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FOOD IRRADIATION PROCESSING IN PAKISTAN[1]

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ABSTRACT

Research studies conducted during the past 3 decades have witnessed significant advancement of food irradiation processing in Pakistan and other countries. Technological and economic feasibility as well as wholesomeness of irradiated food upto 10 kGy had been clearly established. Application of this technology for reducing post-harvest food losses, improving hygienic quality, quarantine treatment and insect disinfestation instead of fumigation has been evaluated in detail. At present, 37 countries have approved one or more food items for human consumption and 25 countries have commercialized this process. Decontamination of animal feed for microorganisms especially pathogens by gamma irradiation has been experimentally tested in Pakistan and is commercially carried out in other countries. Pakistan has established a commercial irradiator PARAS in Lahore for sterilizing medical supplies, and the efforts to establish lagislation (regulations) for food irradiation are continuing. In order to facilitate and regulate inter-country trade for irradiated food materials, a programme under the aegis of IAEA for development of detection methods and lable dosimeters to identify irradiated food is in progress in Pakistan and elsewhere.

INTRODUCTION

Most of the developing countries including Pakistan are facing rapid population growth, high post-harvest food losses, increasing incidences of food brone diseases and the need for staisfaying strict quality requirements and quarantine barriers for exporting their food. Research data and limited commercial scale experience in Pakistan have demonstrated that irradiation offers a broad spectrum technology for reducing post-harvest losses of a wide variety of food items (Sattar *et al.*, 1970; Sattar & Wahid, 1992; Sattar, 1994) e.g. roots, tubers, fruits, vegetables, grain, fish, meat etc. Irradiation offers a unique means of ensuring the hygienic quality of solid food such as poultry, other meats, seafood and spices. The effectiveness of irradiation as technology for food processing/preservation has been demonstrated through a series of co-ordinated research programmes sponsored by the Joint FAO/IAEA Division over the past 25 years. Emphasis is now being given to process control and evaluation of acceptance. This report highlights findings on storage studies, test marketing, economic feasibility, transportation and consumer acceptability of selected irradiated food items.

[1] Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

MATERIALS AND METHODS

The products studied include potatoes, onions, garlic, spices and poultry meat. During their irradiation, storage, marketing, transportation and consumer acceptability studies, strict compliance was made with the Codex General Standards for irradiated foods and Codex Recommended International Code of Practice for operation of radiation facility used for treatment of foods according to the written protocols of ICGFI. Dose mapping of foods and dosimetry were carried out using the Fricke method (Fricke & Hart, 1966). Developing of suitable plastic and aqueous dosimeters is being conducted in view of the proposed commercial food irradiator at Lahore (Khan *et al.*, 1988).

Potatoes and onions of summer and winter harvests (2 tonnes each) were procured from the farmers fields and irradiated with 0.1 kGy of gamma rays. Potatoes were stored at 20 ± 2°C (37-67% relative humidity) in a cold room especially constructed for potatoes while onions were kept at ambient-shad conditions (9-33°C and 32-90% relative humidity) in a especially designed low cost shed. Garlic (about 100 kg) were subjected to same experimental conditions as for onions. The products were evaluated for percentage sprouting, rottage and weight loss. Storage studies, transportation, test marketing, economic feasibility as well as consumer acceptance of these irradiated vegetables were carried out. Spices such as red chillies, black pepper, turmeric and garlic powder were packed in polyethylene (PE, 0.045 mm) pouches and irradiated

with 8.0 kGy of gamma rays. They were stored at ambient conditions (10-35°C) and evaluated for moisture, total fungal and bacterial counts according to the standard methods (Collins & Lyne, 1976). Poultry meat of broiler-chicks was irradiated at different doses of gamma rays (3.0, 5.0, 7.5 kGy) keeping an unirradiated controls as well. The irradiated and unirradiated meat samples were placed in a refrigerator at 5 ± 1°C for subsequent total bacterial tests during the storage.

and 7.5 kGy upto 3 weeks. The results revealed that irradiation treatment significantly increase the shelf-life of poultry meat at refrigerated and frozen storage.

Economic feasibility

Government of Pakistan has already approved irradiation of potatoes, onions, garlic and spices. Final draft of the food regulations for irradiating different food materials has been completed for approval by the Government of Pakistan. For economic feasibility

Table 1. Changes in irradiated potatoes, garlic and onions during storage

Parameters	Storage (Months)	Potatoes		Onions		Garlic	
		Unirradiated	Irradiated	Unirradiated	Irradiated	Unirradiated	Irradiated
Sprouting (%)	3	57	0	21	0	15	0
	6	100	0	100	0	100	0
Rottage (%)	3	5.1	5.0	15.1	8.6	9.0	5.2
	6	31.5	32.7	26.5	23.1	13.6	9.3
Weight loss (%)	3	9.5	8.6	21.0	11.6	14.5	8.0
	6	16.9	13.5	32.4	22.9	33.3	14.8
Acceptability	3	UM	M	UM	M	UM	M
	6	UM	M	UM	M	UM	M

Potatoes storage 20 ± 2°C (relative humidity 37-67%).
Onion/garlic storage: ambient-shade conditions (9-33°C).
UM = Unmarketable; M = Marketable.

RESULTS AND DISCUSSION

Potatoes, onions and garlic irradiated with 0.1 kGy were stored alongwith unirradiated controls, for storage studies. Irradiated materials remained marketable upto 6 months while the unirradiated were found to be unmarketable just after 3 months storage (Table 1). In case of spices the experiment was continued for total period of 12 months. The increase in total bacterial count and total fungal count was staggeringly high in the unirradiated samples of red chilli, black pepper, turmeric and garlic powder (Table 2). The unirradiated samples were found sensorically off-flavoured, visibly discoloured and hence unacceptable to the judges. However, irradiated materials remained acceptable and hygienic even after 12 months. For the poultry meat, the studies for shelf-life extension of the product were conducted during storage at the refrigerated (+5°C) and freezing (-20°C) conditions. The results in Table 3 indicate that unirradiated control was found spoiled after 1 week. The meat treated at 3.0 kGy remained at the acceptable bioload upto 2 weeks while that of 5.0

study, irradiation facility including 100 kCi Co-60 source, major equipment and other building and material costs were considered. Gamma irradiator was considered more versatile for treating a wide variety of food because of simplicity to operate and maintain. On the basis of 100 kCi source, irradiating food 20 tonnes/hr in 3 daily shifts during 6 days a week, approximate cost of irradiation per tonne was established to be Rs.100/- (US $ 3.3) for onions, potatoes and garlic, while Rs.5000/- (US $ 167) for spices.

Transportation trial

Irradiated and unirradiated potatoes and onions (one tonne each) were transported to the harbour city of Karachi by truck covering a distance of about 1500 km. The effect of transportation on obvious physical conditions and texture was determined. The data revealed that although the texture of fresh products was slightly lesser in the irradiated onions and potatoes than their corresponding controls. The trend drastically reversed in the 2 months stored samples. The texture of

irradiated potatoes and onions was found much better than controls during storage.

these and earlier (Khan *et al.*, 1986; Sattar *et al.*, 1991) studies carried out in Pakistan clearly indicate that

Table 2. Effect of storage on total fungal count of irradiated spices

Spices (kGy)	Total bacterial count (g)					
	2 months	4 months	6 months	8 months	10 months	12 months
Red chillies						
Unirradiated	4.1×10^5	3.2×10^6	7.9×10^7	3.0×10^6	1.2×10^7	9.6×10^9
Irradiated	0	0	20	9.0×10	1.0×10^2	4.0×10^2
Blackpepper						
Unirradiated	3.1×10^5	3.2×10^5	2.7×10^5	9.2×10^7	7.4×10^8	9.2×10^9
Irradiated	0	10	15	8.0×10	2.0×10^2	3.5×10^2
Turmericlies						
Unirradiated	1.6×10^4	9.0×10^5	2.7×10^6	3.0×10^6	6.9×10^7	4.6×10^8
Irradiated	0	0	20	5.0×10	1.5×10^2	2.1×10^2
Garlic powder						
Unirradiated	6.7×10^4	7.6×10^5	1.8×10^6	3.5×10^6	4.7×10^7	
Irradiated	0	10	25	2.6×10	1.6×10^2	2.1×10^2

Initial range value: Total fungal count/g: 1.6×104-4.7×10^5.

Table 3. Effect of irradiation on total bacterial count of refrigerated poultry meat (count/cm²)

Radiation doses (kGy)	Storage (weeks)			
	0	1	2	3
Count	2.9×10^4	2.6×10^6	Discarded	Discarded
3.0	1.6×10^3	4.0×10^4	4.5×10^6	6.5×10^7 soiled
5.0	3.2×10^2	5.5×10^3	6.7×10^5	3.2×10^6
7.5	4.0×10	8.2×10^2	2.1×10^4	1.2×10^5

Storage temperature: 5 ± 1 °C.

Transfer of technology

Liaqat Corporation (Private) Ltd. in the city of Gujranwala is getting food samples irradiated for experimental purpose from this Institute. Other Private firms are also showing interest to apply this technology. A Federal Agency, Agricultural Marketing and Storage Ltd. (AMSL) is prepared to market irradiated potatoes and onions on a commercial scale in the country. An active compaign is being carried out to popularise this technology among the public through video films, by participating in local and national exhibitions and several types of publications. Specialized lectures are delivered to important target groups. On the basis of application of Food Irradiation Technology would be greatly beneficial for reducing huge post-harvest loss and in improving the food quality.

World status

The last decade has witnessed significant advancement of the acceptance of food irradiation technology. At present 37 countries have approved several food items for human consumption and 25 countries have commercialized this process. More countries are showing keen interest to introduce food irradiation in order to reduce post-harvest food losses, increase export potential and ensure safety of food for

the people. The emphasis is now being given to replace fumigation with irradiation and develop identification methods for irradiated food to harmonize international trade.

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THIRTY YEARS OF TEACHING AND RESEARCH IN THE DEPARTMENT OF FOOD TECHNOLOGY, UNIVERSITY OF AGRICULTURE FAISALABAD[1]

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The Punjab Agricultural College and Research Institute was established at Lyallpur (now called Faisalabad) in 1909. Research and teaching activities on various aspects of food processing were carried out in the Horticulture Section until 1960. The Agricultural University was incepted in 1961. First batch of 20 students, graduated in Food Technology and 3 students were awarded M.Sc. degree in 1962. Number of graduate students rose to 450 up to 1992 and at the same time, 400 students got M.Sc. degrees during this period. Only three research projects were completed in food processing up to 1960 under the auspices of Horticulture Section. It is gracious to note that 337 projects were completed between 1962 and 1992. A brief description of various research activities in different fields is given as under:

Studies on fruits and vegetables

Summery of projects completed is given in Table 1. It shows that different types of fruits and vegetables have been evaluated as to their suitability for dehydration. Studies have been completed on the dehydration of pears, guava and apricots. It was found that highly acceptable products could be prepared from these fruits. The products were fairly stable when stored at room temperature at a moisture content of 15 to 18 per cent. It was possible to produce dry powders of lemon and mango juice using some filling agents like starch and gums. Carrots, garlic and potatoes resulted in very good dehydrated products with varying rehydration ratio. Garlic powder, prepared from dried garlic had a high rating in the consumer shelf.

Table 1. Research projects completed on fruits and vegetables

Section	No.
Canning	10
Fruits squashes	16
Fruit juices	52
Pectin production	6
Vegetable processing	20
Food enzymes	3
Fruit processing	9
Jam and candy	9
Dehydration	16

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Canned fruits and juices are being consumed in large quantities. Highly acceptable products were prepared from mangoes and apples. Canned mixed fruits had good nutritional value. They were readily accepted as a regular item in hotels. Soft fruits were successfully canned using a calcium chloride (0.5% solution) dip. When canned in 30 per cent sugar syrup, there was an increase in the retention of vitamin C. Consumption of a single pure juice with little addition and mixing of other juice was not successful. However, it was very much encouraging when juices were blended with other fruit and vegetable juices. Blending of such juices invariably improved the flavour, taste and colour of the products. Palatable blends were produced from kinnow, orange and pomegranate. Different other combinations were also tried. Recently, a project is being undertaken to produce sugar cane/Kinnow/lime/watermelon blends.

Use of food additives improves texture, structure and culinary properties of food products. Juices have been stabilized as a result of the addition of pectin, guar gum, carboxymethyl cellulose and various other thickeners. It was observed that the substitution of sucrose by liquid glucose did not affect the physico-chemical and sensory characteristics of orange, lemon and mango squashes. Tomato paste was stabilized by the use of BHA and BHT at a concentration of 0.02 per cent each. Suitability of high fructose syrup made from inedible broken rice as a replacement of sucrose at different concentration in pomegranate and almond syrup was assessed. Sucrose could be replaced by high fructose syrup up to 25 percent with out any adverse effect on the physico-chemical characteristics of the products. Addition of 0.025 to 0.05 per cent of sodium

methyl paraben and sodium propyl paraben tended to increase the shelflife of almond seedcake syrup. Utilization of food wastes to produce economically viable products has given encouraging results. Use of citrus peel for the recovery of pectin, yielded good quality material with high purity. Enriched orange juice and yeast leavened bread was produced using cheese whey solids. Shelflife of sweet lime was increased by 60 days when packed and stored at 5 C in a cold store. It is concluded with the remarks that further research work on processing and dehydration of dates is needed.

Studies on milk and milk products

Studies have been conducted on the quality of processed milk, utilization of by-products of milk, storage stability of butter and cream, microbiology of ice cream, fermented milk products and desserts. The results are summarised in Table 2.

Table 2. Research Projects completed on Milk and milk products

Section	No.
Cheese	6
Dahi	4
Yoghurt	5
Ice cream and other milk products	39

The storage stability of yoghurt was determined at 5 C. Significantly lower microbial load was found in yoghurt as compared to *dahi* showing unhygienic condition of the later during processing and marketing. Fruit yoghurt was of much superior quality as compared to plain yoghurt. It was feasible to incorporate 30-40 per cent of apple and mango in the yoghurt. Similarly, semi-industrial ice cream contained more number of Coliforms as compared to industrial ice cream. It is evident from the results that plant hygiene plays a vital role to control the growth of microorganisms responsible for the spoilage of such products. Butter whey is an important and valuable waste of butter manufacturing plants. Studies were carried out for its possible utilization in various food products. The dry whey powder was produced by spray drying. It was observed that the dried material had as high as 27 per cent protein. It was found to replace 20 per cent milk solids-not-fat in ice cream which reduced the melting point of ice cream while raised its nutritional value. A positive significant effect of whey solids @ 5 per cent was found in case of bread, Which in turn increased its nutritional value to a considerable extent. It is recommended that further investigations on cultured milk products should be undertaken.

Studies on cereal products

Studies have been carried out on the quality and shelflife of wheat and its products. The results are given in Table 3.

Table 3. Research projects completed on cereal products

Section	No.
Biscuits	7
Chapati	9
Nan	7
Bread and other bakery products	37

The concentration of thiamine and lysine in Chenab 70 increased with an increase in the rate of extraction. It was observed that loaf volume of bread was directly related to gluten and its protein (gliadin, glutenin and total protein). Use of sodium chloride (1%), non-fat dry milk (4%), sorbic acid (0.2%) and glycerol monostearate (0.5%) increased significantly the shelflife of *tanoori roti* to 2-3 days at room temperature. The shelflife was further increased to 16-30 days when the *roti* was stored at refrigeration temperature. Nans treated with hydrogenated fat, packed in cellophane bags and frozen, had a shelf life up to 3 months. Studies revealed that wheat cultivars viz. C-273, Chenab 70, SA-42 and maxi-Pak were low in diastatic activities. Flours from these cultivars need to be supplemented with malted barley flour so as to increase the enzyme activity for making a good bread dough. Addition of 25 ppm of potassium bromate had no effect on water absorption of the flour. However, it effected positively significantly other farinographic characteristics. Use of calcium peroxide and non fat dry milk in 75 per cent extraction flour of Pak 81 gave the best results for bread baking. Further studies were conducted to enrich bakery products by the use of coconut flour, sesame seed flour, gram flour, groundnut flour, fish flour and certain vitamins and minerals. Acceptable baked goods were prepared by the use of these ingredients. It will be worthwhile if spoilage of wheat and wheat products is further investigated.

Studies on fats and oils

Fats and oils are good sources of energy and carry fat soluble vitamins (A, D, E and K) and essential fatty acids. Pakistan is in short supply of edible oil. One third of the total requirement is produced in the country and the rest is imported.

Cottonseed is the major source (85%) of the nationally produced oil. About 15 per cent supply is

obtained from other seeds like rape, mustard, peanut, sesame, soybean and sunflower, etc. oils from these seeds have been characterized for their physico-chemical properties. Thirty-nine research projects on various oil seeds have been completed. A lot of research work is needed to develop and characterize different types of margarine.

Studies on sugar technology

Work carried on recovery of sugar and its products is given in Table 4.

Table 4. Research projects completed on various aspects of sugar technology

Section	No.
Recovery of sugar from sugar cane	7
Effect of minerals on the composition of final molasses	2
Clarification of cane juice in relation to lime and phosphate application	3
Reducing sugars of cane juice as affected by temperature and pH	2
Storability of sugar	3
Production and characterization of by-products during sugar manufacturing	2

A total of 19 projects were completed on processing of sugarcane for the production of refined sugar. Research in sugar technology has established that purity of juice during the early harvest of sugarcane is rather below standard which adversely affects the recovery of sugar (sucrose), while the mid-season and late season sugarcane gave good recovery. Sanitation of the mill and staleness of the cane effected the recovery of sugar significantly. Unnecessary storage of juice and syrup particularly at high temperature gave excessively reduced recovery of sugar and an increased amount of molasses.

