensograph areas of their doughs.

It is seen from Table I, that the quantities of GD and GTN correlate negatively and the quantity of RP and ratio RP over GD plus GTN values correlate positively with MSV and EA. These results are similar to farinograph results. At 'r' values of +0.822 and +0.917 with respect to MSV and EA respectively, and +0.773 and +0.868 with respect to specific MSV and specific EA the correlation is best for residue protein. In the case of farinograph, however, DDT (r=+0.944) and DS (r=+0.971) had shown best correlation with respect to the ratio[1]. The residue protein had shown second best correlation (DDT, r=+0.884, DS, r=+0.932).

TABLE 1. CORRELATION COEFFICIENTS (r)

	Micro-sedimentation value	Specific microsedimentation value	Area	Specific Area
Gliadin (GD)	−0.762**	−0.776**	−0.847**	−0.832**
Glutenin (GTN)	−0.675*	−0.725*	−0.869**	−0.848**
Residue protein (RP)	+0.822**	+0.773**	+0.917**	+0.868**
RP/GD + GTN	+0.766**	+0.762*	+0.883**	+0.841**

*Significant at 5% level
**Significant at 1% level

On the basis of the above results, it is suggested, that the relationship between gluten composition and MSV and EA is qualitatively similar to the relationship between gluten composition and farinograph DDT and DS. However, quantitatively there are some differences as the degrees of correlations are higher for farinograph characteristics. Also, in the case of MSV and EA best correlation is with RP, whereas in the case of farinograph characteristics, the best correlation is with the ratio of RP over GD plus GTN.

We wish to thank Council of Scientific and Industrial Research for the grant of Senior Research Fellowship to B. P. Ram.

Central Food Technological Research Institute, Mysore-570 013, India.

B. P. RAM
S. N. NIGAM

Received 23 *April* 1982
Revised 17 *November* 1982

References

1. Ram, B. P. and Nigam, S. N., The quality of wheat flour: intervarietal quantitative differences between gluten components. *J. Fd Sci. Technol.*, 1979, **16**, 189.
2. Pomeranz, Y., *Wheat Chemistry and Technology*, A.A.C.C. St. Paul Minn., 1971, 32, 203.
3. *Approved Methods of Analysis*, American Association of Cereal Chemists, St. Paul, Minn., 7th ed. 1969.

INCORPORATION OF TEXTURIZED SOY PROTEINS IN FRESH PORK SAUSAGES

Texturized soy products (TSP) were added to fresh pork sausages at 3, 5, 10 and 15% levels. Addition of TSP improved the protein content and lowered the fat content. Taste panel studies indicated a high acceptability of fresh pork sausages at 5 and 10% levels and even at 15% addition, fair to good acceptability was observed.

Soy proteins are added to meat products because of the low cost of production, functional and nutritional characteristics[1]. Several comminuted meat products are manufactured in developed countries incorporating various soy products with large economical and technological benefits[2]. Soy bean cultivation and processing are being carried out on a commercial scale in India. Texturized soy products (TSP) are produced in India. Addition of TSP to meat products will improve the prospects of meat industry in India by extending the supply of meat at reasonable prices. The present study was aimed to find out the suitability of adding TSP at different levels to fresh pork sausages and to arrive at the optimum level for acceptacne.

The lean and backfat were collected and kept overnight at 5°C before use. Fresh pork sausages were prepared using the basic recipe (Table 1). Texturized soy proteins (a commercial brand) was hydrated in water (1:2 soy product:water) for 30 min and minced through 3/16" plate and added at levels of 3, 5, 10 and 15 per cent of TSP on dry weight basis to the basic recipe replacing maida (refined wheat flour). No extra fat was added to compensate for dilution by the TSP. Sausages were made in goat casings of 16-18 mm diameter and were stored at 5°C for 2-3 days before subjecting to chemical composition[3] and sensory evaluation. For sensory evaluation, sausages were cooked in water at 80°C to get an internal temperature of 68-70°C. The cooked sausages were slightly fried in oil before serving to a semi-trained panel of 8-10 members. The panelists were asked to evaluate for general appearance, texture, flavour, juiciness and overall acceptability on a 7-point hedonic scale.

Chemical composition: The average proximate composition of fresh pork sausages with 15 per cent TSP was: moisture 59.11, protein 15.80, fat 18.45 and ash 3.60 per cent. The control with 3 per cent wheat flour had moisture 53.80, protein 13.41, fat 25.18 and ash, 3.08 per cent Addition of soy proteins improved the protein content of all sausage recipes and also the protein quality due to the complimentary nature of soy proteins and meat proteins. The fat content of the sausages decreased with increasing levels of TSP. Results of

TABLE 1. BASIC RECIPE FOR FRESH PORK SAUSAGES

Ingredient	Parts
Minced lean	70
Minced backfat	30
Salt	2.5
Refined wheat flour (Maida)	3.0
Seasonings	1.5
Added water	5.0

TABLE 2. AVERAGE TASTE PANEL SCORES OF PORK SAUSAGES WITH DIFFERENT LEVELS OF TEXTURIZED SOY PROTEIN;

TSP in sausage (%)	Appearance	Flavour	Texture	Juiciness	Overall acceptability
3 Maida*	5.33	4.77	4.77	5.00	4.85
3	5.25	5.38	5.38	5.15	5.31
5	5.25	5.46	5.54	4.92	5.15
10	5.33	5.13	5.69	5.54	5.46
15	4.92	4.85	5.54	5.08	5.23

Results are expressed on 7-point Hedonic scale with 7, Excellent/like very much to 1, Extremely poor/dislike very much
*Control; maida was added in place of TSP.

several investigations with experimental animals or human subjects have indicated that TSP substituted meat products had high biological value and the protein efficiency ratios compared favourably with all meat products[4,5].

Sensory evaluation: Average taste panel scores of the fresh pork sausages with different levels of TSP added are given in Table 2. The results showed that upto 10 per cent addition, appearance was not affected. However, at 15 per cent level of addition, appearance was affected but they were still in the acceptable range. All TSP added sausage recipes were comparable to control (3 per cent maida) with respect to texture, flavour, juiciness and overall acceptability.

From this study, it is concluded that TSP could be added upto 15 per cent level on dry weight basis to fresh pork sausages with good acceptability. Addition of TSP improves the protein content and lowers the fat content. Since, it is cheaper than meat, addition of TSP helps in getting meat products of low cost.