Studies on meat, fish and poultry

Research was carried out on the development of meat, fish and poultry products. The results are summerized in Table 5.

Table 5. Research Projects completed on meat, fish and poultry

Section	No.
Effect of processing on the quality of fish	4
Meat curing and presesvation	3
Quality of meat sausages	2
Freezing storage of poultry	2
Irradiation preservation of meat	2

There is a great loss of fish due to spoilage particularly during hot weather. It needs much efforts to save fish from spoilage. Studies were conducted on processing of meat products. It was possible to manufacture canned meat products having a long shelf life. The frozen poultry products were successfully produced having a very good quality which retained best sensory characteristics.

Studies on food waste utilization

Various researches carried out on the utilization of different food waste are given in Table 6.

Table 6. Projects completed on Biotechnology

Section	No.
Utilization of wastes of fruits	3
Utilization of wastes of fish	2
Utilization of wastes of milk	3
Utilization of wastes of oil seed	2
Utilization of wastes during sugar manufacturing	1

Food wastes cause numerous problems of environmental pollution. Utilization of such wastes can help in reducing production costs, maintenance of quality, ease of production procedures and better health of workers. Vinegar and ethyl alcohol were successfully produced from sugar cane molasses.

It is obvious from the above discussion that the research work on development of new food products is rather scanty. Efforts must be directed towards this very important field. Although, lot of work has been completed on fruits and vegetables preservation, yet more suitable and reliable methods should be developed to save fruits and vegetables from spoilage and further research is needed regarding preserves to cope with the needs of the consumer and manufacturers. Notwithstanding, these efforts will reveal new fields for research as well as employment opportunities for graduates in these technologies.

Employment opportunities

It is heartening to note that the graduates of this department are successfully serving the private and public sector and building up the economy of the country along with raising the living standard of the people. Some of the industries, to mention, are bread manufacturing industries, maize processing industries, fruits and vegetables processing units, sugar mills and distilleries, pharmaceutical units, fish processing industries, milk and milk products factories, edible oil processing industries. Government and semi-government organizations like Department of Agriculture, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan Council for Scientific and Industrial Research (PCSIR) Laboratories, Food Department, Pakistan Agriculture and Supplies Corporation, Punjab Agricultural Development and Supplies Corporation, commercial banks and Agricultural Development Bank of Pakistan, schools, colleges and universities of the country and abroad are being served by these graduate with dedication.

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SUITABILITY OF AMERICAN GUAVA VARIETIES FOR PROCESSING PURPOSES[1]

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ABSTRACT

Studies were conducted on three American varieties of guava viz. Waialua, Hong Kong, Beaumont and Local variety (Sufaida). Three different products viz. jelly, squash and drink were prepared from each variety and stored at ambient temperature. The storage behaviour regarding physico-chemical analysis such as total soluble solids (TSS), acidity (%), pH and vitamin C was found similar. However, sensory evaluation for color, flavour and taste indicated that guava jelly and drink prepared from Beaumont was ranked at the top followed by Waialua, Hong Kong and Sufaida. Regarding guava squash, the Waialua scored highest followed by Beaumont variety. The drinks prepared from Beaumont, Waialua and Hong Kong were very attractive due to their natural pink colour.

INTRODUCTION

Guava (*Psidius guajava*) is one of the major fruits of Pakistan grown almost everywhere in the country. The total annual production was 793.7 thousand tonnes in 1992-93 covering an area of 83.6 thousand ha (Anonymous, 1994). Guava is relished by both poor and rich people. It is the richest source of vitamin C. One hundred gram edible portion of guava provides 229 mg vitamin C, 170 mg -carotene, 2.7 g fiber, 22 mg calcium, 20 mg phosphorus and 70 k.cal. of energy (FAO, 1982). Guava grown in Pakistan is good for table purpose but no particular product is available in market. Research on the processing of guava has been reported by different scientists. Mann (1965) conducted analysis of different guava varieties and guava jelly from dehydrated guava. Kalra and Revathi (1981) studied effect of packaging materials and storage temperatures on guava pulp. Kalra and Tandon (1984) studied the storage behaviour of sulfited guava and mango nectars. Yusof *et al.* (1988) used a response surface technique for optimizing production conditions for guava concentrate. Boting *et al.* (1987) evaluated the antimicrobial efficiency of different preservatives on apple and guava juices. Similarly Harris and Karmas (1975) discussed the effect of thermal processing on different products of guava and other fruits.

Studies were planned to compare American guava varieties to local variety for processing suitability. The American varieties are pink in colour, more fruit bearing and acidic and have more seed portion than local.

MATERIALS AND METHODS

Study was conducted during the year 1991-93. Four varieties of guava in which three American and one local were procured from Horticulture Research Institute, Faisalabad.

T_1 = Waialua
T_2 = Hong Kong
T_3 = Beaumont
T_4 = Sufaida (Local)

Three products jelly, squash and drink were prepared from each variety according to standard methods. The products were packed as follows and stored at ambient temperature (20-35 °C):

Jelly:	Pre-sterilized glass jars -	450 g
Squash:	Pre-sterilized glass bottles -	750 mL
Drink:	Pre-sterilized glass bottles -	250 mL

Evaluation

The physico-chemical analysis such as total soluble solids (TSS), acidity (%), pH and vitamin C (AOAC, 1990) were carried out for 6 months at one month interval. Similarly, sensory evaluation for colour, flavour and taste (Larmond, 1987) was conducted using Hedonic scale rating of 1-9. This evaluation was carried out by a panel of five trained judges from Food Technology Section, Ayub Agricultural Research

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

Institute, Faisalabad. The data obtained was analyzed statistically using two factorial design (Steel & Torrie, 1980).

The increase in TSS and acidity might be due to hydrolytic activity during storage. These activities are attributed to the release of pectin from protopectin, and

Table 1. Physicochemical analysis of different treatments of guava jelly

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Total soluble solids (%)								
T1	70.0	70.1	70.3	70.3	70.4	70.5	70.7	70.33 c
T2	70.2	70.3	70.4	70.6	70.6	70.7	70.9	70.53 a
T3	70.1	70.2	70.3	70.5	70.6	70.6	70.8	70.44 b
T4	70.2	70.2	70.4	70.5	70.6	70.7	70.9	70.50 a
Mean	70.13 g	70.20 f	70.35 e	70.47 d	70.55 c	70.63 b	70.82 a	
Acidity (%)								
T1	0.82	0.82	0.83	0.85	0.86	0.87	0.87	0.8457 a
T2	0.69	0.70	0.72	0.74	0.74	0.77	0.79	0.7362 d
T3	0.80	0.82	0.82	0.82	0.84	0.85	0.86	0.8329 b
T4	0.75	0.75	0.75	0.77	0.80	0.80	0.82	0.7771 c
Mean	0.765 f	0.7725 ef	0.785 de	0.795 cd	0.810 bc	0.8225 ab	0.8358 a	
pH								
T1	3.44	3.44	3.42	3.42	3.40	3.20	3.18	3.357 d
T2	3.88	3.88	3.84	3.82	3.77	3.70	3.62	3.787 a
T3	3.66	3.66	3.64	3.63	3.62	3.60	3.54	3.621 c
T4	3.80	3.80	3.75	3.74	3.72	3.64	3.55	3.716 b
Mean	3.694 a	3.695 a	3.662 b	3.653 b	3.628 c	3.535 d	3.475 e	
Vitamin C (mg 100 g^{-1})								
T1	11.00	11.00	8.00	6.00	6.00	6.00	4.00	7.43 bc
T2	12.00	11.00	11.00	11.00	6.00	5.00	5.00	8.71 ab
T3	12.00	10.00	10.00	10.00	10.00	8.00	5.00	9.29 a
T4	10.00	9.00	9.00	6.00	5.00	5.00	3.00	6.71 c
Mean	11.25 a	10.25 a	9.50 ab	8.25 bc	6.75 cd	6.00 de	4.25 e	

RESULTS AND DISCUSSION

The results obtained during storage regarding different products of guava varieties are discussed as under:

Physico-chemical analysis

The results of physico-chemical analysis of jelly, squash and drink are given (Tables 1, 2, 3). These results showed almost similar storage behaviour of jelly, squash and drink. A slight increase in TSS took place during storage in all the treatments in these products. The increase in acidity with corresponding decrease in pH was also observed. A gradual loss in vitamin C in these products of guava also occurred during storage.

some organic acids like pectic acid and pectinic acid from pectin (Babky *et al.*, 1986; Hulme, 1970; Uramil & Bajaj, 1983). Similarly, loss in vitamin C in these products might be due to enzymatic oxidation (Nickerson & Ronsivalli, 1982; Ullah & Hussain, 1983; Zia, 1987). The amount of vitamin C in jelly was much less as compared to squash and drink at the zero day which might be due to thermal processing as reported by Harris and Karmas (1975).

Sensory evaluation

The aggregate scores regarding colour, flavour and taste of jelly, squash and drink along with their levels of means are given (Tables 4, 5, 6). Guava jelly and drink prepared from Beaumont variety ranked at

Table 2. Physicochemical analysis of different treatments of guava squash

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Total soluble solids (%)								
T1	48.0	48.2	48.2	48.4	48.7	48.9	49.0	48.46 c
T2	48.3	48.4	48.5	48.7	48.8	49.0	49.2	48.70 a
T3	48.0	48.1	48.8	48.4	48.6	49.0	49.2	48.53 b
T4	48.2	48.3	48.3	48.5	48.6	49.2	49.4	48.65 a
Mean	48.13 g	48.25 f	48.35 e	48.50 d	48.68 c	48.97 b	49.20 a	
Acidity (%)								
T1	1.20	1.20	1.24	1.26	1.26	1.26	1.29	1.246 b
T2	1.28	1.30	1.33	1.35	1.37	1.37	1.39	1.341 a
T3	1.16	1.17	1.19	1.21	1.22	1.24	1.26	1.207 c
T4	1.15	1.16	1.20	1.22	1.23	1.23	1.25	1.206 c
Mean	1.201 d	1.207 d	1.240 c	1.260 b	1.270 b	1.275 b	1.298 a	
pH								
T1	2.70	2.70	2.64	2.62	2.59	2.52	2.45	2.603 d
T2	2.80	2.78	2.70	2.69	2.66	2.60	2.55	2.683 a
T3	2.77	2.76	2.73	2.70	2.65	2.56	2.50	2.667 b
T4	2.75	2.75	2.70	2.68	2.60	2.54	2.43	2.636 c
Mean	2.755 a	2.747 a	2.693 b	2.673 c	2.625 d	2.555 e	2.483 f	
Vitamin C (mg 100 g^{-1})								
T1	63.0	60.3	58.4	56.2	55.3	53.4	50.3	56.81 a
T2	62.2	59.8	56.3	52.6	51.4	48.9	45.6	53.83 c
T3	62.0	60.0	56.0	54.3	53.6	51.8	46.4	54.87 b
T4	60.6	60.2	54.0	53.2	51.2	50.6	44.8	53.43 d
Mean	61.92 a	60.08 b	56.17 c	54.15 d	52.88 e	51.17 f	46.78 g	

the top followed by Waialua, Honk Kong and Sufaida varieties, whereas in guava squash, Waialua variety scored highest followed by Beaumont after 6 months storage. The squash and drink prepared from Waialua, Beaumont and Hong Kong varieties were very attractive due to their natural pink colour as compared to white coloured local variety, however, the products remained acceptable during storage. Jain and Dorker (1970) reported almost the same results while working on guava beverage.

From these studies, it was concluded that the jelly and drink prepared from Beaumont variety were highly acceptable and stable in quality followed by Waialua, Hong Kong and Sufaida during storage. Whereas in case of squash Waialua ranked the best. Similarly the squash and drink prepared from Beaumont, Waialua and Hong Kong were very attractive due to their natural pink colour.

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BOOK REVIEW

ELEMENTS OF FOOD AND NUTRITION by **Dr. J.A. Awan** draws the attention of the reader towards solution to some health problems related to the intake of foods. the merits of this book are in its structure, clarity, brevity and the coverage. It provides simple explanation of the chemical nature of food with the description of what happens to it when eaten or processed. The author has assumed little prior scientific knowledge on the part of the reader and has conveyed basic scientific facts and principles necessary for the understanding of nutrition.

This book is divided into nine chapters: Introduction, Carbohydrates, Lipids, Proteins, Vitamins, Inorganic Materials, Digestion and Absorption. It describes the role of nutrients in health and disease, their recommended dietary allowances, their fate in the body and contents in selected foods. A glossary of selected terms and an index are included at the end. This book is useful for the students undertaking courses in Food Technology, Home Economics, Nutrition and Dietetics and Nursing.

The book is printed on Art Paper with Soft Cover, has 136 pages and Price Rs. 140.000 (Pakistan)) and US $ 10.00 (Foreign).

The book is available from: **VIRGOS**, 6-Moon Plaza, Chiniot Bazaar, Faisalabad. Tel. (041) 637547-612425, Fax: (041) 641087 and **Pak Book Empire**, 70, A-1, Al-Sheikh Chambers, Muzang Road, Lahore. Tel. (042) 6370660, Fax: (042) 6370849-324740

Table 3. Physicochemical analysis of different treatments of guava drink

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Total soluble solids (%)								
T1	12.00	12.00	12.10	12.10	12.20	12.40	12.60	12.20 c
T2	12.00	12.00	12.20	12.30	12.40	12.40	12.50	12.26 b
T3	12.00	12.00	12.40	12.40	12.50	12.70	12.80	12.40 a
T4	12.00	12.20	12.20	12.20	12.30	12.50	12.50	12.27 b
Mean	12.00 e	12.05 e	12.23 d	12.25 d	12.35 c	12.50 b	12.60 a	
Acidity (%)								
T1	0.22	0.23	0.25	0.26	0.26	0.27	0.29	0.2543 a
T2	0.19	0.19	0.22	0.22	0.22	0.24	0.27	0.2214 b
T3	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.2600 a
T4	0.18	0.19	0.22	0.22	0.22	0.24	0.27	0.2200 b
Mean	0.2100 d	0.2150 d	0.2375 c	0.2400 bc	0.2400 bc	0.2550 b	0.2750 a	
pH								
T1	4.20	4.18	4.16	3.95	3.90	3.86	3.82	4.070 c
T2	4.46	4.44	4.42	4.00	3.90	3.80	3.75	4.110 b
T3	4.18	4.17	4.16	4.02	3.80	3.76	3.72	3.973 d
T4	4.65	4.60	4.58	4.21	4.02	3.96	3.80	4.204 a
Mean	4.372 a	4.347 b	4.330 c	4.045 d	3.905 e	3.845 f	3.779 g	
Vitamin C (mg 100 g^{-1})								
T1	27.00	25.00	25.00	25.00	23.00	18.00	16.00	22.71 b
T2	28.00	26.00	26.00	26.00	21.00	19.00	13.00	22.71 b
T3	29.00	29.00	29.00	24.00	23.00	23.00	18.00	25.00 a
T4	27.00	27.00	27.00	21.00	21.00	16.00	11.00	21.43 b
Mean	27.75 a	26.75 a	26.75 a	24.00 b	22.00 bc	19.00 c	14.50 d	

Table 4. Effect of storage on the sensory evaluation of different treatments of guava jelly

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Colour								
T1	7.0	7.6	6.6	6.4	6.0	6.0	6.0	6.514 b
T2	7.0	7.2	6.4	6.2	6.2	6.2	5.6	6.400 c
T3	8.2	7.6	6.6	6.4	6.4	6.4	6.4	6.857 a
T4	7.0	6.6	6.6	6.4	6.0	6.0	5.4	6.286 d
Mean								
Flavour								
T1	7.0	6.2	6.2	6.0	6.0	5.4	5.0	5.971 b
T2	7.0	6.0	6.0	6.0	5.6	5.2	5.2	5.857 c
T3	7.6	7.2	7.0	6.6	6.4	6.4	6.2	6.771 a
T4	6.6	6.0	5.8	5.6	5.6	5.4	5.0	5.714 d
Mean	7.033 a	6.350 b	6.250 c	6.050 d	5.900 e	5.600 f	5.350 g	
Taste								
T1	7.0	7.0	6.6	6.2	5.6	5.8	5.2	6.200 b
T2	6.8	6.6	6.8	6.0	5.8	5.6	5.2	6.114 c
T3	8.4	7.6	7.0	6.8	6.8	6.8	6.6	7.143 a
T4	7.0	7.0	6.4	6.0	5.6	5.4	5.0	6.057 d
Mean	7.300 a	7.050 b	6.700 c	6.250 d	5.950 e	5.900 e	5.500 f	

Table 5. Effect of storage on the sensory evaluation of different treatments of guava squash

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Colour								
T1	8.2	7.2	7.2	6.6	6.6	6.6	6.0	6.915 a
T2	7.0	6.6	6.4	6.2	6.0	5.8	5.4	6.200 c
T3	8.2	7.6	6.8	6.4	6.0	6.2	6.0	6.743 b
T4	7.0	6.6	6.2	6.0	6.2	6.0	6.0	6.286 c
Mean	7.600 a	7.000 b	6.600 c	6.300 d	6.200 e	6.150 e	5.850 f	
Flavour								
T1	7.0	6.4	5.6	6.0	6.0	5.4	5.0	5.952 b
T2	6.8	5.6	6.0	5.4	5.0	5.0	5.0	5.543 c
T3	8.2	6.8	6.2	6.4	6.2	6.2	6.2	6.600 b
T4	6.6	6.6	6.0	6.2	5.0	5.0	5.2	5.800 a
Mean	7.150 a	6.133 b	6.000 b	5.983 b	5.617 c	5.400 d	5.333 d	
Taste								
T1	8.0	7.0	6.0	6.8	5.6	5.2	5.0	6.228 a
T2	6.6	5.6	6.0	6.0	5.6	5.4	5.0	5.743 c
T3	7.0	6.2	6.2	6.2	6.4	5.4	6.6	6.219 a
T4	7.0	6.6	5.6	6.0	5.6	5.6	5.2	5.981 b
Mean	7.217 a	6.350 b	6.250 b	5.850 c	5.783 c	5.450 d	5.400 d	

Table 6. Effect of storage on the sensory evaluation of different treatments of guava drink

Treatment	Storage period (days)							
	0	30	60	90	120	150	180	Mean
Colour								
T1	7.6	7.2	7.0	7.0	7.0	7.0	7.0	7.114 b
T2	7.0	6.4	6.6	6.4	6.2	6.2	6.0	6.400 c
T3	8.0	7.6	7.2	7.2	7.4	7.4	7.6	7.486 a
T4	7.0	6.4	6.4	6.6	5.8	5.6	5.6	6.400 c
Mean	7.400 a	7.050 b	6.800 c	6.750 d	6.800 c	6.600 e	6.550 f	
Flavour								
T1	7.4	7.0	7.0	7.0	6.6	5.4	5.0	6.486 d
T2	7.0	7.0	7.0	6.8	6.6	6.4	6.0	6.686 b
T3	7.2	7.6	7.6	7.6	7.6	7.6	7.2	7.486 a
T4	7.0	6.8	6.8	6.4	6.4,	6.2	6.0	6.514 c
Mean	7.150 a	7.100 b	7.100 b	7.000 c	6.800 d	6.400 e	6.050 f	
Taste								
T1	7.2	7.2	7.0	6.8	6.8	6.4	6.4	6.829 b
T2	7.2	7.0	7.0	7.0	6.8	6.2	5.6	6.686 c
T3	7.6	7.4	7.4	7.4	7.2	7.2	7.0	6.571 d
T4	7.2	7.4	7.2	7.0	6.6	5.6	5.0	6.571 d
Mean	7.300 a	7.250 b	7.150 c	7.050 d	6.850 e	6.350	6.000 g	

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EFFECT OF IRRADIATION AND STORAGE ON GROWTH AND O-DIPHENOL OXIDASES OF MUSHROOMS[1]

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ABSTRACT

Pleurotus and *Agaricus* mushrooms were picked and freshly analysed for the proximate composition, vitamins and sugars. The mushrooms were also subjected to gamma radiation (0-3.0 kGy) and studied for the o-Diphenol oxidase (o-DPO) activities during storage at 20 ± 2°C. The enzyme activity in *Agaricus* mushrooms increased about 2-3 times during first 4 days and then decreased during later storage. In *Pleurotus* the o-DPO activity increased during the first 2 days and then decreased (P = 0.05) during further storage. Stipe had a higher concentration of o-DPO than the lamella and pileus portions. Irradiation had no immediate effect on fresh mushroom but during later storage treated samples gave significantly higher values of o-DPO. Ionization radiation inhibited the growth and spore production in mushroom and extended their storage life.

INTRODUCTION

Mushrooms are being relished the world over as delicacy due to their flavour and snob values. Mushroom is a very delicate crop which cannot be stored for more than 1-2 days at room temperatures. Enzymatic activities have been used as parameters of metabolic activities while studying fruit growth or tissue reactions (Monselise & Kahan, 1965). Browning of plant tissue is a well known phenomena which take place during growth and development of plants. Enzymatic browning is an indirect result of polyphenol oxidases (PPO, o-diphenol oxygen reductases, EC 1.10, 3.1). Enzymatic browning may be desirable in products such as black tea, sultana raisins and prunes. It is highly undesirable in most other food products (Vamos-Vigyazo, 1981). The enzyme oxidizes the natural o-diphenol of fruits and vegetables to quinones, which are transferred to partly insoluble dark compounds by secondary nonenzymatic reactions. The enzyme has no access to its substrate in intact cells and, therefore, enzymatic browning may develop only in presence of air (oxygen) in fruits and vegetable cell damaged by peeling or comminution (Vamos-Vigyazo *et al.*, 1977). Ionizing radiations have been extensively used for increasing the storage life of fruits and vegetables (Rowley & Brynjolfsson, 1980). Gamma rays have been applied for inhibiting the growth of mushrooms during storage (Staden, 1965; Kovacs *et al.*, 1981). The review of literature shows that there are few reported references about the polyphenol oxidases of mushrooms. The present studies were, therefore, undertaken to extend the storage life of mushroom by gamma irradiation and investigate the changes in o-DPO activity in different mushrooms.

MATERIALS AND METHODS

Pleurotus and *Agaricus* mushroooms were used in these experiments. The *Pleurotus ostreatus* were grown at the Institute. The mushrooms were cultivated on paddystraw. The *Agaricus bisporus* (L.) variety of mushroom was obtained from the Mushroom Production Unit of National Logistic Cell, Rawalpindi. The mushrooms were picked in young and mature states. The mushrooms were stored for 8 days at 20 ± 2°C and 70-80 per cent relative humidity. Radiation treatment of mushrooms was carried out in the Co-60 gamma irradiation source of 4.0 kCi activity at the institute. The samples were irradiated at a dose rate of 3.290 kGy per hour. Irradiation doses of 1.0, 2.0 and 3.0 kGy were applied in air (20-26°C). One fifth of the mushrooms were used as non-irradiated control.

Experimental samples were sorted for uniform shape and size and divided into five lots of 12 mushrooms each for 0, 1.0, 2.0 and 3.0 kGy treatments. Proximate composition, vitamin and sugar analysis of mushroom samples was carried out according to AOAC (1984). Pileus diameter of the selected samples were determined in fresh condition and changes in growth during the storage were measured using vernier caliper. The samples were also rated visually for the

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extent of veil opening. For o-DPO studies of the basidocarps of each lot were separated into their morphological parts i.e. pileus (cap), stipe (stalk) and lamella (gill). These parts were analyzed separately for the enzyme activity according to the method described by Vamos-Vigyazo *et al.* (1973). The degree of enzymes activity was determined by the regression equations. The enzyme activity was expressed in units, which is defined as producing a change of 1.10^{-4} optical density modulus per minute.

Table 1. Composition of mushroom

Nutrients	*A. bisporus*	*P. ostreatus*	Mean	CV
Proximate composition (%)				
Protein	23.34	19.44	21.39	12.89
Fats	2.86	1.20	2.03	57.82
Ash	8.88	8.00	8.44	7.37
Fibre	12.31	14.33	13.32	10.72
Carbohydrate	52.61	57.03	54.82	5.70
Energy (k.cal/100 g)	309.14	312.54	310.84	0.77
Vitamins				
Ascorbic acid (mg/100 g)	107.60	120.47	114.04	7.98
Riboflavin (μg/g)	327.80	288.53	308.17	9.01
Sugars (%)				
Red sugar	17.73	15.06	16.40	11.52
Non-red sugar	0.93	1.14	1.40	14.35
Total	18.86	16.20	17.53	20.18

On moisture free basis and values are the average of three determination(n = 3)

RESULTS AND DISCUSSION

Composition and growth changes in mushrooms

Nutritional evaluation of *Agaricus* and *Pleurotus* mushrooms was carried out and it was observed that these mushrooms are rich sources of different nutrients. The moisture content of the mushrooms had a range of 90.4-91.8 per cent. The proximate analysis data indicated that, on a dry matter basis, the *Agaricus* mushroom samples had higher protein contents than the *Pleurotus* mushroom. The fat and ash contents were also highest in *A. bisporus* and lower in *P. ostreatus*. The statistical analysis of the data on the proximate composition indicated that the mushroom species generally differed significantly in their contents of these nutrients (Table 1).

Krula *et al.* (1978) reported values which ranged from 12 to 35 per cent for protein and 2 to 9 per cent for fat contents in 15 different species of mushrooms. The crude fibre content was higher (14.33%) in *Pleurotus* than the *Agaricus* mushroom (12.31%). The fibre contents observed in our studies is in agreement with Zakhary *et al.* (1984). The energy level calculated indicated higher values (312.54 k.cal/100 g) in *Pleurotus* than the *Agaricus* mushroom (309.14 k.cal/100 g). The low caloric values of mushrooms is due to their low fat and carbohydrate contents. The ascorbic acid and riboflavin contents of *Agaricus* and *Pleurotus* mushrooms were 107.60 mg/100 g, 327.80 mg/g and 120.47 mg/100 g and 288.53 mg/g, respectively. The concentration of reducing and non-reducing sugars were 17.73 and 0.93 and 15.06 and 1.14 per cent, respectively in *Agaricus* and *Pleurotus* mushrooms.

Agricus bisporus mushroom when harvested had closed caps and were white and attractive in colour. Storage studies revealed that the non-irradiated samples deteriorated most rapidly. It was observed that on second day storage the veil started opening and during later storage all mushrooms were with broken veils. The pileus of mushroom started expanding and growth was somewhat linear in unirradiated samples during their storage period of 8 days. Growth was strongly inhibited by the radiation treatments of 2-3 kGy. The 1.0 kGy treated samples were found intermediate between control and 2-3 kGy treatments. In *Pleurotus* mushrooms the pileus is usually broad and fan shaped. The lamella is normally closed, broad and pallid to cream colour. During storage no prominent

changes occurred in this fungus except shedding of spore. Ionizing radiation strongly inhibited spore production and the effect of higher doses was more prominent.

2. Significantly higher enzyme activity was observed due to the irradiation doses (1-3 kGy) in both the investigated mushrooms. The activity of o-DPO in *A. bisporus* mushroom varied in the range of 23260-44933,

Table 2. o-DPO activity in irradiated and stored Pleurotus mushrooms (units/g tissue)

Dose kGy	Morphological parts	Storage time (days)				
		0	2	4	6	8
0	Pileus	2363	2608	2506	2550	1927
	Stipe	3467	3683	3600	3517	3087
	Lamella	1830	1820	1823	1790	1730
1	Pileus	2367	2967	2660	2827	2017
	Stipe	3433	3957	3783	3787	3010
	Lamella	1833	1863	1887	1840	1790
2	Pileus	2366	3080	2567	2907	2066
	Stipe	3433	4120	3850	3953	3110
	Lamella	1833	1893	1883	1887	1830
3	Pileus	2380	3177	2590	2817	2126
	Stipe	3466	4373	3900	3880	3183
	Lamella	1850	1946	1873	1866	
	Mean	2552 c	2962 a	2744 b	2802 ab	2320 ab

Values are average of three determinations of the same sample.
Enzyme activity-change of 1.10-4 optical density modulus per minute.

Ripening or senescence delay has been regarded as one of the most important consideration of irradiation preservation of fruits and vegetables. Numerious workers have reported different dose values for growth inhibition in muishrooms. Skou *et al.* (1974) observed a significant but transitory effect of 0.25 kGy which improved upto 2.0 kGy on the growth inhibition of mushrooms. Gill *et al.* (1969) found suitable doses of 1.0 kGy or above. Yamaguchi and Campbell (1973) reported that a dose of 1.0 kGy was more effective than 0.5 kGy. As temperature and relative humidity seriously effect the opening ability of mushrooms, therefore, the varied experimental conditions may be the reasons for the reported varying doses of irradiation mentioned in literature. The results of the present work show that all doses of irradiation inhibit the growth and spore production in mushrooms and this effect was improved with the higher doses of irradiation.

o-Diphenol oxidase activity

The results of the effects of irradiation and storage experiments for o-DPO enzyme are presented in Table

9893-28907 and 6366-13193 units per gram of stipe, pileus and lamella portions of mushroom, respectively. Storage produced a gradual and significant (P = 0.05) increase in o-DPO activity upto period of 4 days in all the parts. The activity increase to about 2-3 times in different samples during this time. After 4 days of storage there was a significant decline of enzyme activity in all the investigated samples. Stipes of the fruiting body contained about two fold more activity of the enzyme than other portions, while pileus had comparatively higher values of o-DPO than the lamella portion.

In *Pleurotus ostreatus* mushroom the o-DPO activity varied in the range of 2363-3177, 3467-4373 and 1830-1964 units per gram of pileus, stipe and lamella portions (Table 3). Significant increase in o-DPO activity was observed in the beginning (2 days) in all the parts and then there was a gradual and significant decline of the enzyme activity in all the morphological parts. Stipe contained highest concentration of the enzyme which was followed by pileus and lamella portions.

Table 3. o-DPO activity in irradiated and stored Agaricus mushrooms (units/g tissue)

Dose kGy	Morphological parts	Storage time (days)				
		0	2	4	6	8
0	Pileus	9893	19000	26610	10333	12087
	Stipe	23260	36933	44513	36607	23347
	Lamella	6366	9953	12720	11293	4952
1	Pileus	9897	21407	28733	18897	12877
	Stipe	23266	40480	54513	45313	24800
	Lamella	4627	11577	13193	11910	5933
2	Pileus	9900	21687	28907	20200	12753
	Stipe	23333	41707	55200	45153	24777
	Lamella	6467	11813	12860	11270	5935
3	Pileus	9920	21677	28587	19860	12780
	Stipe	23334	41127	54987	45933	24200
	Lamella	6473	11270	12860	11490	5713
	Mean					

Values are average of three determinations of the same sample.
Enzyme activity-change of 1.10-4 optical density modulus per minute.

Ketesz and Zito (1956) noted an increase in the enzymatic activity of polyphenol oxidases in mushroom extract during their purification procedure. Murr and Morris (1975) observed that o-DPO activity increased during storage and pointed out that the rate of change was related to temperature. Yamaguchi and Campbell (1973) have shown that o-DPO activity (latent form) in mushrooms increased about two fold from bottom to the stage of veil opening. It was also reported that the stipe portion contained about 2-3 time more o-DPO than the pileus of the cultivated mushroom. The results of the present study corroborate the earlier findings. The observed increase in the enzyme activity may be due to the reason that enzyme transitions happened which can be related to non-readily observable changes during the process of maturation and senescence. Owawa *et al.* (1968) reported no change of polyphenol oxidase in potatoes, while Thomas and Niar (1971) observed the activation of o-DPO enzyme in banana by gamma irradiation.

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BOOK REVIEW

ELEMENTS OF FOOD SCIENCE AND TECHNOLOGY by **Dr. J.A. Awan** is useful for the first course in food preservation. It is recommended for the students undertaking a course or diploma programme in Food Science and technology in Colleges and Universities of Pakistan. Students studying Home Economics will also find this book very useful for their course on food preservation.

This book is divided into 17 chapters. First eight chapters describe the significance and developments in the field with information on nature of food, its classification and spoilage. Spoilage agents are described at length followed by the principles of food preservation and preparatory operations in food processing. Subsequent, six chapters elaborate on the methods of food preservation, Use of High Temperature, Use of Low Temperature, removal or Binding of Moisture, Use of Chemical Additives, Use of Fermentations and Use of Irradiations. This book ends with details about food packaging.

The book is printed on White Paper with Hard Cover, has 239 pages and Price Rs. 220.00 (Pakistan)) and US $ 15.00 (Foreign).

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DETECTION OF IRRADIATED DRIED FRUITS AND PLANT NUTS BY CHEMILUMINESCENCE MEASUREMENTS[1]

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ABSTRACT

Chemiluminescence (CL) intensities using luminol and lucigenin reactions of different dried fruits and plant nuts such as apricot, date, raisin, almond, peanut, pinenut and walnut were measured. The data showed irreproducible and dispersed values in case of control and irradiated (0.5, 1.0 and 1.5 kGy) samples tested on as such basis. The CL method originally developed for detecting irradiated spices was then modified for dried fruits, which involved the use of mineral matter obtained as a result of dry ashing in a muffle furnace. Thus the results so obtained revealed that there was profound difference in the CL-intensities between unirradiated and irradiated samples and that the response was found to be dose depended in each case. The technique is now being tested on fresh fruits and the seeds of dried fruits.

INTRODUCTION

Dried fruits and plant nuts are considered as concentrated source of nutrients. They are consumed throughout the year by common masses and are also useful during military and space missions. Being an important food commodity, various methods are employed to preserve theme in their original form. Radiation technology is being used worldwide to extend the shelf life, minimize losses and as a quarentine treatment during international trade. In order to harmonize inter-country trade, identification of irradiated dried fruits and plant nuts has become imperative. Radical formation is associated with radiation treatment of foods. These radicals persists for considerable time. For identification purposes no general method is available which is applicable to all foods. A number of analytical detection methods showing promise have been presented (Delincee, 1992; Bogl & Heide, 1985). In Pakistan, extensive work on food irradiation processing has been conducted (Wahid, *et al.*, 1987; Sattar *et al.*, 1989) and it was, therefore, desired important to develope some routine detection method for irradiated foods especially the dried fruits and plant nuts.