Division of Livestock Products Technology,
Indian Veterinary Research Institute,
Izatnagar-243 122, India.
G. S. PADDA
N. KONDAIAH
Received 8 *March* 1982
Revised 26 *November* 1982

References

1. Waggle, B. H. and Kolar, C. W. in *Types of soya protein products in soy protein and human nutrition.* Eds. Harold, L. W., Daniel, T. H. and Doyle, H. W., Academic Press, London, 1979.
2. Brincker, A., Review of European legislation on vegetable proteins in meat products. *J. Am. Oil Chem. Soc.*, 1979, **56**, 211.
3. *Official Methods of Analysis. Association of Official Analytical Chemists*, Washington, D. C., 12th Ed, 1975.
4. Hamedy, M., Nutritional aspects of texturized soy proteins. *J. Am. Oil Chem., Soc.*, 1974, **51**, 85A.
5. Wilding, M., Textured proteins in meats and meat like products. *J. Am. Oil. Chem., Soci.*, 1974, **51**, 128A.

GAS CHROMATOGRAPHIC DETERMINATION OF MENTHOL IN MENTHOLATED SWEETS AND *PANMASALA*

Menthol, along with the other flavouring matter was steam distilled into chloroform and the distillate was extracted with chloroform. The dry chloroform extract was directly subjected to gas chromatography. The menthol content was calculated from the area under the curve using a standard. A good recovery of about 100% was obtained. Some commercial mentholated sweets and *panmasala* samples analysed had menthol content in the range of 0.20-0.26 and 0.12-0.62 per cent respectively.

Spectrophotometric[1-4] and gas chromatographic methods[1,5-6] reported earlier involve extraction of non-volatiles which interfere in the determination of menthol. A gas chromatographic method is described for the determination of menthol in flavoured sweets and *Panmasala* (a mixture of betelnut, sugar and flavouring agents etc., used for chewing) using steam distillate of the sample.

To a known quantity of the sample (10 g) in a distillation flask, 200 ml of distilled water was added and fitted with a condenser. The other end of the condenser was dipped into chloroform (15-20 ml) taken in a conical flask. The contents of the flask were slowly distilled under a low flame and about 50 ml of the distillate was collected in about 8-10 min. The distillate was transferred to a 100 ml separating funnel. The chloroform layer was separated, concentrated under nitrogen and made up to a known volume (10 ml). It was dried over anhydrous sodium sulphate and 0.5 to 1.0 μl of this extract was used for gas chromatographic separation.

The gas chromatographic analysis was carried out using CIC model dual column gas chromatograph fitted with FID, stainless steel column (6 ft $\times$1/8 O.D) packed with 10 per cent Carbowax-20 M on chromosorb-W (80-100 mesh); column temperature, 185°C detector and injector temperature, 240°C; nitrogen and hydrogen at 25 and 20 ml/min respectively. Identification of the peak was made using standard menthol (RRL, Jammu). Retention time was found to be 3.0 min. Quantitation was made by comparing the peak area obtained for the sample with that of the standard (8 μg menthol=1.0 cm^2 peak). The recovery experiments were carried out by adding known amount of menthol to powdered sugar and arecanut powder in the range of 5-50 mg/10 g of the sample.

A good recovery ranging from 98.5 to 101.7 per cent was obtained. Menthol content determined in commercial samples of sweets and *panmasala* by this method ranged from 0.20 to 0.26 and 0.12 to 0.62 per cent respectively. This method can also be extended to other samples containing this flavouring matter.

The authors express their thanks to the Director, CFTRI, Mysore for the encouragement during the investigation.

Central Food Technological Research Institute, Mysore-570 013, India.

M. VEERABHADRA RAO
M. N. KRISHNAMURTHY
K. V. NAGARAJA
O. P. KAPUR

Received 30 *July* 1982
Revised 17 *December* 1982

References

1. *Official Methods of Analysis*, Association of Official Analytical Chemists, 12th Ed., 1975, 55.
2. Limli, J.A.J.M., Determination of menthol, menthone and menthofuran in peppermint oil. *Ann. Pharm.*, 1954, **12**, 275.
3. Malla, S., Nigam, M. C. and Handa, K. L., Spectrophotometric determination of menthone and menthol in essential oils. *Riechstoffe Aromen.*, 1962, **12**, 221.
4. Beer, J. and Poniatowaska, H., Colourimetric determination of menthol in peppermint oil. *Biul. Inst. Roslin. Leoznicych.*, 1963, **9**, 85.
5. Bajat, K. J., Determination of camphor and menthol in pharmaceutical products by gas chromatography., *J. Pharm. Soc.*, 1963, **52**, 1006.
6. Tucker, C. L. and Ogg, C. L., Determination of menthol in cigarette-tobbaco filler. J. Ass. off. anal. chem., 1967, **50**, 770.

INHIBITION OF GROWTH AND AFLATOXIN B_1 PRODUCTION OF *ASPERGILLUS PARASITICUS* BY SPICE OILS

The effect of oils of eucalyptus, ginger, thymol, cinnamon, anise, rosemary, orange bitter and nutmeg on the growth and aflatoxin B_1 production by *Aspergillus parasiticus* ATCC 15517 in yeast-extract-sucrose medium was studied. All the oils tested decreased the growth and toxin production at all the concentrations tested (100, 200 and 300 p.p.m). Anise and cinnamon oils had most pronounced effect and completely inhibited the growth as well as toxin production at 200 and 300 p.p.m concentration. In other oils, at least 40% decrease in aflatoxin B_1 production was observed. The reduction in toxin level could be related to inhibition of growth of this fungi.

Aflatoxin B_1, a potent carcinogen is produced by *Aspergillus spp* which can grow easily on carbohydrate rich sources. In India, first report on the isolation of aflatoxin from fungal contaminated peanuts appeared in 1965[1]. Though the antifungal effects of spices are known, yet very few reports are available on the effect of spices or spice-extracts on the aflatoxin production.