MATERIALS AND METHODS

The dried fruits such as apricot, date, raisin and the plant nuts like almond, pinenut and walnut were obtained in fresh form from a local whole sale dealer in Peshawar. The samples were sorted and packed in clear polyethylene pouches for irradiation treatment with doses of 0.5, 1.0 and 1.5 kGy using Co-60 source ISSLEDOVATEL (CIS) and subsequent chemical detection assay involving chemiluminescence technique. The samples of the fruits were cut into small pieces manually while those of nuts were ground in a blender. The chemiluminescence (CL) intensities were measured with luminol (5-amino 2, 3 dihydro-1,4 phthalazine dione) and lucigenine (bis N-methyle acridinium nitrate) reactions using luminameter model 1250. The composition of these solutions has already been reported (Sattar *et al.*, 1987). Although, this method has been proposed original for identification of spices (Khan *et al.*, 1993), it was modified for the CL measurement in dried fruits and tree nuts in the following ways:

a. CL measurement of samples as such
b. CL measurement of char-sample
c. CL measurement of sample-mineral matter

RESULTS AND DISCUSSION

The chemiluminescence (CL) measurements using luminol and lucigenin reactions indicated wide variation among different samples. The CL values of samples as such were not consistent and did not correlate well with absorb doses tried in this experiment. The results on CL measurements of samples after charring in open air were slightly consistent (Table 1). The treated samples can be identified but the data values were not dose dependent. However the values pertaining luminol and

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

Table 1. Chemiluminescence intensities with luminol and lucigenin reactions using charred material of dried fruits and nuts (Millivolts)

Sample	Luminol reaction radiation doses				Lucigenin reaction radiation doses			
	0	0.5	1.0	1.5	0	0.5	1.0	1.5
Apricot	0.45	0.60	0.58	0.60	8.0	8.5	8.5	7.0
Date	0.78	0.80	0.85	0.83	2.3	2.6	2.9	2.8
Raisin	0.19	0.40	0.40	0.40	10.0	11.0	11.5	12.0
Almond	0.22	0.30	0.25	0.27	3.4	4.4	4.7	5.0
Pinenut	0.20	0.34	0.30	0.40	3.0	3.5	3.0	3.5
Walnut	0.19	0.20	0.22	0.22	2.4	4.0	5.0	5.0
Mean	0.34	0.39	0.40	0.45	4.8	5.7	5.9	5.9
CV	64.4	55.5	54.1	54.6	62.2	53.4	52.3	51.7

Values are average of three determinations.

Table 2. Chemiluminescence intensities with luminol and lucigenin reactions using mineral matter of dried fruits and nuts (Millivolts)

Sample	Luminol reaction radiation doses				Lucigenin reaction radiation doses			
	0	0.5	1.0	1.5	0	0.5	1.0	1.5
Apricot	0.40	0.50	0.63	0.75	7.4	7.6	8.4	13.0
Date	0.70	0.80	1.20	1.60	1.9	1.9	2.5	3.0
Raisin	0.14	0.30	0.90	1.30	9.8	10.5	11.0	13.5
Almond	0.10	0.13	0.20	0.30	1.4	3.2	3.4	4.5
Pinenut	0.15	0.34	0.50	0.78	3.0	10.5	15.5	22.0
Walnut	0.12	0.15	0.25	0.44	2.0	9.5	14.3	19.0
Mean	0.27	0.37	0.61	0.86	4.25	7.2	9.2	12.5
CV	88.89	67.60	62.80	116	82.18	52.45	59.0	60.72

Values are average of three determinations.

lucigenin reactions with mineral matter obtained by dry ashing at 550°C in a muffle furnace were noted to be more consistent and correlated well with applied doses as shown in Table 2. The reliability and reproducibility of using CL technique for identification of irradiated dried fruits and plant nuts using the ashed mineral matter was quite satisfactory. The technique is quite simple, inexpensive and therefore can be used as a routine methods.

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NIR METHOD FOR THE DETECTION OF ADULTERATION OF BREAD WHEAT FARINA IN DURUM WHEAT SEMOLINA AND PASTA[1]

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ABSTRACT

NIR method which also measures chemical components and is environment friendly, rapid and inexpensive, was investigated for detecting adulteration of bread wheat into durum wheat. Thirty two samples of known moisture, protein and sterol ester contents were adulterated with known samples of bread wheat. The ranges of moisture and protein were randomly fixed over the entire range of adulteration for protection of errors derived by components other than adulteration. The calibrations were made for adulteration levels and validated on an other set of adulterated samples. The calibration equation with high R-square and low mean square error were selected for testing the adulteration in test samples and upto as low as 3% adulteration levels were detected by using InfraAlyzer-400 NIR instrument with 19 wavelengths.

INTRODUCTION

There is no doubt that pasta prepared from semolina is preferred by consumers (Garcia-Faure, 1969). Higher prices of durum in the world market can be a cause of adulteration. The existing methods for the detection of farina in semolina and pasta are not good (Dick & Youngs, 1988). The work on this project is going on for the last many years. The methods for adulteration detection are based on the chemical differences in durum and bread wheats. Walde and Mangels (1930) reported the presence of sterol esters (-sitosteryl and campesteryl palmitates) in bread wheats. Gilles and Youngs (1964; 1969) and Hsieh *et al.* (1980; 1981) confirmed the presence of sterol esters in bread wheat and their absence in durum. Polyphenol oxidase is present in bread but not in durum wheat (French Official Methods, 1975). Some gliadin fractions are present in bread but absent in durum wheat (McCarthy *et al.*, 1990). Differences in durum and bread wheat starches have also been reported (Solazzo, 1966).

For the determination of these components, different techniques like thin layer chromatography (TLC) and gas layer chromatography (GLC) for sterol esters (Gilles & Youngs, 1964; 1969) and Hsieh *et al.* (1980; 1981) and electrophoresis and RP-HPLC for gliadin fractions had been used by different scientists (Garcia *et al.* 1969; Payne *et al.* 1984; McCarthy *et al.*, 1990; Detmold, 1990; 1991).

All methods are time consuming and they do not work when pasta dried at high or ultra high temperatures because sterol esters bind to proteins and other components at mixing and processing and also may be oxidized at high temperatures (Laignelt, 1982) and protein denature at high temperature drying (Detmold 1990 and 1991). Due to less drying time and high quality products, high temperature drying of pasta is frequently used in industry.

In this study, a relatively new method, NIR spectroscopy which also measures chemical components (Osborne and Fern, 1986) and is environment friendly, rapid and less laborius, was used for adulteration detection. This method has been used for the analysis of fat, eggs, protein and moisture in pasta. It was assumed that changes during processing will be predicted and used for adulteration detection.

MATERIALS AND METHODS

Samples

33 bread wheat (Hard Red Spring) varieties were milled to farina and 26 durum wheats were milled to semolina. The farina and semolina samples prepared from the bread and durum wheats of a wide range of protein content were blended randomly to avoid the protein correlation with the adulteration (Table 1).

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

Table 1. Protein contents of farina and semolina blended at different adulteration levels for calibrations development

Farina (%)	0	1	2	3	4	5	6	7
Farina protein (%)	-	12.7	15.4	16.4	15.6	12.8	16.6	11.7
Semolina protein[a] (%)	17.7	12.9	15.4	16.6	16.0	12.8	14.4	12.8
Farina (%)	8	9	10	12.5	15	17.5	20	22.5
Farina prtein (%)	12.5	14.0	12.7	12.4	12.1	13.4	14.5	14.1
Semolina protein[a] (%)	12.5	14.4	12.7	12.2	12.4	14.7	15.8	14.4
Farina (%)	25	30	35	40	50			
Farina protein (%)	13.0	12.4	14.4	16.6	17.9	15.1		
Semolina protein[a] (%)	12.7	11.7	13.3	16.5	16.7	15.5		

[a]Protein levels (12-18%) on as-is moisture basis, selected at random for the 22 levels of adulteration.

Pasta Processing

With the semolina-farina mixtures, spaghetties were prepared under vacuum on Demaco Semi-Commercial Laboratory Extruder and one half was dried by conventional method at low temperature (40 C over a cycle of 18 hours), the other one half at high temperature (using a drying cycle with a temperature range of 28 C to 72 C) as ilusterated in Figure 1.

NIR calibrations

Grinding was done on willey mill with # 10 screen and then with Udy Mill with 0.5 mm Screen at constant feed rate of 2g second^{-1}. Moisture of the ground pasta samples was adjusted randomly over a range of 8.5 - 13.5 per cent. For calibration equation development, R-square and regression on log values and laboratory adulteration were determined by using SAS (1985) procedures of the North Dakota State University Mainframe Computer. The best calibration equations were selected on the basis of their high R-square, low root mean square (RMSE) and highly significant *t*-test on filter coefficients. Calibration constants were entered in the NIR-instrument and 10 samples of low or high temperature dried pasta were analyzed for bias adjustment before the final testing of the test samples (Technicon, 1984).

To reduce the effect of instrument noise on adulteration measurements 4 replicate log 1/R values on each sample were used for the R-square and regression analyses for selection of regression equations for adulterated. The criteria for selecting regression equation were high correlation (R), low root mean square error, highly significant Student's *t*-test for all filter coefficients and a wavelength filter in each calibration with known constituent absorption.

RESULTS AND DISCUSSION

The values for the constituents in 22 ground test samples of low temperature dried pasta and 16 ground test samples of high temperature dried pasta are given in Table 2. Test farina-semolina blend samples had a random range of 11-17 per cent protein (Table 1).

The calibration procedure is the key to success in NIR analysis and the tools used are statistics (Osborn & Fern, 1984). Here, we used the R-Square procedure of SAS for all combinations of filters to select filter combinations with the highest R-square values up to 7 filters to be tested by multiple regression analysis.

Calibrations were developed for adulteration levels in low and high temperature dried pasta and for combined low and high temperature dried pasta using the 19 NIR filters found in the InfraAlyzer 400.

NIR adulteration calibrations and testing

The calibrations for per cent adulteration of semolina pasta with farina were entered into the InfraAlyzer 400. The wavelengths and statistics on calibrations are given in the Table 3. The standard deviation was rather high for the calibrations derived from 19 filters (about 0.10). The high coefficient of variation is due partly to the large number of samples in the low range of adulteration that lowered the adulteration mean. All the calibrations had at least one filter (2348 nm, 2336 nm, 1772 nm, 1759 nm and 2310 nm) for oil or cellulose (Technicon, 1980). All the filter coefficients in calibration equations were highly significant (P 0.0001).

The standard error of prediction (SEP) was not low enough to ensure accurate prediction of adulteration levels (Tables 4, 5). The means of NIR predicted adulteration and reference adulteration were somewhat

Table 2. Ground test samples of farina-semolina for NIR adulteration analysis

Adulteration (%)	Moisture[a] (%)	Protein[ab] (%)	Total sterol esters[bc] (mg %)
Low temperature dried			
0	9.17	11.12	0.00
1	11.72	11.01	0.00
2	8.71	11.90	0.40
3	8.20	12.42	0.34
4	11.53	11.95	0.89
7	12.21	11.65	1.15
7	8.01	13.26	1.32
12	13.00	12.53	2.22
14	10.50	13.39	2.48
18	10.00	13.68	3.72
20	8.49	13.57	3.94
22	10.21	14.91	4.78
24	11.20	14.66	4.98
26	11.00	15.52	5.44
28	10.70	15.86	5.80
30	13.50	16.22	7.48
32	9.66	16.71	8.21
34	12.04	13.10	7.45
40	9.42	14.52	7.90
50	12.50	13.66	9.14
77	12.70	14.26	18.26
100	8.97	14.90	28.73
High temperature dried			
0	8.00	11.31	0.00
1	12.20	10.95	0.00
2	10.70	11.64	0.37
3	11.70	11.96	0.38
5	9.97	12.16	0.93
7	13.50	12.47	1.24
12	11.31	12.77	2.33
14	12.72	13.06	2.54
18	8.34	13.93	3.62
20	9.69	13.39	4.44
22	11.01	14.78	4.94
24	10.29	14.81	4.89
26	11.99	15.35	5.35
28	9.27	16.11	5.86
30	8.66	17.12	7.50
32	13.00	16.09	8.23

[a]Mean of duplicate analysis.
[b]12% moisture basis.
[c]Mean of duplicate analysis by gas chromatography on duplicate petroleum ether extracts of farina-semolina blends used for making pasta.

different. The standard deviation of repeatability was not consistent throughout the testing, indicating unstable calibration in some cases (Tables 4, 5).

The NIR wavelength for better prediction may not be the 19 ones available on the InfraAlyzer 400. NIR on 19 filter research instrument was able to measure as low as 3 per cent adulteration in pasta. The high coefficient of variance and SEP in the statistics in Tables 4 and 5 might be due to the NIR instrument InfraAlyzer 400's lack of proper wavelengths for the determination of components. Preliminary work indicated that NIR method could successfully be used for adulteration detection in pasta. Moreover, the variation in the detection of adulteration at different levels seems to be due to the differences in chemical components in bread and durum wheats used for calibrations and testing. The calibrations and testing statistics encourage the use of NIR spectroscopy for detection of adulteration of farina in semolina. The changes in the components responsible may also be established with more filters in the instrument.

Instead of 19 filter instrument, this work will be enhanced on 700 wavelengths (1100-2500nm with data points every 2 nm) options in NIR instrument (Systems Model 6250) at United States Department of Agri. Laboratories at North Dakota State University Campus, Fargo, North Dakota.

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Table 3. Statistics[a] of calibration equations for adulteration levels

Filters						Roote Mean ± SE	Coefficient of variance	R
Low temperature dried pasta								
2348	2190	2139				0.150	74.11	0.811
2336	2230	2100	1722			0.118	58.30	0.895
2236	2230	2100	1734			0.118	58.32	0.918
2348	2230	1778	2100	1759		0.099	48.95	0.918
2348	2270	2230	1778	2100	1759	0.098	48.40	0.924
High temperature dried pasta								
2348	2139	2100				0.145	68.01	0.804
2310	2139	1759	1734			0.116	57.48	0.868
2348	2230	2139	1778	1759		0.095	46.65	0.917
2348	2230	2139	1778	1445		0.095	46.67	0.919
Combined low and high temperature dried pasta								
2348	2190	2139				0.150	74.11	0.748
2236	2230	2100	1734			0.118	58.32	0.855
2348	2230	1778	2100	1759		0.099	48.95	0.901
2348	2270	2230	1778	2100	1759	0.098	48.40	0.905

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Table 4. NIR analysis[a] in duplicate for adulteration (%) in low temperature dried pasta with calibration for low temperature dried pasta and combined low and high temperature dried pasta

Laboratory adulteration (%)	Combined calibration		Low temperature calibration	
	NIR adulteration (%)		NIR adulteration (%)	
0	3.4	2.3	2.1	1.4
1	1.1	2.2	2.3	2.6
2	5.1	4.8	4.8	5.4
3	1.3	2.9	2.7	3.2
4	4.6	5.7	4.1	5.3
7	12.7	9.5	7.3	8.4
7	5.5	2.3	5.2	6.1
12	20.5	18.4	16.1	13.9
14	19.9	17.6	20.1	21.2
18	20.7	18.9	20.3	20.5
20	31.1	25.7	27.3	21.9
22	30.7	26.2	24.2	29.1
24	32.9	29.3	31.2	30.7
26	32.8	30.6	20.3	21.5
28	31.2	30.3	22.6	27.4
30	45.3	38.4	40.7	39.5
32	47.5	39.6	45.2	44.1
34	48.1	40.3	46.1	42.4
40	54.0	46.2	53.3	58.1
50	61.8	57.6	57.2	62.5
77	82.2	80.1	80.2	85.9
100	117.5	109.2	112.7	103.4
Statistical parametersb for N = 22				
Mean	25.04	32.27	29.00	29.36	29.75
SEP	-	5.78	3.24	5.63	5.33
C.V.	-	138.22	75.69	22.49	21.29
Sr	-	6.48	3.56	20.61	22.06

[a]Calibration equations used were:
Adulteration (%) = 10.42 - 180.20 (1759 nm) + 213.00 (2348 nm) + 541.63 (2230 nm) + 71.73 (1778 nm) - 674.80 (2100 nm)
Adulteration (%) + 10.63 (2336 nm) - 211.70 (2330 nm) + 177.00 (2100 nm) + 121.43 (1734 nm) - 118.80
for combined and low temperature equations, respectively.
bSEP = Standard error of performance for NIR method.
Sr = Standard deviation of repeatability of the NIR analysis.

Table 5. NIR analysis[a] in duplicate for adulteration (%) in high temperature dried pasta with calibration for high temperature dried pasta and combined low and high temperature dried pasta

Laboratory adulteration (%)	Combined calibration		Low temperature calibration	
	NIR adulteration (%)		NIR adulteration (%)	
0	2.2	1.1	1.3	1.0
1	0.3	1.2	1.5	2.2
2	1.3	1.4	1.6	1.5
3	3.2	4.3	4.1	4.7
4	7.4	6.1	4.1	7.2
7	4.2	4.1	3.9	4.8
12	2.7	4.8	9.3	7.9
14	15.7	13.2	12.4	14.5
18	11.8	15.2	21.3	16.9
20	17.2	18.1	24.8	22.6
22	19.4	21.9	26.7	19.3
24	20.0	21.0	27.2	21.5
26	22.8	24.3	28.4	19.9
28	24.5	25.9	26.3	22.8
30	15.4	25.5	26.8	28.2
32	30.2	35.1	36.6	34.5
Statistical parametersb for N = 16				
Mean	15.19	12.12	13.95	16.02	14.38
SEP	-	4.97	2.60	2.89	2.83
C.V.	-	41.00	18.63	19.06	18.68
Sr	-	3.80	1.99	1.82	3.22

[a]Calibration equations used were:
Adulteration (%) = 10.42 - 180.20 (1759 nm) + 213.00 (2348 nm) + 541.63 (2230 nm) + 71.73 (1778 nm) - 674.80 (2100 nm)
Adulteration (%) + 10.63 (2336 nm) - 211.70 (2330 nm) + 177.00 (2100 nm) + 121.43 (1734 nm) - 118.80
for combined and low temperature equations, respectively.
bSEP = Standard error of performance for NIR method.
Sr = Standard deviation of repeatability of the NIR analysis.