The effect of nine different filter-sterilized spice oils (Kalsac, Michigan, USA) on growth and aflatoxin B_1 production by *Asp. parasiticus* ATCC 15517 was studied in yeast-extract-sucrose medium[2] (28 ± 1°C, 50 r.p.m). Flasks without oils served as controls. Daily one millilitre sample was withdrawn from each flask for fourteen days and toxin estimated.[3]

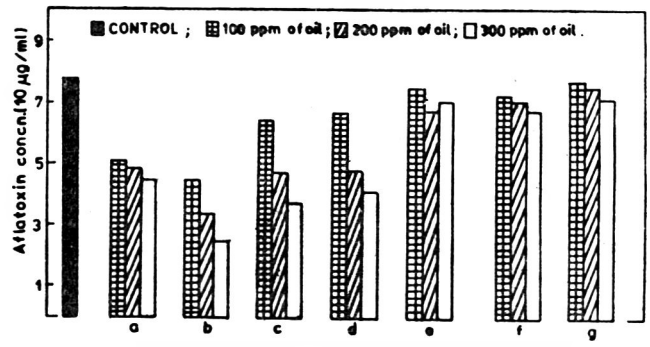


Fig. 1. Effect of spice oils on the production of aflatoxin B_1 by *Aspergillus parasiticus* ATCC 15517 grown in yeast-extract-sucrose medium at 28 ± 1°C. (*a*) cinnamon (*b*) thymol, (*c*) ginger (*d*) orange bitter, (*e*) rosemary (*f*) nutmeg (*g*) sandalwood (*h*) eucylyptus.

All the oils tested decreased the toxin production, though the extent of inhibition varied with type and amount of spice oil used (Fig. 1). Maximum inhibition was observed with anise oil, as no toxin could be detected at all the concentrations of this oil tested. Oils of cinnamon, thymol, ginger and orange bitter reduced the toxin output to less than one-fourth of the control value on the seventh day, when the amount of toxin was maximum in the control flasks. Other oils like, rosemary, nutmeg, sandalwood and eucalyptus were effective to a lesser extent. In most of the cases, increas-

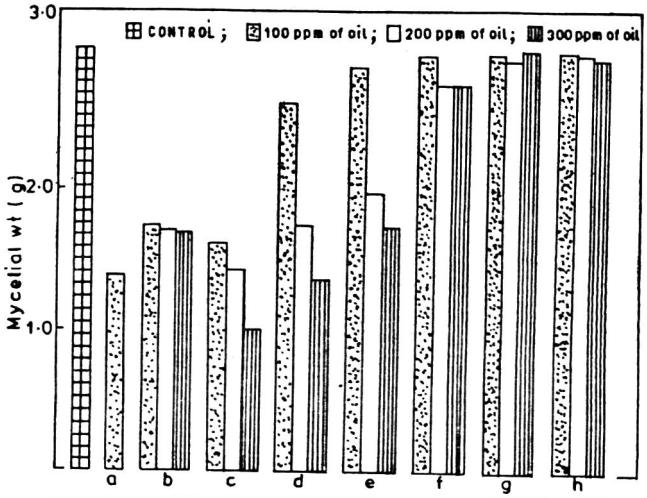


Fig. 2. Effect of spice oils on the final mycelial wieghts of *Aspergillus parasiticus* ATCC 15517 grown YES broth at 28 ± 1°C for 16 days.

ing the spice oil concentration decreased the aflatoxin content.

This decrease in toxin production was due to the result of less growth of fungal mycelium in the presence of spice oils (Fig. 2). Little aflatoxin production in the presence of anise oil (at all concentrations) and cinnamon oil (200 and 300 p.p.m concentration) was due to complete inhibition of the growth of *Aspergillus parasiticus* in these flasks. Other seven oils tested brought about 40-50 per cent decrease in the mycelial weight as compared to weight of mycelium in control flasks.

The varied effect of different spice oils may be due to the differences in the amount of effective anti-fungal compounds present in them. Though some workers[4,5] have identified a few ingredients of spice oils like alcohols (eugenol) and aldehydes (cinnamic aldehyde) which inhibited the growth as well as aflatoxin production by *Aspergillus parasiticus*. But, it is yet to be ascertained, whether only alcohols and aldehydes are responsible for the inhibition of mycelial growth or some other compounds can also bring about tihs detrimental effect on molds.

Department of Microbiology
Panjab University,
Chandigarh-160 014, India.
Received 8 *February* 1982
Revised 8 *October* 1982

R. TIWARI
R. P. DIKSHIT
N. C. CHANDAN
A. SAXENA
K. G. GUPTA
D. E. VADEHRA

References

1. Sreenivasmurthy, V. Jayaraman, A. and Parpia, H. A. B., *Mycotoxins in Foodstuffs*, Wogan, G. N. (Ed.) MIT Press, Cambridge, 1965, 251-60.
2. Davis, N. O., Diener, U. S. and Eldridge, D. W., Production of aflatoxin B_1 and G_1 by *Aspergillus flavus* in a semi-synthetic medium. *Appl. Microbiol.*, 1966, **14**, 378.
3. Mateles, R. I. and Adye, J. A., Production of aflatoxins in sub-merged culture. *Appl. Microbiol.*, 1967, **13**, 208.
4. Bullerman, L. B., Inhibition of aflatoxin production by cinnamon. *J. Fd Sci.*, 1974, **39**, 1163.
5. Bullerman, L. B., Lieu, F. Y. and Seier, S. A., Inhibition of growth and aflatoxin production by cinnamon and clove oils. Cinnamic aldehyde and Eugenol. *J. Fd Sci.*, 1977, **42**, 1107.

Statement about ownership and other particulars about the periodical entitled JOURNAL OF FOOD SCIENCE AND TECHNOLOGY as required to be published under Rule 8 of the Registration of Newspapers (Central) Rules 1956.

FORM IV

1.	Place of Publication	Mysore City
2.	Periodicity of the Publication	Bimonthly
3.	Printer's Name	Dr. S. C. Basappa (For and on behalf of AFST (I)
	Nationality	Indian
	Address	CFTRI, Mysore-570 013
4.	Publisher's Name	Dr. S. C. Basappa (For and on behalf of AFST (I)
	Nationality	Indian
	Address	CFTRI, Mysore-570 013
5.	Editor's Name	Dr. K. R. Sreekantiah
	Nationality	Indian
	Address	CFTRI, Mysore-570 013

I, Dr. S. C. Basappa, hereby declare that the particulars given above are true to the best of my knowledge and belief.

S. C. Basappa
Signature of the Publisher

BOOK REVIEWS

Cheese making practice: by R. Scott, Applied Science Publishers Ltd., London, 1981; pp. XIX+475; Price; £ 24.50.

The book is written by a recognized expert in the field who has got about 50 years of experience in cheese-making. The cheese manufacturing is a multidisciplinary area which encompasses many fields of science such as chemistry, biochemistry, physiology, biology, enzymology, microbiology, mathematics, economics and engineering and thus care has been taken to discuss these subjects by the author wherever it has been found apt and necessary in different chapters. It is a compilation and interpretation of the recent developments in the field. The emphasis is purely on those aspects which are of great interest now. This book is intended for readers with limited back ground in cheese technology, but provides a good general overview of a variety of cheese making practices.

The book contains many tables, figures, drawings and photographs but the photogphs of equipments which are used in cheese making are few and if more were there, would have made the text more realistic. The text is presented in eighteen chapters attempting to cover brief history of cheese to future trends in cheese making. It is also accompanied with comprehensive cheese recipes used in different parts of world and a bibliography of books, reports, reviews and documents which would be of use to cheese makers. Few selected and pertinent references are also given.

The first three chapters deal with, in brief, the history, production and nutritional aspects of cheese. The chapter that follows, discusses about the definition and classification of cheese. In chapter 5, are given the chemical composition of milk and its components responsible for flavour, texture and aroma during ripening of cheese. The text of the next two chapters deal with the bacteriological and chemical qualities of milk for cheese making. Then, there are four chapters which broadly cover topics on additives, treatment and standardization of milk, starter culture and coagulating agents used for preparing different varieties of cheese. Particular attention has been given to microbial rennets which find wide application nowadays, as the substitute, for calf-rennet. The next five chapters are devoted specifically to cheese preperation, defects, and grading, and ripening, whey processing and general comments on different varieties of cheese. The chapter on whey treatment gets very little attention by the author. Of special interest, is the information on the mechanization of cheese making, an area that deserves more attention, has got a good coverage in chapter 17. Mechanization in cheese making and concentration of milk by ultrafiltration or reverse osmosis are discussed in an effective manner covering their future possibilities for commercialization. The final chapter of the book examines the future developments in the cheese industry, focussing the possibility of more production of flavour modified soft and quick-ripened hard varieties of cheese. Current knowledge about longer storage of milk, secondary enzyme system for flavour development, immobilized coagulants for ultrafiltered milk, frozen or dried starter cultures and automation of mechanized cheese making, is also discussed.

The text is nicely printed with a readable typeface. It is an excellent book for students in food science and dairy technology and for individuals who are working in the dairy industry. This would be a valuable addition to the library.

KRISHNANAND
C.F.T.R.I., MYSORE

Fermented Foods: by A. H. Rose, (Ed.), Academic Press, 1982, pp. 337; Price $ 29.20.

This is the seventh volume in the Economic Microbiology series brought out by the publishers. This may be considered as a complimentary volume to, 'Microorganisms of Food Fermentations' published by the AVI Publishing Company in 1979 (2nd edition). Fermented foods like bread, cheese, fermented milk, fermented vegetables, coffee, cocoa and yeast extracts are dealt exhaustively in individual chapters written by experts in the field. The first of the ten chapters is devoted to the history and scientific basis of microbial activity in fermented foods, written by the editor where the origin of fermented indigenous foods and sources are traced. Factors affecting microbial activity are also discussed.

Major fermented foods of the world have been dealt with, based on microflora involved and the substrates used for fermentation, in the second chapter.

In the third chapter, popular fermented foods of the orient, shou and miso have been exhaustively treated. First, the author briefly describes the process of soy sauce preparation and then highlights the other aspects like raw materials, development of inoculum and the course of fermentation. Miso preparation is also dealt

with in similar manner. Finally, the trade and export statistics of the products are presented.

In almost all the countries, bread, in one form or other, is made and consumed. The author traces the early history of making leavened bread and the role of yeast in carrying out the fermentation. Complete technology of baker's yeast production, measuring their activity, their physiology and actual role in bread making are discussed in detail in the fourth chapter. Sour doughs, most commonly rye, in which lactic acid bacteria, rather than baker's yeast, is involved in the fermentation of flour, are also dealt with in detail in this chapter.

The next chapter is devoted to cheese followed by a chapter on fermented milk products. The author first gives a brief description of different categories of cheese and the starter microorganisms involved in each of the types. All aspects of cheese starter bacteria are dealt in detail. Mould ripened cheeses and occurrence and behaviour of pathogens in cheese are also mentioned. Among the fermented milk products, emphasis has been laid on microbial modification of the constitutients. Individual products referred are: ripened cream butter, cultured buttermilk, soucream, yogurt, kefir, koumiss, Bulgarian milk, acidophilus milk, leben, dahi and vilia.

The methods of preservation of vegetables by fermentation is the topic of the seventh chapter. General principles governing brine fermentation of vegetables and certain fruits are emphasised by reviewing cabbage, olives and cucumber fermentations. All aspects of vegetable fermentations including the spoilage problems are also presented.

Eighth and Ninth chapters refer to the processing of coffee and cocoa, through fermentation. In the case of coffee, the most important aspect is the removal of mucilage through the agency of microbial fermentation. Methods adopted for this purpose, microbiology and biochemistry of coffee fermentation are the main subject matters of this chapter.

The concluding chapter of this book is on yeast extract. Extracts derived from live yeasts, autolysed yeast extracts and yeast hydrolysates are discussed. Outlook for yeast extract is presented at the end.

In conclusion, it may be mentioned that the book gives an uptodate account of fermented foods with special emphasis on the microorganisms involved, their biochemical activity and the modifications they bring about in the substrates. Exhaustive literature references at the end of each chapter makes the book more useful as a reference volume to food scientists and technologists. The editing and the get up of the volume are very good. The book will be a valuable addition to the library.

K. R. SREEKANTIAH
C.F.T.R.I., MYSORE

Biotechnology and Exploitation of Algae: The Indian Approach. E. W. Becker and L. V. Venkataraman; German Academy for Technical Cooperation (GTZ); 1982; pp. 216.

As early as 1949, Spoehr and Milner suggested that the use of algal protein could help overcome global protein shortages. The basis for their optimism was that algae have a crude protein content of over 50 per cent and a biomass productivity of the order of 25t/ha/year. Since then, several microalgae such as *Chlorella*, *Scenedesmus*, *Coelastrum* and *Spirulina* have been promoted as protein sources. Recent work in Pirt's laboratory has shown that in light-limited cultures of microalgae, photosynthetic efficiency (PE) values as high as 43 per cent can be realized, yielding practical efficiency of solar energy conversions of 18 percent. An added advantage is the ability to manipulate reactor conditions in order that protein, fat or starch-rich biomass is produced as desired.

During the last decade, considerable interest has been generated in India in harnessing photosynthetic algal systems for the economic betterment of the society as an inexpensive renewable source of fertilizer, food, feed and fuel. The present publication is an elegant testimony to this and the authors deserve credit for highlighting not only the scope of microalgae, but also for summarizing the enormous work done in India. The major thrust on algal protein, as could be seen, has come from the Central Food Technological Research Institute under the leadership of L. V. Venkataraman. The work was initiated originally on *Scenedsmus* under an Indo-German collaborative programme and later switched over to *Spirulina* under the All India Coordinated Project on Algae, sponsored by the Department of Science and Technology, Government of India.