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EFFECT OF GAMMA IRRADIATION AND SUBSEQUENT GERMINATION ON THE AMINO ACID CONTENTS OF CHICKPEA[1]

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ABSTRACT

Effect of gamma irradiation and subsequent germination on protein and amino acid contents of chickpea was studied. The chickpea seeds (CM 72) were irradiated with rays. Irradiation treatment of seed with 0.1 kGy enhanced germination and marked increase in protein contents (21.70-27.98%) and amino acid contents. Amino acid profile indicated that the increase in amino acids like proline, glycine, alanine, valine, methionine, lysin, etc. after 120 hours of germination was more in the 0.1 kGy irradiated samples of chickpea than the unirradiated originals. Germination of seed increased the nutritional value of chickpea with regard to essential amino acids.

INTRODUCTION

Chickpea (*Cicer arietinum*) is extensively cultivated as a winter crop throughout Pakistan especially in the Southern areas of Punjab and NWFP. Like other legumes, it occupies a prominent position in our agriculture because it has the major protein component of our average diet. It has been recognised in the recent years that cultivation of pulses is perhaps the most practical means of solving the protein malnutrition problems in developing countries as it will take many years to bring about a major advance in production of high protein concentration of protein but also their protein is more adequate in its lysine content and other essential amino acids except for the sulphur amino acids and tryptophan (Boulter *et al.*, 1972).

In many parts of the world, legumes are often consumed after germination and can be used as fresh salad and processed vegetables (Chen *et al.*, 1975). During germination, the proteins are hydrolysed to peptides and amino acids (Beevers, 1968). The amino acids contents of legumes has been shown to generally increase during germination (Sattar *et al.*, 1990; Hsu *et al.*, 1980). Irradiation treatment has shown to increase the nutrient level and decrease the antinutrients of legumes (Sattar *et al.*, 1989; 1990 a, b). In view of the rapidly developing interest in chickpea as a protein crop for developing countries and its possible use in food and feed formulations, studies on the effect of irradiation and subsequent germination on the amino acid profile was studied.

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

MATERIALS AND METHODS

Samples of chickpea variety CM 72 were obtained from Mutation Breeding Division, Nuclear Institute for Food and Agriculture, Peshawar.

Irradiation

The seeds were irradiated with gamma rays at doses of 0.05, 0.10, 0.15 and 0.20 kGy using Co^{60} irradiator (ISSOLEDOVAL ICS). Germination of the seeds were carried out at ambient temperatures (30-35°C) as already described (Sattar *et al.*, 1990). The germinated seeds were dried in oven at 50-60°C, ground in Wiley mill to pass through 60-100 mesh screen. The ground samples were kept in air tight plastic bottles and stored in a deep freezer for subsequent analysis.

Biochemical analysis

Moisture was determined by drying at 105°C until constant weight and crude protein (per cent N x 5.71) by the micro-Kjeldahl method according to AOAC (1984). For amino acid assays, dried samples were defatted by extraction with petroleum ether (boiling point 40-60°C) for 3 hours. The residue was air-dried in an oven at 60°C for 4 hours, ground in a stainless steel Wiley Mill to pass through a 60 mesh sieve and then placed in a vacuum oven maintained at 65°C for 4 hours. A procedure described by Blackburn (1968) was used for amino acid assay.

RESULTS AND DISCUSSION

Improvement in the protein value of food grains on germination has been observed by several workers

Table 1. Effect of irradiation and germination on protein content of chickpea

Germination hours	Distilled water				Tap water			
	Unirradiated		Mean of 4 doses		Unirradiated		Mean of 4 doses	
	(g/100 g)	Increase (%)	(g/100 g)	Increase (%)	(g/100 g)	Increase (%)	(g/100 g)	Increase (%)
0	21.70	-	21.80		21.70	-	21.80	-
24	25.90	19.35	25.50		23.10	6.45	23.60	8.25
48	26.20	20.73	26.50		25.20	16.12	25.30	16.05
72	26.60	22.58	26.60		26.25	20.96	26.50	21.55
96	26.20	20.73	26.40		27.55	26.95	27.70	27.06
120	27.30	25.80	26.40		27.95	28.80	27.90	27.98
Mean	25.65		25.20		25.29		25.46	
CV	7.77		3.96		9.81		3.92	

Table 2. Effect of irradiation and germination in tap water on amino acids of chickpea (g/100 g of sample)

Amino acid	Germination time (hours)						
	Unirradiated						Irradiated 0.1 kGy
	0	24	48	72	96	120	120 hours
Essential							
Arginine	1.97	0.98	1.10	1.15	1.26	1.38	1.39
Lysine	1.35	1.47	1.50	1.67	1.78	1.88	1.63
Tyrosine	0.60	0.75	0.88	0.95	1.05	1.10	0.81
Phenylalanine	1.19	1.29	1.42	1.50	1.69	0.70	0.80
Methionine	0.37	0.49	0.59	0.58	0.62	0.73	0.95
Leucine	1.66	1.70	1.75	1.80	1.88	1.85	2.08
Isoleucine	1.00	1.30	1.33	1.36	1.45	1.50	1.60
Threonine	0.73	0.74	0.88	0.90	0.93	0.93	1.23
Valine	0.94	1.06	1.12	1.28	1.37	1.45	1.40
Total EAA	9.81	9.78	10.57	11.29	12.03	11.52	11.89
Non-essential							
Alanine	0.89	0.98	1.10	1.15	1.26	1.38	1.39
Aspartic acid	2.57	2.57	2.66	2.95	3.10	3.15	3.18
Cystine	0.35	0.35	0.37	0.38	0.39	0.42	0.43
Glutamic acid	3.86	3.89	3.95	4.09	4.18	4.19	4.34
Glycine	0.84	0.86	0.90	1.09	1.16	1.30	1.30
Proline	0.93	0.99	1.15	1.26	1.39	1.42	1.60
Serine	1.04	1.04	1.06	1.12	1.18	1.23	1.32
Histidine	0.50	0.51	0.60	0.68	0.69	0.70	0.80
Total non-EAA	10.98	11.19	11.79	12.72	12.66	13.79	14.36
Total AA	20.79	20.97	22.36	24.01	24.69	25.31	26.25

(Chen *et al.*, 1975; Sattar *et al.*, 1989, 1990). It was considered important to investigate the effects of radiation and germination on the protein and amino acids content of chickpea. Table 1 shows the influence of irradiation and germination in distilled and tap water on the protein content. The total protein value increased in both the cases and the increase was comparatively more in tap than distilled water whereas influence of radiation alone was negligible. The same observation in fenngreek(El-Shimi *et al.*, 1984), chickpea (Sattar *et al.*, 1990) and soybeans (Sattar *et al.*, 1990) has been reported. The increases in total protein in this and other legumes are not considered in fact the real ones but merely the result of oxidation and consumption of other 1280 during the germination process.

Amino acids content of treated and untreated seed during germination are shown in Table 2. It is clear from these results that the total essential 2140 amino acids increased on and beyond second day of germination whereas non-essential amino acids showed continuous increase during the germination period of 120 hours. Lysine, a limiting amino acid in cereals exhibited a continuous increase. Substantial increase in the amino acids during germination have been observed (Mostafa *et al.*, 1987; King & Puwastein, 1987; Sattar *et al.*, 1989). Recently, Youssef *et al.* (1987) reported that germination of Fababeans for 3 days initiated disappearance of some protein bands while other newbands were detected. In this regard, Chen and Thacker (1978) found that during germination, there probably is a turnover of protein and amino acids with the balance between the synthetic and degradative processes determining the resultant pattern. The relative change in amino acid content may be due to a net synthesis of enzyme protein during germination, possibly accounting for a major portion of the reported protein increase (Young & Varner, 1959).

It is concluded that germinated chickpea contained significantly higher values for protein and amino acids especially the essential ones than the ungerminated seeds. Low dose irradiation could further improve the nutritional value by increasing some essential nutrients than unirradiated originals.

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EFFECTS OF FEEDING RAPESEED MEAL IN THE DIET ON THE GROWTH PERFORMANCE AND SENSORY QUALITY OF MEAT OF BROILER CHICKS[1]

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ABSTRACT

An experiment was conducted to study the effect of including rapeseed meal at varying levels in the ration of broiler chicks on the performance and sensoric quality of their meat. Three different levels of rapeseed meal inclusion (15, 20, and 25%) were tested in comparision to a standard commercial feed formula without rapeseed meal. In a six week feeding trial, it was observed that feed consumption per chick, feed to gain ratio and dressing percentage were not affected by any level of rapeseed meal inclusion in the diet. Significant ($P<0.025$) reduction was recorded in weight gain per chick with 25% rapeseed meal, whereas there was no significant reduction up to 20% rapeseed meal inclusion. Final weight also observed the same pattern. Organoleptic evaluation of the meat from these chicks revealed that feeding rapeseed meal had no effect on the consumer's acceptance of meat.

INTRODUCTION

About 70% of the expenditures involved in poultry raising are feeding expenses. The higher the cost of feed, the more difficult it will be to raise poultry birds. The non availability of soybean meal in substantial amounts and at cheaper rates, compels the local poultry feed producers to use combinations of different feed concentrates as protein source. These commonly include fish meal, meat meal, blood meal, corn gluten of different protein concentrations etc. They are not only very costly, resulting in an overall increase in the cost of production of feed, but also the animal source protein concentrates are suspected to be highly infested and carry heavy microbial loads. Another reservation against these meals is that they are heavily salted at the time of processing, which can adversely affect the ion ratios in the resultant feed. Some of the reports in this field have also suggested that fish meal is a rich source of methyl- groups; this can result in the production of fishy odour in the eggs of layers with brown shelled eggs (Miller *et al.*, 1969; Opstvedt, 1974). The preceding discussion suggests a search for such protein concentrates which can be easily available in the local market, and will be nutritionally safe.

Rapeseed ranks third among other oilseed crops in the world (Shahidi, 1990) and second in Pakistan. The meal left after the extraction of oil contains up to 48% of good quality protein (Lo & Hill,1971). The amino acid profile of rapeseed protein compares favourably with that of soybean meal protein, except that it has more sulphur-amino acids and is low in lysine than soybean meal (Bell, 1984). It has been frequently suggested that in combination with some complementary protein source it can replace part or all of the soybean meal in poultry rations.

However, inclusion of rapeseed meal in poultry rations has been subject to several objections. One such objection is the development of off (fishy) flavour in the meat (Yule & McBride, 1976), which has been related to the high amounts of sinapin in rapeseed meal (Steedmann *et al.*, 1979 a, b). On the other hand there are reports which clearly demonstrate a complete lack of such flavour in the meat due to rapeseed meal feeding (Griffiths *et al.*, 1980). Present research was instituted to study the effect of including up to 25% rapeseed meal in the diet of chicks on the groth performance and organoleptic characteristics of their meat.

METHODS AND MATERIALS

Materials

Rapeseed of (double high) commercial variety Pakcheen was obtained from the mutation breeding

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & Technologists held on December 22, 1994 at NWFP Agricultural University, Peshawar.

section of the Nuclear Agriculture Division of Nuclear Institute for Food and Agriculture (NIFA) Peshawar. Crushing and exraction of oil was conducted according to the standard procedures (Shahidi, 1990).

Feeding trial

Day old broiler chicks were procured from M/s Big Bird (Private) Ltd., Lahore through an agent in Peshawar. The chicks were divided into four groups, each replicated three times. Eight chicks were included in every group. One group was fed on standard commercial formula diet without rapeseed meal while the other three groups were given diets containing 15, 20, and 25% rapeseed meal. Rapeseed meal was incorporated into the diet at the expense of cotton seed meal and a part of corn glutin meal (Table 1). Feed and water were given *ad libitum* throughout the experimental period. Data on feed consumption and weight gain was recorded weekly. The experiment was of six week duration at the end of which the chicks were slaughtered and dressed. Dressing percentage was determined according to the method reported by Paik (1991) except that skin was aslo removed.

Table 1. Composition of standard diet

Ingredient	Diet (%)	Protein (%)	Protein contribution to diet
Wheat	26	11.90	3.09
Maize	25	8.80	2.20
Rice polishings	10	13.79	1.38
Fish meal	7	35.66	2.50
Blood meal	3	81.23	2.44
Cottonseed cake	8	36.53	2.92
Corn gluten	8	64.46	5.16
Meat meal	6	41.40	2.48
Molasses	5	7.88	0.39
DCP	1	-	-
$CaCO_3$	1	-	-
Vita-minerals	12.5 g	5 kg^{-1}	-

Sensoric evaluation

Meat samples were de boned, minced and boiled to cook with the addition of table salt. These were then presented to a panel of 8 judges trained on the subject and to whom the phenomenon of off flavour production was explained. The samples were scored (1-10) for appearance, odour and tast with 1 extremely disliked and 10 extremely liked. Average of the scores for odour and taste were calculated and reported as flavour scores and average of all the parameters were calculated and reported as overall acceptibility (Larmond *et al.*, 1980).

Statistical analysis

Analysis of variance for all the data were determined using Co-Stat package and means were seperated using DNMRT.

RESULTS

Results regarding the effect of feeding rapeseed meal at various levels in the diet on the growth performance of broiler chicks are given in Table. 2. Maximun feed intake (3538g $chick^{-1}$) was noted for control followed by 25% rapeseed meal fed group (3443 g). The differences, however, were statistically non significant. Weight gain $chick^{-1}$ was not significantly reduced up to 20% rapeseed meal feeding, however, increasing the rapeseed meal upto 25% in the diet significantly ($P<0.025$) reduced the weight gain $chick^{-1}$. The gain in weight $chick^{-1}$ was maximum with 15% rapeseed meal feeding (1333 g) followed by control (1328 g) and 20% rapeseed meal fed group (1138 g) and minimum with 25% rapeseed meal feeding (1083 g). Final weight $chick^{-1}$ followed the same pattern. Although, not significantly different from other groups, the feed to gain ratio was lowest (2.52) in 15% rapeseed meal group followed by control group. Dressing percentage ranged from 52.12 to 54.92 among different groups and was not significantly affected by any treatment.

Results of the sensory evaluation of the meat samples from chicks of these groups are presented in Table.3. It can be noted that none of the organoleptic characteristics was influenced by any of the rapeseed meal levels in the diet of broiler chicks, and the judges could not destinguish the meat of rapeseed meal fed chicks from those of control ones.

DISCUSSION

Results of the present study clearly demonstrate that feeding high glucosinolates-rapeseed meal to broiler chicks up to 20% level had no significant effect on their performance. These finding are supported by those of Hulan and Proudfoot (1978) who stated that in combination with a complementary protein source, such as fish meal, rapeseed meal can replace all of the soybean meal in practical type broiler diets. Hulan *et al.* (1980) reported improved growth and growth efficiency when turkey broilers were fed starter, grower and finisher diets containing 10, 20 and 30% canola rapeseed meal, respectively, replacing soybean meal in the diets that also contained fish meal. The authors attributed the superior performance to the complementary amino acid balance of canola and fish meal. Pokniak *et al.* (1985) evaluated rapeseed meal at

three different levels of inclusion (0, 8 and 14% in the broiler diets and concluded that it was safe to add 14% rapeseed meal in the broiler starter rations.

Addition of thyroxin to the diet did not correct this effect. They rejected the idea that the growth depression in rapeseed meal fed birds was solely due to

Table 2. Effects of feeding rapeseed meal on the performance of broiler chicks

Treatment	Feed chick^{-1}	Gain chick^{-1}	Feed:gain	Final weight	Dry
Control	3538 a	1328 A	2.67 a	1378 A	52.39
RSM 15%	3353 a	1333 A	2.52 a	1381 A	53.58
RSM 20%	3367 a	1338 AB	2.98 a	1188 AB	52.92
RSM 25%	3443 a	1083 B	3.18 a	1132 B	52.12

Similarly, Anwar *et al.* (1971) reported that when the same levels of energy and gross protein values were fed to broilers from 6 day age onwards, soybean meal and rapeseed meal as protein sources produced similar results in weight gains.

classical hypothyrotic condition. It was suggested that although rapeseed meal fed birds were abnormal with respect to their thyroid activity, it seems probable that factors other than a simple reduction in serum thyroxin concentrations are responsible for the growth

Table 3. Effects of feeding rapeseed meal on the sensory quality of meat of broiler chicks

Treatment	Appearance (1-10)	Odour (1-10)	taste (1-10)	Flavour (1-10)	Overall acceptability
Control	7.62	7.25	7.25	7.25	7.25
RSM 15%	7.50	7.50	7.50	7.50	7.25
RSM 20%	7.50	7.25	7.25	7.25	7.25
RSM 25%	7.00	7.25	7.25	7.25	7.25

Léslie *et al.* (1976) demonstrated that when fortified with arginine and methionine, rapeseed meal can be fed to broilers at a level of 40% to supply the entire protein requirements without any adverse effects on growth. Vogt and Schubert (1969) fed rapeseed meal up to 35% of the diet for different lengths of times and noted that weight gain was slightly reduced but feed to gain ratio was increased from 1.85 in control group to 3.40 in group fed rapeseed meal for 8 weeks.

Leeson and Summers (1976) on the other hand recorded significantly lower final weight in broiler chicks fed 11% rapeseed meal from variety Span than soybean meal. The depression in weight gain was found to be associated with reduced feed intake and an increased feed:gain ratio. Similarly, Summers and Leeson (1977a) studied the effects of feeding up to 31% Span rapeseed meal to broilers on their performance. Significantly (P 0.05) lower weight gains with rapeseed meal than soybean meal (194 vs 214 g) were noted. Addition of choline and iodine did not affect the performance. Feed intake was not affected but feed:gain ratio was increased with rapeseed meal.

depression.

Arena and Penz (1988) recorded reduced weight gains but high feed conversions in broilers with rapeseed meal at 22.5 or 30% inclusion level in their diet. Slinger (1977) fed meal from *Brassica napus* variety Tower to turkey broilers to 16 weeks of age at a level of 250 g kg^{-1} of the diet and noted that gain in weight was equal to corn soybean meal diet.

The gross differences on results of present study and some other reports can be explained on the basis of results obtained by Pearson *et al.* (1983 a) who reported from a study involving four different broiler strains, that the growth rate with feeding high glucosinolates rapeseed meal was reduced only in one broiler strain, although, hypertrophic effects in all strain was evident.

In the present study, no effect of feeding rapeseed meal could be noted on the sensory quality of meat of chicks. These findings are in accordance with those of Griffiths *et al.* (1980) noted no effect on the flavour of the chickens meat with 10% high glucosinolates rapeseed meal in the diet. Yule and McBride (1976) on the other hand observed that feeding greater than 5%

rapeseed meal to broilers could produce off flavours in chickens meat. Steedmann *et al.* (1979 a) noted that overall acceptability of dark meat was significantly lower with rapeseed meal than with soybean meal whereas for light coloured meat there was no difference in the overall acceptability scores. These results were confirmed in a subsequent study by the same workers (1979 b). It was noted that although palatability scores for chickens fed span rapeseed meal at 15% level of inclusion in the diet were slightly lower than comparable scores given to the soybean meal-control chickens, the consumers panel rated the rapeseed meal-group as acceptable in quality.

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PORPHYRIDIUM CRUENTUM BIOMASS AS A POTENTIAL SOURCE OF FOOD COLOUR[1]

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INTRODUCTION

International Food Laws prohibit completely or partly the use of numerous artificial colours in foods (Walford, 1980), many of which are suspected to be carcinogens (Taylor, 1984). Consumer acceptability has thus shifted in favour of food items containing additives of natural origin. Major impediment in the elimination of synthetic colours in food products, however, is the limited range of available natural colours. This points to the need for search of bioresources from which safe pigments of suitable stability can be isolated. *Porphyridium cruentum*, a unicellular red alga, containing two proteinaceous pigments, phycoerythrin and phycocyanin, has been suggested to offer such a potential for food, drug and cosmetic industries (Vonshak, 1988). Advantages of these phycobiliprotein pigments over other dyes currently in use, are their intense colour, high solubility in water and stability to changes in pH (Cohen, 1986). Phycoerythrin can be easily extracted from the algal cells by heating them in phosphate buffer (Thepenier *et al.*, 1987), by their repeated alternate freezing and thawning (Siegelman & Kycia, 1978), by using the French pressure cell (Gantt *et al.*, 1979) or by sonification (Jahn *et al.*, 1984).

Biosynthesis of pigments by *P. cruentum* is reported to be linked with nitrogen concentration in the culture medium (Iqbal *et al.*, 1992). This observation has been (Hitachi 220S); uninoculated culture medium served as the reference.

MATERIALS AND METHODS

Dry weight determination of the algal biomass in a known culture volume was made by centrifugation of the sample for 15 minutes at 20,000 x *g* and subsequent washing of the algal cell pellet with distilled water to remove ions and bound polysaccharides from the cells. Centrifugation was repeated by resuspending the pellet in distilled water. Cell pellet was then dried at 80° for 24 hours and weighed. For determination of red pigment phycoerythrin, the algal cell suspension was centrifuged at 20,000 x *g* for 15 minutes. The algal cell pellet was rinsed with, and resuspended in 0.067 M phosphate buffer, pH 6.8. Cell wall of the centrifuged algal cells was broken by freezing at -15°C for 10 hours followed by thawing at 25°C, repeated twice. Cell debris was removed by centrifugation at 30,000 x *g* for 20 minutes. Phycoerythrin released along with the cell contents, on cell wall breakage, was determined in the supernatant by measuring the absorbance at 545 nm. Total phycoerythrin was calculated by using the extinction coefficient according to Neufeld (1966). Nitrate content remaining in the culture medium at differentstages of growth was determined spectrophotometrically (Greenberg *et al.*, 1980). Extracellular polysaccharides were determined according to Ramus (1977).

RESULTS AND DISCUSSION

Effect of nitrogen sources on growth

Porphyridium cruentum cells grown in batch culture in media containing 0.1% of various nitrogen compounds responded differently for growth as biomass yield (Fig. 1 a). Cultures were completely inhibited in the presence of $NaNO_3$ and $(NH_4)_2HPO_4$. Growth response to $(NH_4)_2SO_4$, KNO_3 and during the exponential phase up to 14 days was similar. Significant differences were, however, noted during the later stages of growth as evident from the entry into stationary phase on 14 days with $(NH_4)_2SO_4$ and urea while the exponential phase of the cultures in the presence of KNO_3 continued until 24 days. Compared with these three nitrogen sources, growth although slower during the early exponential phase (up to 14 days) when NH_4NO_3 was added to the medium, entry into stationary phase occurred on 21 days showing greater final biomass yield on 28 days than with urea and $(NH_4)_2SO_4$. On a comparative basis, KNO_3 as the nitrogen source during 28 days growth period appeared to be best suited for biomass production which was 24, 18 and 78 per cent greater, respectively when the cultures were grown in $(NH_4)_2SO_4$, $NHNO_3$ and urea.

[1]Paper presented at the 5th Annual General Meeting of Pakistan Society of Food Scientists & technologists on December 22, 1994 at NWFP Agricultural University, Peshawar.

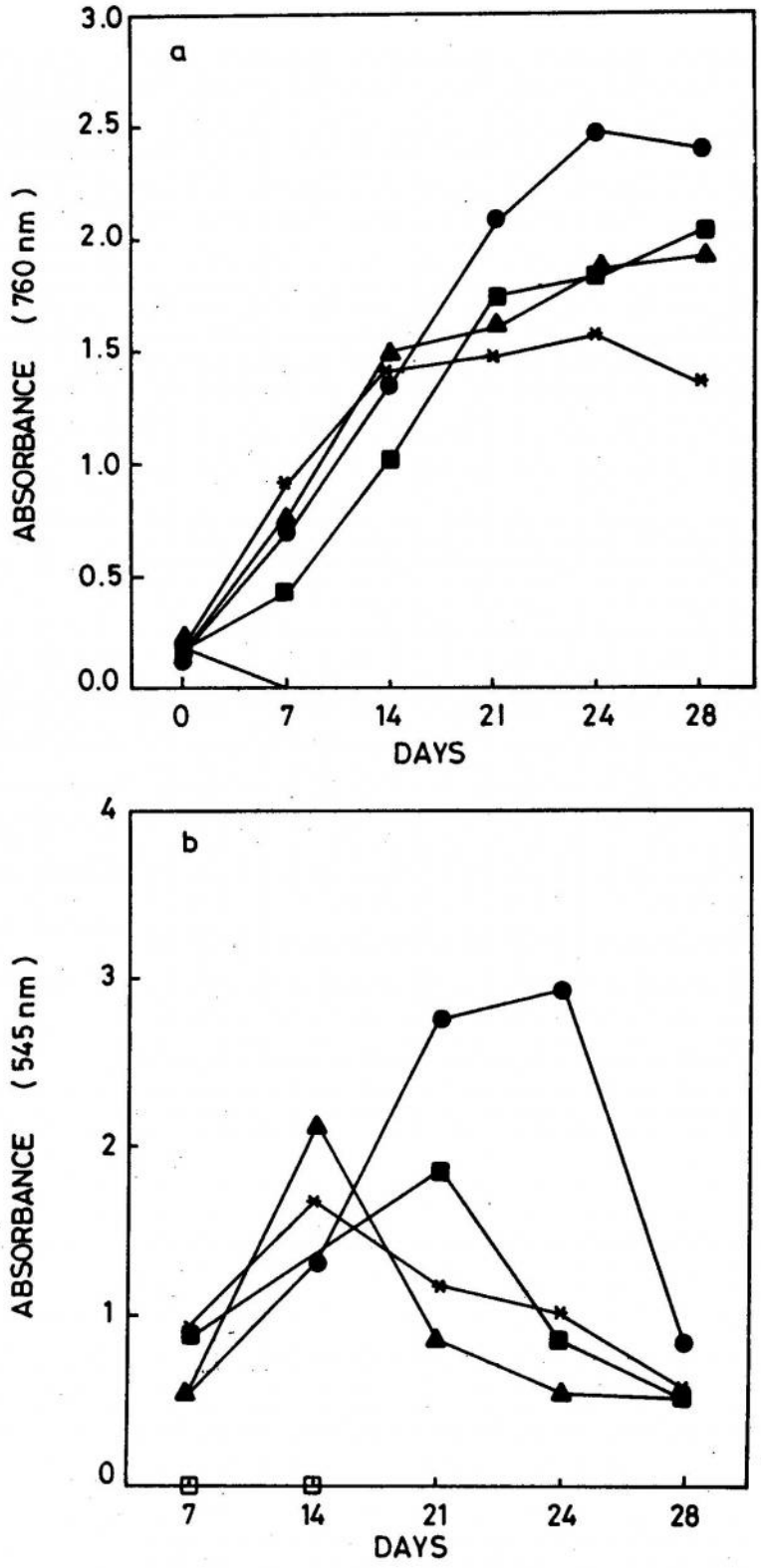

Fig. 1. Growth (a) and pigment production (b) by *Porphyridium cruentum* cells grown in various types of nitrogen sources. NH_4NO_3 (■), $(NH_4)_2SO_4$ (▲), KNO_3 (●), $NaNO_3$ (△), $(NH_4)_2HPO_4$ (□) and urea (*).

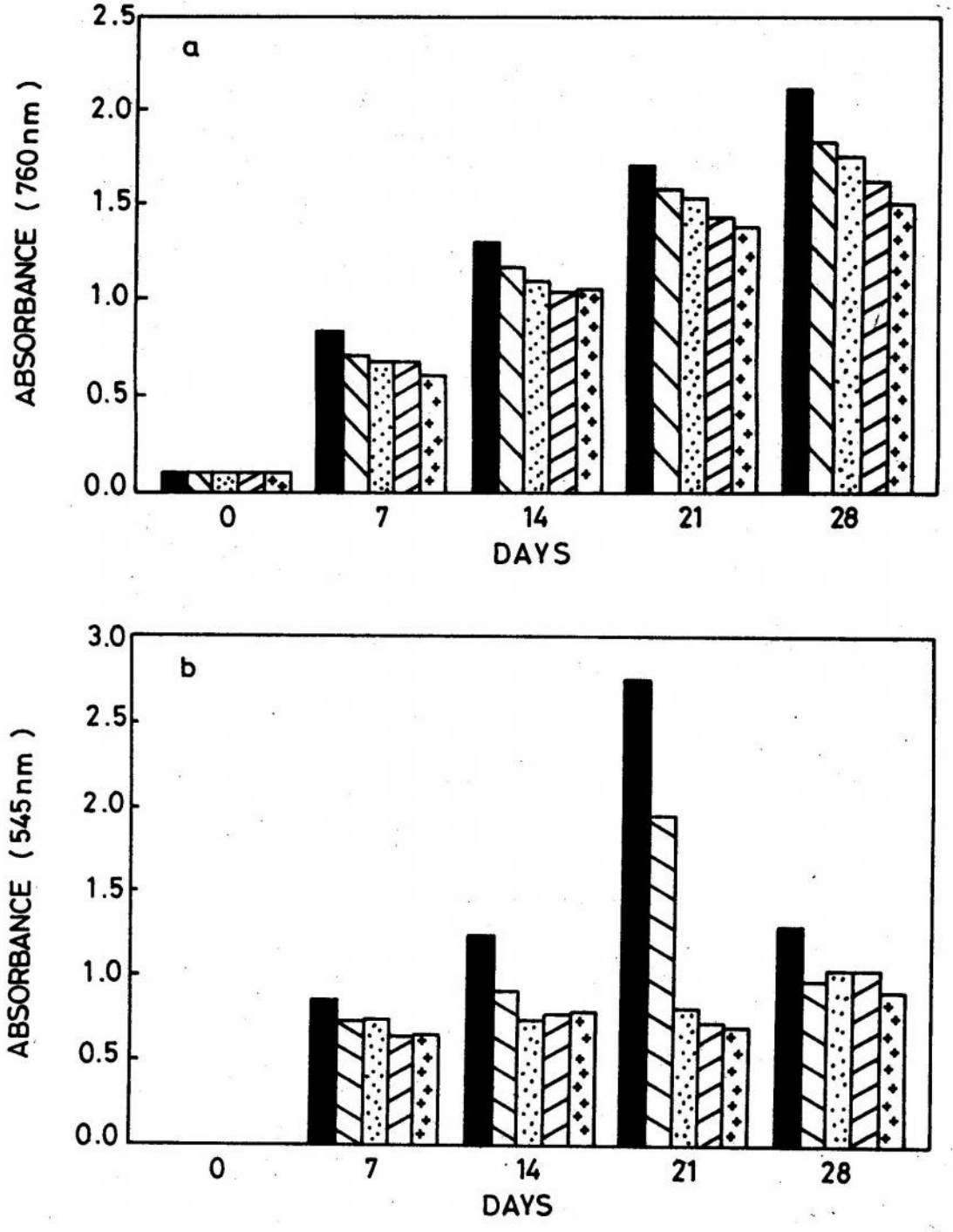

Fig. 2. Effect of nitrate concentration on growth (a) and pigment production (b) by *Prophyridium cruentum*. 0.1% (■), 0.2% (▨), 0.4% (▩), 0.6% (▨) and 0.8% (⊞).

Effect of nitrogen sources on pigment production

Like growth, intracellular pigment production with different nitrogen sources at 0.1% in the culture medium differed significantly (Fig. 1 b). Highest pigment yield was achieved when *P. cruentum* was grown with KNO_3 which compared with $(NH_4)_2SO_4$, NH_4NO_3 and urea, respectively and 36, 57 and 75 per cent greater. Maximum pigment production was, however, noted to be related with the phase of cultural growth. Highest pigment yields with $(NH_4)_2SO_4$ and urea on 14 days, with NH_4NO_3 on 21 days and with KNO_3 on 24 days corresponded with their respective late exponential phases of growth (Fig. 1 a). A sharp decline in the pigment yield occurred as the cultures entered into stationary phase.

intracellular production of the pigment, studies were carried out by incorporating KNO_3 in the culture medium at different concentrations (0.1, 0.2, 0.4, 0.6 and 0.8%). The effect of nitrogen concentration on growth and pigment yield is presented in Fiure 2 from which it is evident that 0.1% nitrate incorporation was the optimum level in the culture medium. During the period of culture up to 21 days, however, there was no significant difference in the biomass yield at the various nitrate concentrations studied, whereas difference at 21 days compared with 0.1% was 29, 70, 73 and 74% at 0.2, 0.4, 0.6 and 0.8%, respectively. Highest pigment yield at 0.1% and 0.2% nitrate in the medium was achieved on 21 days as compared with 28 days when the concentrations were 0.4, 0.6 and 0.8%. From Figure 2 b,

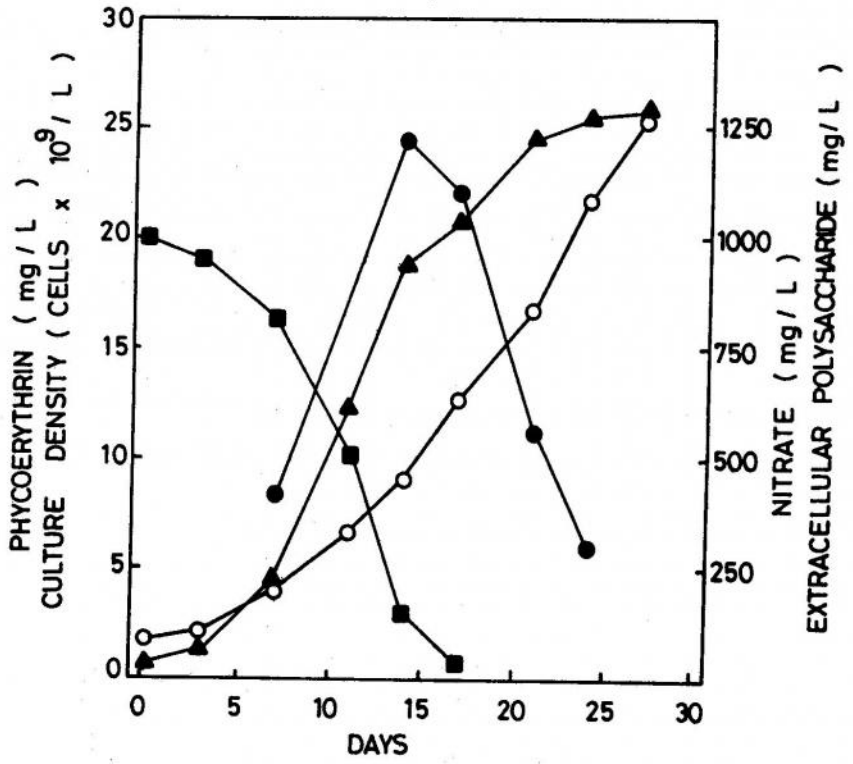

Fig. 3. The relationship between biomass (▲), pigment (●) and extracellular polysaccharide production (○) as related with nitrogen consumption (■) in the culture medium during growth of *Porphyridium cruentum* in 5 L aspirator jar containing 0.1% nitrate nitrogen.