This 216-page volume summarizes the information under 20 sections ranging from the choice of algae to the economics of commercial production. What strikes one is the cautious optimism of the authors in recommending algal protein for human consumption in India. It should be emphasized that algal biomass as a source of protein has great potential in our country as poultry and fish feed and can form an effective component in rural integrated waste recycling systems. Various technological aspects such as production, harvesting and processing have been elaborately dealt with and supported by experimental data. The sections on nutritional, metabolic, supplementation, digestibility and toxicological aspects are particularly interesting and informative.

The major consideration in proper husbandary of algal biomass for economic utilization is the cost of the product and its competetiveness with the con-

ventional feeds. In our country, if algal protein is to make any impact as animal feed, the cost of algae should be atleast at the level of defatted groundnut flour, though not lower. Production processes have got to be tailored.

The long list of 308 references cited shows the global activity in the biotechnological aspects of algal systems. The book fulfills the need to realize the potential of algae in developing countries as a promising source of natural resource. This volume will stimulate many to look upon algae as economically viable and technologically feasible energy conversion systems.

G. S. VENKATARAMAN
I.A.R.I., NEW DELHI

Advance in the refrigerated treatment of fish: International Institute of Refrigeration, Paris. Price 190FF, 1981, pp. 637.

The book is a compilation of papers presented at the meetings of the different Commissions of the International Institute of Refrigeration, held during August 3-6, 1981 on the topic of "Advance in technology in chilling, freezing, processing, storage and transportation of fish especially underutilized species". It is the 49th, volume in the series "Refrigeration Science and Technology" brought out by the Institute.

Against the background of rising population and malnutrition affecting a large section of the human population, it has became imperative to exploit all the potential food resources.

Sea covers more than 70 per cent of earth's surface and from the amount of energy absorbed by the surface layer of the sea, Gustav Lonentzen, in his paper presented on the meeting, has calculated that on a conservative estimate, 50,000 million tons of carbon should be fixed at the sea surface leading to 10 times this amount of bio-mass production which is 150 times more than the amount of food presently consumed by man. But at present, marine resources provide less than 1 percent of the nutritional energy in the world's food supply, alternatively in terms of proteins it is 4-5 per cent protein and 14 per cent in terms of animal protein. Main reasons for low contribution of marine resources to the world's human food stock are: (1) commercial fishing is now mainly confined to only the aquatic animals at the summit of the ocean echo-chain; (2) even amongst them, only few species are considered to be commercially important leading to the waste of large amount of what as known as by-catch fish and (3) cost of harvesting of thinly dispersed marine organisms. Besides concentration of fishing efforts on only few species, has raised the danger of over-exploitation and ultimate extinction of some of these species.

Important among the steps to increase the world fishery supplies indicated by John T. Everett, in his paper presented at the opening session are, (1) development of new, non-traditional fisheries, (2) reduction of waste in existing fisheries through improved harvesting and processing techniques and more efficient use of incidental catches and (3) continued sharp increases in fish farming especially the high volume species. In conformity with the main theme of the meetings, the papers presented and reproduced in the publication deal mainly with processing by refrigeration of marine fish for larger availability in the market and emphasis is on under-utilized species of fish.

The publication reproduces, besides two papers presented in the opening session and three papers at the plenary session, 61 scientific communications made under the following six sections: (1) chilling and freezing of sea food (10 papers), (2) processing, cold storage and transport (8 papers), (3) chilling and freezing (18 papers) (5) new products, packaging and analytical criteria (7 papers) (6) quality and utilization of sea fish (10 papers). Besides, 5 papers were presented under section 7-Research round table, dealing with research and development programmes in some countries as well as on needs of R and D programmes in refrigeration of sea foods from a wider international perspective, including special problems in the tropics.

A group of six papers were presented at the panel meeting on "Environmental and human safety considerations of ammonia and chlorofluro carbons". Ammonia has been used as refrigerant for long time although its high toxicity when inhaled and physical injury it causes when it comes in contact with skin have been a matter of concern not only for the health of the factory workers, but also for environmental pollution it causes. Regulation in the use of ammonia and safety measures necessary in its use have been receiving the attention of government agencies as also of scientific workers for some time. Chloroflurocarbons has, on the other hand been considered to be one of the safe refrigerants. However, theory postulated by Rawland and Molina on the possibilities of decomposition of ozone in stratosphere caused by halogen ions produced by radiation-disassociation of CFCs led to regulatory measures on CFC-uses as refrigerant and in other uses. The communications at the panel meeting have covered different aspects of the probelm in depth.

The book gives a comprehensive account, through its 77 contributed papers, the present state of knowledge concerning transport, storage, processing, quality profiles of sea foods under refrigeration as well as perfor-

mance and development of related equipment for refrigeration preservation of fish. Emphasis on underutilised species of fish has brought to focus the danger of over exploitation and consequent irreversible depletion of stock of few selected species which constitute the present day commercial fishery and need to harness this resource of under-utilized fish to increase fish production and make more protein food available through a number of methods and process, mentioned in the papers for human consumption.

A. N. BOSE
I.I.T. KHARAGPUR

Dairy Microbiology: Volume 1. *The Microbiology of Milk*, pp. 258; Vol. 2. *The Microbiology of Milk Products*. pp. 332; by R. K. Robinson (Ed). Applied Science Publishers, London and New Jersey, 1981, Price: $ 45.00.

These books have appeared after more than two decades since the publication of the two major works on dairy microbiology by Hammer and Babel and Foster and Associates. During this period, many developments have taken place in the methods of milk handling and marketing, milk processing technology and manufacture of products necessitating the introduction of modified procedures for the control of microbial contamination and growth in dairy products. Both the volumes are compilations of articles on different aspects of dairy microbiology contributed by different authors with specialised knowledge and expertise in the subjects. The information given under each topic is quite exhaustive and comprehensive and is amply supported by illustrations and figures to show the dairy processing equipments and operations. Appropriate data from published literature have been included and list of refrences and bibliography is given at the end of each chapter.