Effect of nitrogen concentration on growth and pigment yield

After observing KNO_3 as the most suitable nitrogenous compound for biomass yield and it may be noted that optimum level for pigment yield was achieved at 0.1% nitrate. Higher concentrations thus exerted progressively inhibitory effect.

Effect of large scale culture on growth and pigment yield

Having identified KNO_3 as the best nitrogen source at the concentration of 0.1% in the ASW culture medium, *P. cruentum* was grown in 5 L aspirator jar for biomass and pigment yield under large scale culture conditions (Fig. 3). This study was also linked with extracellular polysaccharides production, another commercially important metabolic product of the alga. The cultures were aerated with air containing 2.5% CO_2 at the rate of 500 mL L^{-1} $minute^{-1}$. As noticed with cultures in 500 mL and 1 L Erlenmeyer flasks, the highest pigment yield in 5 L aspirator jars also corresponded with the late exponential phase of growth. It was additionally found that pigment production was dependent upon the presence of nitrogen in the culture medium. Depletion of nitrogen concentration in the growth medium resulted in slowing the culture growth through early entry into the stationary phase and decline in pigment biosynthesis (Fig. 3). As already reported (Iqbal *et al.*, 1992), this stage of culture growth was associated with higher level of extracellular polysaccharides production.

CONCLUSIONS

The correlation between sharp decline in the yield of pigment content, nitrate depletion in the culture medium and the maximum production of pigments associated with the late exponential phase of growth (Fig. 3) are observations of signficance for obtaining better yields of the pigment. If the cultures were allowed to lapse into the stationary phase, however, the metabolic biosynthesis shifted to the production of extracellular polysaccharides. From the foregoing, it may be concluded that with suitable manipulation of cultural conditions two commercially important biproducts viz. pigment and the extracellular polysaccharides, can be produced in a biotechnological operation. The optimal conditions obtained in 250 mL Erlenmeyer flasks showing similar results on large scale growth in 5 L batch culture conditions for pigment biosynthesis and extractability further point that the potential of *P. cruentum* as a source of natural colour for food products may be considered for development.

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PROCEEDINGS OF THE
FIFTH ANNUAL GENERAL MEETING 1994

The Fifth Annual General Meeting of the Pakistan Society of Food Scientists and Technologists was held on Thursday December 22, 1994 in the NWFP Agricultural University, Peshawar. The Secretary of the Society, Dr. Javaid Aziz Awan, welcomed the participants. The proceedings of the meeting started with the recitation from the Holy Quran by Mr. Ajab Khan who beautifully presented the English translation of each verse simultaneously. Mr. Fayyaz Hussain Jafri followed with *Naat-e-Rasool-e-Maqbool* (PBUH). Prof. Dr. Muhammad Saeed welcomed the dignitaries and highlighted the challenges and opportunities for the food scientists and technologists in NWFP. He also enlightened them with some issues confronting the Province.

In his Presidential address Prof. Dr Muhammad Shafiq Chaudhry, President, Pakistan Society of Food Scientists and Technologists elaborated on the food quality and standards in Pakistan and the world over. He recalled some events that have passed during the last decade in this regard. Among these, he mentioned GATT (General Agreement on Trade and Tariffs) and WTO (World Trade Organization), the ISO-9000 series of international standards and HACCP (Hazards Analysis Critical Control Point). In the presence of these, he said that the survival of the trade would depend upon the production of quality goods at competitive costs (quality and efficiency). He said that this was the time to study the international requirements and advise the industries for their adoption.

The Chief Guest, Prof. Dr. Syed Basit Ali Shah, Vice-Chancellor, NWFP Agricultural University, Peshawar, pointed out that the University is really proud of hosting the 5th Annual General Meeting of the Society. He was impressed with the concept and the lead that the Society has taken in bringing research scientists, university professors and food industry people together on a common platform to address the problems relating to food processing, distribution and marketing. The Chief Guest expressed the desire that the NWFP Agricultural University will be keen to train students at B.Sc., M.Sc. or even at diploma level, specifically tailored to the requirements of food industry. He also emphasised the need for closer collaboration between industry and research scientists to help solve the problems of food industry. He expressed the hope that the Society will come up with solid recommendations from the deliberations of this meeting for solving the problems faced by the food industry.

TECHNICAL SESSIONS

Two Technical Sessions were held, one in the morning and one in the afternoon. The morning session was chaired by Dr. A. K. Baloch, Dean Faculty of Agricultural Sciences, Gomal University, D.I. Khan. He was assisted by Mr. Fazli Karim, Food Technologist, Agricultural Research Institute, Tarnab-Peshawar and Mr. Ajab Khan, Postharvest Technologist, Agricultural Research Institute, Tarnab-Peshawar. Following five papers were presented in this session:

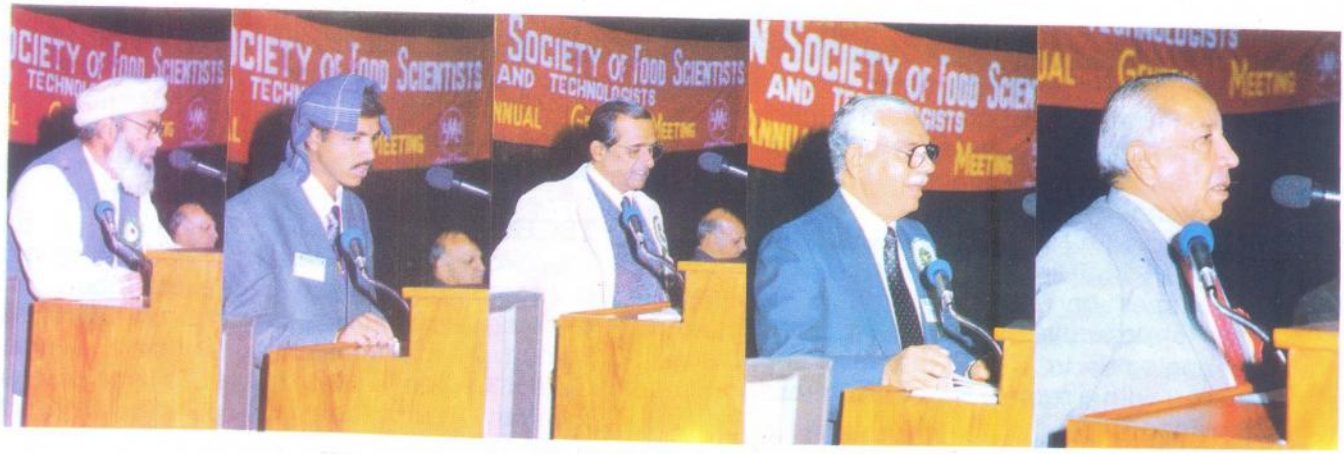
1. ***Porhyridium cruentum* biomass as a potential source of food colour**
   M. Iqbal
   Biotechnology and Food Research Centre,
   PCSIR Laboratories Complex,
   Lahore.

2. **Minichurn for laboratory demonstration of butter making**
   Tariq Aziz
   Senior Scientific Officer,
   Animal Sciences Division,
   National Agricultural Research Council,
   Islamabad.

3. **Therapeutic value of yoghurt**
   Tafazzal Hussain Shah
   Associate Professor,
   Department of Food Technology,
   University of Agriculture,
   Faisalabad.

4. **Suitability of American guava varieties for processing purposes**
   Mian Abdul Malik

Glimpses of the 5th Annual General Meeting, 1994.



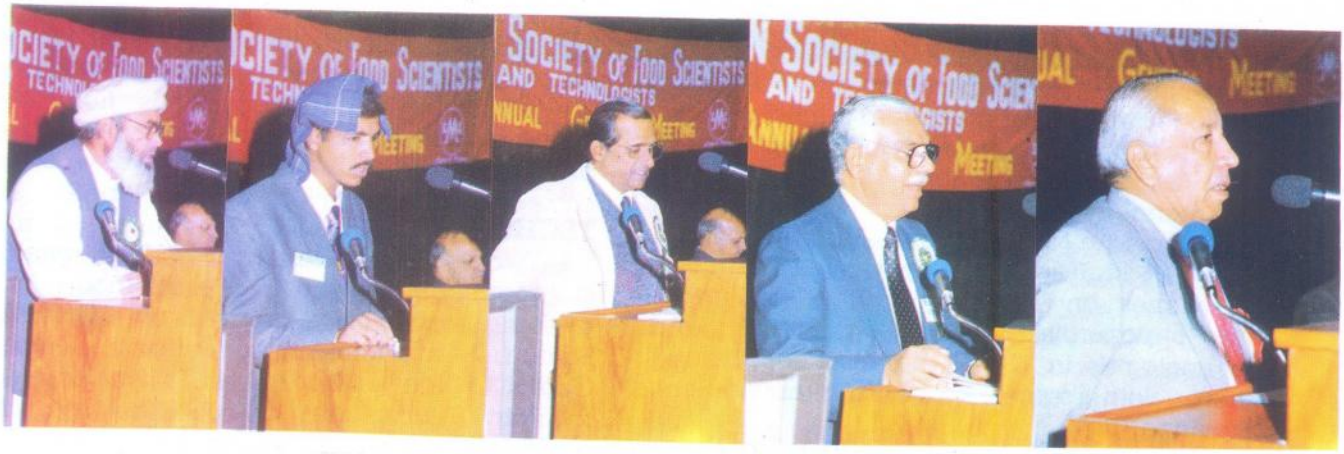
From Left to Right: Mr. Adam Khan reciting verses from the Holy Quran; Fayyaz Hussain Jafri reciting *Na'at-e-Rasool-e-Maqbool* (pbuh). Addressing on the occasion are: Prof. Dr. Muhammad Saeed, Dean, Faculty of Nutrition Sciences, NWFP Agricultural University, Peshawar; Prof. Dr. M. Shafiq Chaudhry, President, Pakistan Society of Food Scientists & Technologists and the Chief Guest, Dr. Syed Basit Ali Shah, Vice Chancellor, NWFP Agricultural University, Peshawar.

Delegates on Registration Desk

Delegates exchanging views.

At the Inaugural Session. Dr. Syed Basit Ali Shah (Chief Guest) is flanked by Dr. J.A. Awan, Prof. Dr. M. Shafiq Ch. and Prof. Dr. Muhammad Saeed.

Glimpses of the 5th Annual General Meeting, 1994.



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Delegates on Registration Desk

Delegates exchanging views.

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Food Technologist
Food Technology Section,
Ayub Agricultural Research Institute,
Faisalabad.

5. **NIR method for the detection of adulteration of bread wheat farina in durum wheat semolina and pasta**
Dr. Muhammad Sarwar
Food Technology Section,
Ayub Agricultural Research Institute,
Faisalabad.

In the afternoon technical session, six papers were presented. It was chaired by Mr. M.B. Bhatti, Retd. Prof. and Food Industry/Venture Capital Consultant, Islamabad. He was assisted by Dr. Jamil ud Din Warsi, Associate Professor and Head, Department of Dairy Technology, Sindh Agricultural University, Tando Jam and Dr. Nazir Ahmad Sufi, Chief Scientific Officer, Head Food Technology Research Division, PCSIR Laboratories, Peshawar. Following six papers were presented in this session:

1. **Traditional and modern drinks in the light of human health**
Dr. K. M. Janjua
Principal Scientific Officer,
PCSIR Laboratories Complex,
Lahore.

2. **Food matter of life and food matter for life and death**
Dr. Muhammad Azam Sheikh
Editor-in-Chief,
Science International,
11-D, Sabzazar, Wahdat Road,
Lahore.

3. **Status of food irradiation processing**
Dr. Abdus Sattar
Principal Scientific Officer,
Nuclear Institute for Food and Agriculture,
Tarnab, Peshawar.

4. **Effect of gamma irradiation and storage on growth and polyphenol oxidases of mushrooms**
Muhammed Wahid
Nuclear Institute for Food and Agriculture,
Tarnab, Peshawar.

5. **Microbial decontamination of spices by gamma irradiation**
Fazal Mahmood
Nuclear Institute for Food and Agriculture,
Tarnab, Peshawar.

6. **Detection of irradiated dried fruits and plant nuts by chemiluminescence measurements**
Anwar Ahmad
Nuclear Institute for Food and Agriculture,
Tarnab, Peshawar.

Some papers presented in the Technical Sessions are being published in this issue of the Journal.

BUSINESS SESSION

The Business Session was chaired by the President, Prof. Dr. Muhammad Shafiq Chaudhry who was assisted by the Vice-President, Prof. Dr. Muhammad Saeed and the Secretary, Dr. Javaid Aziz Awan.

Adoption of the Revised Constitution

The Secretary drew the attention of the House to the revised/amended Constitution of the Society that had been circulated to the members and invited comments. Dr. F.M. Anjum observed a duplication in Articles XI and XIII. It was decided to delete one of them. He also suggested that procedure for elections should be spelt out. This was noted for compliance. In the absence of any other observation/suggestion, the House unanimously adopted the revised Constitution.

Food Science News

A proposal was placed before the house for upgradation of the Food Science News to the level of a scientific Journal. The house unanimously accepted the proposal. Suggestions were then invited for an appropriate name for the Society's Journal that would contain both Society news as well as research and other articles. From among the several suggestions, the name "Pakistan Journal of Food Sciences" was selected unanimously. The House also agreed that this would be a continuation of the existing Food Science News. Hence this issue is appearing as a sequel of the Food Science News with Volume No. 5.

Other Matters

The members unanimously agreed to hold future meetings for two days. The issue of Membership Certificates was also raised at the meeting. It was decided that the Executive Council would get the certificate designed and issue to the members. Some student members enquired about the S.M.C. Merit Scholarship which was to be awarded to the top student pursuing Masters degree in Food Technology at the University of Agriculture, Faisalabad. They were informed of the progress made and promised that the award would be made as soon as the University of Agriculture, Faisalabad selected the right candidate.

Award of Commemorative Shields

In order to recognize personalities and organizations who have contributed towards developments in Food Science and Technology in the Country, special commemorative shields were presented. The recipients were:

1. Dr. F. H. Shah (T.I.)
   Director General (Retd.),
   PCSIR Laboratories Complex,
   Lahore.
2. Dr. Muhammad Latif Rasulpuri
   Prof. and Chairman (Retd.),
   Department of Food Technology,
   University of Agriculture,
   Faisalabad.
3. Prof. Dr. Syed Basit Ali Shah
   Vice-Chancellor,
   NWFP Agricultural University,
   Peshawar.
4. Prof. Dr. Muhammad Saeed
   Dean,
   Faculty of Nutrition Sciences,
   NWFP Agricultural University,
   Peshawar.
5. Mian Abdul Malik
   Food Technologist
   Ayub Agricultural Research Institute,
   Faisalabad.
6. Mr. Muhammad Sultan Mahmood
   Director Technical Services
   Standard Manufacturing Co. (Pvt) Ltd.,
   Lahore.
7. Mr. Mansoor Ahmad of Graphics, Lahore designer of the monogram of the Society.
8. Khamisa Enterprises Inc., Karachi.
9. Shezan International Ltd., Lahore.
10. Tetra Pak Limited, Lahore.
11. Synarome Manufacturing Co. (Pvt.) Ltd. Lahore.

Prizes by Standard Manufacturing Co. (Pvt.) Ltd.

Standard Manufacturing Co. (Pvt) Ltd., Lahore offered five prizes which were presented to participants of the meeting on the basis of lucky draws. The recipients were Mr. Said Wahab, Dr. Jamil ud Din Warsi, Mr. Kamran Peter, Mr. Sadiq Shamim and Mr. Javed Iqbal Qureshi.

S.M.C. (Pvt.) Ltd. also presented gifts to the President, Prof. Dr. M. Shafiq Chaudhry, Prof. Dr. Muhammad Saeed, Vice-President and the Secretary, Dr. Javaid Aziz Awan, in recognition of their efforts for the promotion of the cause of the Society.

Before the adjournment of the meeting, the Secretary thanked the authorities of the NWFP Agricultural University, Peshawar for the facilities provided to hold the meeting. He also paid tribute to the staff and students of the Department of Food Science and Technology, NWFP Agricultural University, Peshawar, the PCSIR Laboratories, Peshawar, Nuclear Institute for Food and Agriculture, Peshawar and Agricultural Research Institute, Tarnab-Peshawar. Special thanks were paid to Mr. Muhammad Sultan Mahmood who contributed immensely towards the arrangements for the meeting. Financial and material support provided by the following organizations and others was also gratefully acknowledged:

Big Mak Food (Pvt.) Ltd.,
137, Industrial Estate, Kot Lakhpat,
Lahore.

Classic Bread,
13-B, Industrial Estate,
Jamrud Road, Peshawar.

Khamisa Enterprises Inc.,
Ali Akbar Street, Old Market,
Karachi.

Maaher Food Industry,
212 S, Industrial Estate,
Kot Lakhpat. Lahore.

Makk Beverages & Mineral Waters (Pvt) Ltd.,
Charsadda Road, Peshawar.

Marhaba Dawakhana,
142, Main Industrial Area, Lahore.

Nestle Milkpak (Pvt.) Limited,
308 Upper Mall, Lahore.

Northern Bottle Co. (Pvt) Ltd.,
16 Industrial Area, Jamrud Road,
Peshawar.