Volume 1. Microbiology of Milk

Tnis volume consists of seven chapters each one dealing with a particular aspect of the microbiology of milk and written by a separate author. The first chapter is different fro n the other chapters in that it describes the chemical composition and physico-chemical properties of milk and its constituents and the changes caused during various milk processing operations. These basic concepts are intended to help the reader in understanding the changes occurring in milk and milk products as a result of microbial growth. In chapter 2, various groups and species of microorganisms associated with dairy products and their role are described adopting the taxonomic approach of the latest Bergey's Manual (1974). Some microorganisms, whose occurrence and significance had not been generally known, have also been included in the descriptions, e.g. *Acenitobacter viscosus*, Moraexella like organisms, Campylobacter sp., Yersinia sp. The author has made a commendable job of including all microorganisms relevant to dairy field in this chapter and this arrangement reduces the task of dairy scientist in his reference work. Chapter 3 deals with the conditions favouring microbial contamination and growth in raw milk, concepts regarding destruction of microorganisms by heat, various heat systems and chemicals used for killing micro-organism, cleaning and sanitization of milk handling equipment and survival or destruction of microorganisms at low temperature. In chapters 4 and 5, the numbers and types of organisms occurring in raw and pasteurised milks, natural antimicrobial systems in raw milk, influence of the conditions of storage and transport on the microflora of milk, regulatory aspects of market milk industry, bacteriological tests and standards and effects of dairy processing operations on the microbiological quality of market milk are discussed. Some information regarding the microbiological characteristics of modified milk products like chocolate, reconstituted, filled, lactose-treated and sweet acidophilus milks, egg nog, boiled milk and milk-borne diseases has also been presented in chapter 5 Chapters 6 and 7 are devoted to a critical evaluation of various processes involved in the manufacture of dried and concentrated milks and their effects on the survival of microorganisms in the products and problems of post-contamination and production of retentates by reverse osmosis and ultrafilteration techniques has also been included in chapter 7.

Volume 2. Microbiology of Milk Products

This volume deals with the microbiology of milk products other than condensed and dried milks which have been included in Volume 1. It is divided into seven chapters each one pertaining to a particular type of product or topic contributed by a separate author. In the first three chapters, microbiological aspects of ice cream and related products, cream and dairy desserts and butter respectively have been discussed. Each chapter contains information on different varieties of the product, their composition, methods of manufacture and packaging, microbial contamination at different stages, numbers and types of organisms surviving in the product or gaining entry as post-contaminants and their effect on the quality and shelf-life of the product, hygienic measures to be adopted in the plant, laboratory quality control tests and microbiological standards prescribed in different countries.

The role of these products in outbreaks of infections and intoxications and the importance of human carriers as major sources of contamination in ice cream have been highlighted.

The microbiology of starter cultures forms the subject matter of chapter 4. The classification and characteristics of starter bacteria used in the production of cheese and other fermented milk products, their preservation by means of freezing and their inhibition by bacteriophages and other factors have been outlined. Reference has also been made to the techniques used for mass production and continuous cultivation of starter cultures and their preservation. Chapters 5 and 6 describe several varieties of cheese and fermented milks. After giving a general description of different varieties of cheese originating from different countires, the types of starter cultures used for each type of cheese, various steps in cheese making, chemical and microbiological changes during manufacture and ripening of cheese and defects caused by microbial activity in cheese have been discussed in detail. In regard to fermented milks, special attention has been given to the production of yoghurt, while other fermented milks like kefir, kumis, acidophilus milk and cultured butter milk have been mentioned briefly. No reference has been made to the Indian fermented milk *Dahi*, which is consumed by large sections of the people and about which considerable amount of published literature is available. The last chapter deals with the practical problems of microbiological quality control in the dairy industry. Various steps and precautions required for preventing contamination in the dairy plant and relative merits and limitations of different tests used in quality control work have been described.

Since the topics covered in the two volumes have been contributed by different authors, there are several instances of duplication of information in regard to topics like cleaning and sanitation of equipment, milk processing operations and microorganisms surviving heat treatment and low temperature storage. Both the volumes contain exhaustive information on various theoretical as well as practical aspects of dairy microbiology. The books should prove very useful to students of dairy science and research workers in the field. However, the price ($ 45.00) for the two volumes may be beyond the reach of many Indian students and scientists.

H. LAXMINARAYANA
UNIVERSITY OF AGRICULTURAL SCIENCE
BANGALORE-24

WORKSHOP ON FOOD HYGIENE AND SANITATION

A Workshop on Food Hygiene and Sanitation is scheduled to be held at CFTRI from 19/30 September 1983.

The Workshop would cover basic aspects of sanitation and the requirements of hygiene in handling, distribution, processing and marketing of foods. It is especially designed for inculcating awareness of sanitary measures required in food processing and catering establishments at middle-level managerial and supervisory staff. The course is expected to play a vital role in reducing food borne diseases and poisoning in organised sectors of food industry.

Details may please be obtained from the Secretary, AMI, Mysore Unit, Department of Microbiology, CFTRI, Mysore-13.

ASSOCIATION NEWS

Annual General Body Meeting

The eighteenth Annual General Body Meeting of the Association was held on 3rd June 1983 at 6.15 p.m. in the Assembly Hall of CFTRI, Mysore-13., which was attended by 105 members including those representing different Chapters. Mr. S. K. Majumder, President of the Association conducted the proceedings of the meeting. Dr. L. V. Venkataraman, Hony. Exec. Secretary presented the report of the Association for the year 1982-83. He pointed out that the membership of the Association has increased from 1890 to 2050 during the year. Four new Chapters were added during the year and now there are 15 Chapters of the Association functioning all over the country.

The awards of the Association for 1982 are as follows: Mr. Vittal Mallya of United Breweries, Bangalore was conferred with the Prof. V. Subrahmanyan Industrial Achievement award. Mr. K. Singaravadivel of Paddy Processing Research Centre, Tiruvarur, Tamil Nadu was the receipient of the Young Scientist Award. The receipients of Best Student Award were Mr Khan Mujeeb Ahmed of Marathwada Agricultural University, Parbhani and Mr. Ralkar Purshotham Raghunath of UDCT, University of Bombay, Bombay. Dr. S. K. Gupta of National Dairy Research Institute, Karnal and Dr. C. M. Kapoor of College of Animal Science, Haryana Agricultural University Hissar were presented the Gardner's Award for the best paper entitled *Soy-whey weaning food. I. Method of manufacture and II. Storage studies* published in the *Journal of Food Science and Technology* Vol. 18, No. 2, 1981. Suman Food Consultants Travel Award was given to Mr. H. S. Veerappa Gowda of the College of Fisheries, University of Agricultural Sciences, Mangalore, for his article entitled *Role of biotechnology in augmenting India's food supplies.*

The Proceedings of Ahara-82 is under preparation and it will be sent to the press in due course of time.

A one-day colloquium on Centenary of Kjeldahl method for estimation of nitrogen in organic substances was held by AFST(I) in September 1982 at the CFTRI campus.

The guidelines for eligibility of the Fellowships of AFST(I) have been finalised and efforts are being made to initiate this Fellowship at an early date.

The Journal of Food Science and Technology is in the 20th year of its publication and has attained an international reputation. Efforts are being made to reduce the time in refering the papers. The Indian Food Industry is in its second year of publication. Dr. K. R. Sreekantiah, has succeeded Dr. R. Radhakrishna Murthy as the new Editor and a new Editiorial Board has been constituted.

It was also pointed out by the President that a special general body may be called to discuss matters relating to Ahara-82.

In the course of discussion, it was decided that the Chapters should be informed about the new membership coming under their jurisdiction, and the subscription paid by the members directly to the Headquarters. It was also decided that a list of members belonging to each Chapter should be sent to the respective Chapters at the end of each year. It was also pointed out that a better rapport should be established between the Chapters and headquarters. The Report was adopted and unanimously approved by the General Body.

This was followed by the presentation of the report by the Hony. Treasurer Mr. C. T. Dwarakanath. He indicated that the total receipts have gone up by Rs. 56,650 as compared to the previous year. The total expenditure during the year was Rs. 2,28,000 with an increase of 0.37 lakhs compared to previous year. The budget estimate for the year 1983 has been projected to be Rs. 2.72 lakhs. After some discussion, the Treasurer's report was adopted and unanimously approved by the General Body.

The Secretary read out the list of office-bearers who got duly elected, for the year 1983-84.

President designate

Mr. Laljeet Singh, New Delhi

Vice President (Headquarters)

Dr. M. V. Rama Rao, Mysore

Vice Presidents (Chapters) 4 posts[2]

Dr. G. Lakshminarayana, Hyderabad

Prof. Maharaj Narain, Pantnagar

Mr. B. Raghuramaiah, Madras

Mr. A. K. Sachdev, New Delhi

Hony. Jt. Secretary

Dr. M. Mahadeviah, Mysore

Hony. Treasurer

Mr. G. Radhakrishniah Setty, Mysore

The President, Mr S. K. Majumder requested Lt Col. O. P. Kapur President-designate and Dr. S. C. Basappa, the Hony. Jt. Secretary to take over as the President and Hony. Exec. Secretary of the Association. This was received with ovation from the House. The new President Col. Kapur exhorted about the high ideals of the Association and expressed his gratitude to the members for electing him to the high office. He also thanked the outgoing Executive Committee members

especially Mr S. K. Majumder, and Dr. L. V. Venkataraman, for running the Association effectively and organising the Convention successfully.

The amendments suggested to the Constitution could not be taken up, as the members pointed out that the amendments should have been widely circulated in advance before taking them up for discussion. In view of these suggestions, it was decided that the new Executive Committee take necessary steps to convene a special general body meeting to discuss the issues relating to Amendments.

The meeting ended with the expression of thanks to the incoming and outgoing executives of AFST(I) and to the members by the outgoing Secretary, Dr. L. V. Venkataraman.

Lucknow Chapter

The Annual General Body Meeting was held on 25th May 1983 and the following Office bearers were elected: President—Dr. Surjeet Singh, Vice Presidents—Mr. B. Revis, Dr. S. K. Khanna, Secretary—Mr. M. C. Tomar, Joint Secretary—Mr. Kamal Prakas and Treasurer—Mr. K. S. Verma.

OIL TECHNOLOGISTS' ASSOCIATION OF INDIA

Announcement of Awards for 1983

Dr. S. Husain Zaheer Memorial Award.

R. B. G. V. Swarka Memorial Award.

G. S. Nivetia Memorial Award of M/s. Kusum Products Ltd., Calcutta.

The last date for the receipt of the applications with details is fixed for 30th September 1983.

For further information, please contact: The Honorary Secretaries of the respective Zones or from the Honorary General Secretary, Oil Technologists' Association of India (H. qrs.), c/o. Technological Institute, Kanpur-208 002.

ERRATUM

In the Research note 'Effect of heat treatments on stability of ascorbic acid in Copper Contaminated milk of Cows and Buffaloes' by Syed Anwar and V. Unnikrishnan, published in *this Journal* 1982, Vol. 20, No. 1, page 36-37, the last sentence of first paragraph on page 37 should read as:

Thus, the destruction of ascorbic acid during heating in the presence of copper was less in buffalo milk than in cow milk.

Announcement of a Publication

By

The Central Food Technological Research Institute, Mysore (India)

R & D AT THE CFTRI: THREE DECADES (1950–1980)

The book is about the CFTRI, its genesis, growth, its research and developmental activities. From an humble beginning in 1950, it has grown into a premier centre for research, development, transfer of technology, training and information in food science and technology. During the period 1950–1980, a tremendous volume of original R & D publications and other information has emerged from the Institute. The book is the first attempt to review comprehensively the R & D work and other information of the CFTRI since its inception.

The book comprises twenty chapters divided into five parts, four appendices and an index. It begins with a resume of the genesis, growth, organizational structure and functions of the CFTRI. This is followed by a detailed review in five chapters of the R & D work on different food commodities viz., food grains, oilseeds and unconventional sources of protein and fat, animal foods, fruits and vegetables, and plantation products and food flavours. Multi-commodity researches in areas such as the control of infestation of stored grains, process engineering, design and fabrication of food machinery, packaging technology, sensory evaluation of foods, fermentations and food microbiology, chemical, biochemical, nutritional and toxicological investigations are reviewed in the subsequent six chapters. The formulated foods and beverages developed in the Institute are described in detail under a separate head. Each chapter is followed by a comprehensive bibliography. Other essential activities of the Institute such as the transfer of technology and industrial consultancy services, food science and technology information service, the Animal House, sophisticated instruments facility, food quality analysis and public relations have been recounted in detail. Training of personnel for the food industry is an important function of the CFTRI and the UNU activity and aims at providing training facilities in food science and technology at postgraduate, postdoctoral and research management levels for personnel from other developing countries. Comprehensive lists of processes released to industry, processes ready for commercialization, feasibility reports and consultancy services rendered are included in the four appendices. The book ends with subject and author indices. The book will therefore, be of great use to postgraduate students, teachers and researchers in all R & D institutions in the area of food science and technology as well as to industrialists and policy makers.

Priced at Rs. 100/- in India and US $ 50.00 abroad (exclusive of packing and forwarding charges), the publication (Royal 8 vo, pp. 375 text and pp. 64 art plates, full calico bound, 1982) can be had from the Director, Central Food Technological Research Institute, Mysore-570 013, India.

PUBLICATIONS

OF

THE ASSOCIATION OF FOOD SCIENTISTS & TECHNOLOGISTS (I)

(CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE CAMPUS, MYSORE)

1. **REVIEWS IN FOOD SCIENCE AND TECHNOLOGY—VOL. IV**
   Royal 8vo, hard bound, P. 255.
   Price: India **Rs. 8/-**
   Abroad: **$5 Surface mail**
   $8 Air mail.

2. **PROCEEDINGS OF THE SYMPOSIUM ON FATS AND OILS IN RELATION TO FOOD PRODUCTS AND THEIR PREPARATIONS**
   Demi-quarto, paper back, P. 155
   Price: India **Rs. 25/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

3. **PROCEEDINGS OF THE FIRST INDIAN CONVENTION OF FOOD SCIENTISTS AND TECHNOLOGISTS**
   Demi-quarto, paper back, P. 123
   Price: India **Rs. 25/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

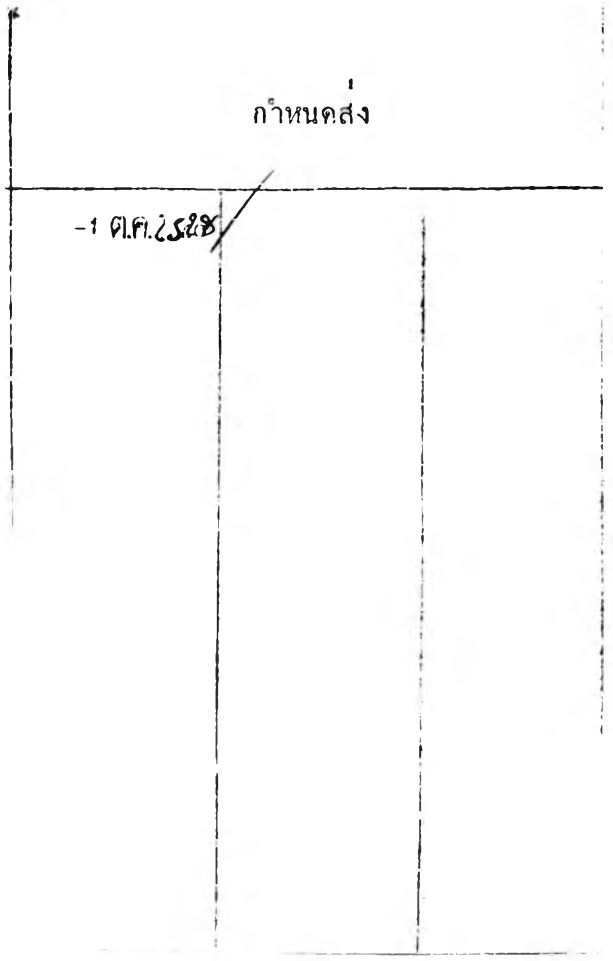
4. **TECHNICAL DIRECTORY OF THE CONFECTIONERY INDUSTRY IN INDIA**
   Demi-quarto, paper back, P. 128
   Price: India **Rs. 25/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

5. **PROCEEDINGS OF THE SYMPOSIUM ON STATUS AND PROSPECTS OF CONFECTIONERY INDUSTRY IN INDIA**
   Demi-quarto, calico bound, P. 135
   Price: India **Rs. 30/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

6. **PROF. V. SUBRAHMANYAN COMMEMORATION ISSUE**
   Demi-quarto calico bound, P. 125
   Price: India **Rs. 30/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

7. **PROCEEDINGS OF THE SYMPOSIUM ON BY-PRODUCTS FROM FOOD INDUSTRIES: UTILIZATION AND DISPOSAL**
   Demi-quarto, calico bound, P. 56
   Price: India **Rs. 30/-**
   Abroad: **$8 Surface mail**
   $10 Air mail

8. **PROCEEDINGS OF THE SECOND INDIAN CONVENTION OF FOOD SCIENTISTS AND TECHNOLOGISTS**
   Demi-quarto, P. 134
   Price: Paper back **Rs. 30/-**
   Calico bound: **Rs. 40/-**


กำหนดส่ง
-1 ต.ค. 2548

INSTRUCTIONS TO AUTHORS

1. Manuscripts of papers (*in triplicate*) should be typewritten in double space on one side of bond paper. The manuscripts should be complete and in final form, since only minor corrections are allowed at the proof stage. The paper submitted should not have been published or data communicated for publication anywhere else. Review papers are also accepted.

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

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

4. **Abstract:** The abstract should indicate the principal findings of the paper. It should be about 200 words. It should be in such a form that abstracting periodicals can readily use it.

5. **Tables:** Tables as well as graphs, 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. They should be typed on separate paper. Nil results should be indicated and distinguished clearly from absence of data, which is indicated by '—' sign. Tables should not have more than nine columns.

6. **Illustrations:** Graphs and other line drawings should be drawn in *Indian ink* on tracing paper or white drawing paper preferably art paper. The lettering should be in double the size of printed letters. For satisfactory reproduction, graphs and line drawings should be at least twice the printed size 16cms (ox axis) × 20cms (oy axis); photographs must be on glossy paper and must have good contrast; *three 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 along with title of the paper should be cited completely in each reference. Abbreviations such as *et al.*, *ibid. idem*, should be avoided.

   The list of references should be included at the end of the article in serial order and the respective serial number should be indicated in the text as superscript.

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

   (*a*) *Research Paper:* Jadhav, S. S. and Kulkarni, P. R., Presser amines in foods, *J. Fd Sci. Technol.*, 1981, **18**, 156.

   (*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 Papers:* Nambudiri, E. S. and Lewis, Y. S., Cocoa in confectionery, *Proceedings of the Symposium on the Status and Prospects of the Confectionery Industry in India*, Mysore, May 1979, 27.

   (*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.

9. Consult the latest copy of the *Journal* for guidance.

REG. NO. 24918/64

JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

Vol. 20 No. 4 **Contents of forthcoming issue** **July/Aug. 1983**

Research Papers

Research Notes

Printed and Published by Dr. S.C. Basappa, Secretary, AFST (India), CFTRI, Mysore-570013, at Sharada Press, Mangalore-575 001.