Popular Food Industry,
Old SITE, Tando Adam,
Hyderabad.

Prime Dairies and Ice Cream,
38 Empress Road, Lahore.

Rafhan Maize Products (Pvt.) Ltd.,
Consumer Products Division,
5-A, New Muslim Town,
Lahore.

Shezan International Ltd.,
Bund Road, Lahore.

Sufi Biscuits,
6 - Industrial Estate,
Jamrud Road, Peshawar.

Sunny Biscuits,
Darogha Wala, G.T. Road,
Lahore.

Tetra Pak Pakistan Ltd.,
316, Upper Mall, Lahore.

Yummy Milk Products (Pvt) Ltd.,
124/4 Industrial Area,
Kot Lakhpat, Lahore.

The Secretary also thanked all the exhibitors and participants who came from all over Pakistan and wished them safe journey home.

6th Annual General Meeting

The 6th Annual General Meeting of the Pakistan Society of Food Scientists and Technologists has been scheduled inthe 3rd week of December, 1995. Exact date and venue will be announced later.

WELCOME ADDRESS

Prof. Dr. Muhammad Saeed
Dean, Faculty of Nutrition Sciences
NWFP Agricultural University, Peshawar
and Vice President,
Pakistan Society of Food Scientists and Technologists

Respected Vice-Chancellor, NWFP Agricultural University, Peshawar Prof. Dr. S. Basit Ali Shah, President Pakistan Society of Food Scientists and Technologists, Prof. Dr. M. Shafiq Chaudhry, Members Executive Council, Distinguished Delegates, Colleagues, Students, Ladies and Gentlemen.

I, on behalf of all my colleagues, faculty, research scientists from NIFA, ARI Tarnab, PCSIR Laboratories Peshawar and students of this University welcome you to the premises of this University for holding this important meeting. It is indeed a rare privilege and honour for us that Pakistan Society of Food Scientists and Technologists has organized its annual meeting in this University. On behalf of the Society, I welcome our worthy Vice Chancellor, Prof Dr. S. Basit Ali Shah, who spared some time in spite of his very busy schedule and graced this occasion as chief guest.

I cónsider it appropriate to highlight the challenges and opportunities for the food scientists and technologists in this region. NWFP is a small province with nearly 1/3rd of its land mass irrigated, the rest rainfed. This small province is blessed with a variety of agroecological zones ranging from snowclad mountains in Chitral, Swat and Hazara Divisions down to the tropical rainfed plains of Bannu and D. I. Khan. The enormous variation in climate makes it suitable for the production of all kinds of crops. Fruits, vegetables, maize, sugarcane and tobacco are the choice major crops of irrigated plains, where as wheat is mostly grown in rainfed area. Deciduous fruits such as apples, apricots, peaches, plums, persimmon and even walnuts are abundantly grown in the cool northern parts of the province. This area is also home to the fine quality citrus fruits. Vegetables such as peas, tomatoes, onions, cauliflower, potatoes, to name a few are almost abundantly grown in irrigated areas and northern parts of the province.

ISSUES

In general the production of a particular fruit or vegetable which is a perishable commodity is much more than can be locally consumed or marketed during the peak harvest season. This results in market glut and brings a very low return to the grower. It also results in huge wastage due to lack of preservation and marketing facilities. To quote an example, tomatoes crop in Peshawar, Mardan in particular and for that matter in every major growing area in frontier has to be ploughed down in the field almost every alternate year because the prices are so low that the grower cannot afford to pick and market the crop. Yet, as soon as the peak harvest season is over, prices of the crop in the market go up enormously. Here is a challenge as well as an opportunity for all of us. The solution to this problem should not be very difficult. Could not the extra quantity be preserved and efficiently marketed to save the grower from perpetual loss and at the same time provide the consumer a reasonable price? Similar is the case with most fruits available during the summer season in particular. The story of most vegetables is no different. To my mind here the problem is not of producing more but of properly grading, packing, preserving, and marketing, both in home market and abroad. N.W.F.P. is home to fine quality maize. Maize varieties evolved at the research stations over here are the nation's leading varieties both in quality and production wise, partly because of favourable soil and climate. A number of

crops can be grown in a single season. Rafhan is a very fine combination of CPC International with local partners at Faisalabad where a variety of food products are prepared from wet and dry mills of corn beside starch for textile industry. The experience of Rafhan could be utilized to establish facilities of wet and dry milling in places where corn is actually grown. Swabi, Swat and Hazara are ideal places where such facilities should be established.

The N.W.F.P. is probably the only place where sugarbeet is produced only for sugar production but no other byproduct. Sugarbeet pulp provides the base for the production of a variety of products by fermentation technology. In spite of unfavourable climate Frontier also produces sugarcane and has a number of sugar industries. In some of these plants there are distilleries where molasses is converted into alcohol. In the neighbouring country, India, molasses is considered too precious a raw material to be used for alcohol production and is used for the production of numerous industrial products. The processes used are far from being efficient and it is of course a challenge for the microbiologists to suggest ways and means to improve alcohol production, besides producing other raw materials such as yeast as a by product. With modern genetically engineered microorganisms and optimum conditions of fermentation using membrane technology, the alcohol production can be increased manifold.

Pakistan consumes on an average 1.3 million tons of edible oil/fat annually. Eighty percent of this is imported in the form of soybean and palm oils. Only 20 percent is produced locally, a major portion of which comes from the crushing of cotton seed. The Government has started a large scheme worth millions of rupees for increasing the production of oilseeds with no obvious success in sight. To bridge the huge gap in production and consumption, scientists over here have shown a remarkable progress in the production of non-conventional oilseed such as hybrid sunflower which has surpassed the imported sunflower in yield and quality. The major problem, to my mind, to increase production of edible oil and fat is the non-availability of processing facilities particularly in places where these oilseeds could be successfully produced. As a food scientist, I can see a favourable revolution if we were ever able to successfully establish a modern oil extraction and processing facilities. Beside oil and oil cake as major products, hundred other non food consumer products such as bath and washing soaps, detergents, shampoo, moisturizers, etc. can be produced as the base in all these products is mono-, di- and triglycerides.

There are numerous other issues like food adulteration, food colours and standards of identity of food and food products, quality assurance, etc. Only few have been pointed out which need your attention.

At the end I welcome you all once again and express my sincere thanks to you for attending this meeting.

I am also much thankful to the worthy Vice Chancellor who has spared some time to grace this occasion in spite of his busy schedule.

KEYNOTE ADDRESS

Prof. Dr. Muhammad Shafiq Chaudhry
President
Pakistan Society of Food Scientists and Technologists

Twenty-first century is just around the corner and a lot has been said about Pakistan entering this century as a developed nation. Every time a project is launched, be it a motorway or a telecommunication station, we are told or reminded that this project will lead us into the next century. It is described like we are going to pass under a ceremonial arch or a decorated gate and there will be all green pasture beyond and we will live there happily ever after. But let me tell you, ladies and gentlemen, that the picture of 21st century is not as rosy as described or said.

In order to see what will be expected in the next century, let us take a look at some of the recent global events.

In the last two decades, we have observed the formation of regional associations like ASEAN, SAARC, NAFTA, EEC, etc. All these organizations have the common objective of promoting regional economic activities. Very recently we observed the formation of organization of Pacific states and also Pan American states. These activities will limit the scope of trade of developing countries with the developed ones.

Another very important event occurred on 15th April 1994, when the final round of the Uruguay talks on GATT (General Agreement on Trade & Tariffs) was completed in Morocco after 47 years of negotiations. This agreement will now be superseded by WTO (World Trade Organization) which comes into effect from 1st January 1995. It will cut tariffs on industrial and farm goods by 37%. Services including banking, insurance, travel and movement of labour (worth $ 4 billion) will be governed by WTO. Pakistan is a signatory to these agreements.

It is apprehended (as seen from some of the recent newspaper reports) that Pakistani trade will not be favourably placed under these agreements.

These agreements will also affect the trade of foods (raw or processed). The future of trade in all commodities including food will be governed by adherence to certain standards. These are designed to cover all manufacturing industries and service organizations. The International Organization of Standards located in Geneva, Switzerland issued ISO-9000 series of international standards. This Organization (ISO) is a federation of national standards bodies of more than 90 countries. These standards are generic standards for quality management and quality assurance and consist of the following:

ISO 9000 - Quality management and quality assurance standards - Guidelines for selection and use.

ISO 9001 - Quality systems: Model for quality assurance in design/development, production, installation and servicing.

ISO 9002 - Quality systems: Model for quality assurance in production and installation.

ISO 9003 - Quality system: Model for quality assurance in final inspection and test.

ISO 9004 - Quality management and quality system elements guidelines.

ISO 9001 is the most comprehensive and covers all the elements considered essential to a quality assurance system.

ISO is not the acronym of the founding Organization, but is derived from a Greek word meaning 'equal'. These standards are

meant to replace multitude of standards in various countries and states and will be useful in two way transactions. The standards have become the basis for the registration of suppliers by third parties.

Now, on the one hand the tariffs will be reduced and on the other, the quality standards of products will be established and enforced. The survival of the trade will depend upon the production of quality goods at competitive cost. Quality and efficacy will be the key words for success in international trade.

How can these standards of quality of food and food products be achieved?

There are some newer concepts of quality management which if adopted in their true spirit can help in achieving these objectives:
Total Quality Management (T.Q.M.)

Central idea of this system is "Quality is everybody's job" and is opposed to the present system where a Quality Control Office or Department is given the responsibility of the job. It is said that the Japanese have been using this system of management since 1970. This management philosophy focusses on these points:

1. Management commitment.
2. Empowered employees.
3. Continuous Improvement.

It can only be successful if led by top management and every one committed its success. In this system every employee is responsible for quality and this responsibility is achieved through empowerment, i.e. employees are involved in decision making.

Another concept which is gaining popularity for quality management is called HACCP (Hazards Analysis Critical Control Point). This system envisages the identification and elimination of steps in the processing line which can be a source of hazard, be it microbiological, chemical or toxicological, etc. A Critical Control Point is a position in the food processing or handling system where inadequate control would result in food contamination and there are no management programms, procedures, or practices downstream of the position to prevent the contaminated/adulterated food from reaching the consumer.

HACCP should form an integral part of quality management. It does not need to be completed to be functional. In some cases a small change may be required in a processing line to fulfil the requirements of HACCP.

Both TQM & HACCP are considered to be essential for achieving the goals for ISO - 9000.

So, Ladies and Gentlemen, the food processing industries and related service organizations and those involved in export marketing will have to work hard to compete with other nations. It is also time for our scientists in various research and teaching organizations to study the ISO-9000, TQM and HACCP systems and advise the industries for their adoption.

Let us hope that we can enter the Golden Gate of the 21st century with grace and honour.

INAUGURAL ADDRESS

Prof. Dr. Syed Basit Ali Shah
Vice Chancellor
NWFP Agricultural University, Peshawar.

President, Pakistan Society of Food Scientists and Technologists, Prof. Dr. M. Shafiq Chaudhry, Members of the Executive Council, Distinguished Guests, Colleagues, Students, Ladies and Gentlemen.

I am thankful to the President and Executive Council of the Pakistan Society of Food Scientists and Technologists for inviting me to the inaugural session of 5th Annual General Meeting of the Society. I am impressed with the concept and the lead your Society has taken in bringing research scientists, teachers and food industry people together on a common plate-form to address the problems of food processing, distribution and marketing. It is an opportunity and a challenge for all of you fellow scientists and industrialists to prove your worth by preserving what would otherwise go waste, making a variety of food items available throughout the year with the ultimate objective of enhancing the quality of life of common man. I am also pleased to know that you have developed a well representative society where everybody associated with food processing and marketing is represented which is so essential for solving the problems of the food industry.

We, in this University, are engaged in developing agriculture on sustainable basis, because I believe that in almost all the countries of the world economic development started with the advancement in agriculture. Development in agriculture generates more jobs, higher income, export earnings and national wealth as well as more food and fibre for the ever increasing population. This pattern of development in which agriculture plays a key role in the development of economy is well established throughout the world and has been responsible for the economic progress recently recorded in China and countries in South East Asia.

Presently there is a huge gap in achievable production potential and actual agricultural productivity, but whatever little is produced, a major portion of it is wasted due to lack of preservation and marketing facilities as referred to by Prof. Saeed. To avoid this huge wastage and to bring more economic return to the grower, new and proven technologies are needed to be made available. The new technologies must be socially acceptable, environmentally appropriate and economically feasible.

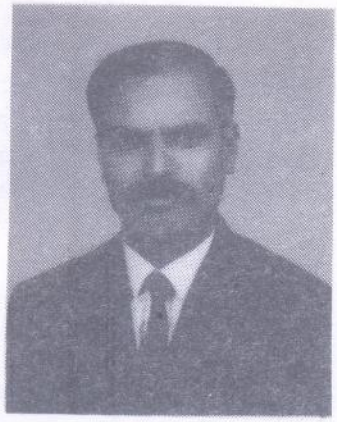
The two most important resources for development are human resource and knowledge. Over the years we have neglected investment in human resource development, but I am glad to point out that this University has made appropriate investment in this sector. The critical mass of highly trained faculty and research scientists qualified from the most prestigious universities in the USA and European countries fully equipped with most modern laboratory and library facilities will certainly help in solving the present and emerging problems of food industry not only in this province but all over Pakistan. Let me assure you that this University will not only be willing but would be keen to train students at B.Sc., M.Sc. or even at diploma level specifically tailored to the requirements of food industry. This will not only help in providing job opportunities to the agricultural graduates, but will also provide the necessary trained manpower for the industry. I will be keen to encourage research scientists associated with food science to undertake research on specific problems faced by the food industry. I wish to emphasize that closer collaboration between the food industry and food scientists in the University and research stations is extremely essential.

I look forward to solid recommendations from the deliberation of your meeting for solving the multifarious problems faced by the food industry in the country. Your endeavor to help establish food industry at village and town level will stabilize prices by avoiding huge post harvest losses, bring more return to the grower and prevent, to certain extent, the big problem of migration from the rural area to the cities. I fully assure you of our whole hearted cooperation and support in your endeavor in this direction.

I thank you once again for giving me the honour to act as chief guest in this important function to-day.

Ph.D. Degree Awarded

Dr. Abdul Majeed Salariya, Professional Member and Junior Technical Officer, PCSIR Laboratories Complex, Lahore has been awarded Ph.D. Degree in Chemistry on the approval of his thesis entitled "The effect of recycling poultry manure on the accumulation of heavy metals in poultry tissues" under the supervision



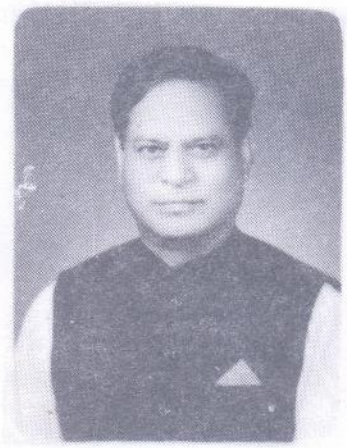
of Prof. Dr. Muhammad Zafar Iqbal, Director, Institute of Chemistry, Punjab University, Lahore and late Dr. F.H. Shah, Ex. Director General, PCSIR Laboratories Complex, Lahore.

Ms Dilshad Akhtar awarded Gold Medal

Ms Dilshad Akhtar, a Professional Member and Head, Department of Food & Nutrition, College of Home Economics, University of Peshawar, Peshawar has been awarded a Gold Medal on the 11th Convocation of the College in December, 1994. She has been honoured with this distinction in recognition of her being the best teacher and research advisor in the College. Ms Akhtar did her M.Sc. in 1962 from the College of Home Economics, Lahore and joined the College of Home Economics, Peshawar the same year. She was promoted to Assistant Professor in 1970 and became Associate Professor in 1983. During her meritorious service, she performed multiple duties in the College and has been a member of National Textbook Review Committee as well as Curriculum Planning Committee. She has been holding executive posts in PUTA, University Women Federation and has been an elected member of the Senate of Peshawar University for two consecutive terms. She has devoted her whole life to the upliftment of cause of education.

Dr. Farooqi takes up FAO job

Dr. Wasim A. Farooqi has been selected as Postharvest Expert in the Food and Agriculture Organization (FAO) of the United Nations and posted in Fruit Development and Outreach Project at Quetta. Prior to this assignment, Dr. Farooqi was working as Principal Scientific Officer and Group Leader (Postharvest) at Nuclear Institute for Agriculture and Biology, Faisalabad. He was also a visiting Professor in the Department of Horticulture, University of Agriculture, Faisalabad. Dr. Farooqi did his M.Sc. (Agri.) from the University of Agriculture, Faisalabad, M.Sc. (Hons.) from Macquarie University, Sydney and Ph.D. from the University of Punjab, Lahore. Apart from his academic education in postharvest aspect



of horticulture, he received specialized training in Postharvest Technology from the CSIRO, Division of Food Research at North Ryde, NSW Australia and ENEA, Agro-Biotechnology Department at Rome, Italy. Dr. Farooqi is author of 2 patents and over 70 technical papers in his field of specialization published in Aus-

tralia, France, Italy, Morocco, Pakistan, Thailand, UK and USA. He has been/and is technical advisor/ consultant/ member of several national and international organisations/ societies/ committees dealing with fresh fruit handling, processing, storage, distribution, trade and industry.

Mr. M. Sadiq Shamim joins Big Mak

Mr. Muhammad Sadiq Shamim Chaudhry has been appointed as Manager Quality Control with the Big Mak Foods Ltd., Lahore. This is one of the largest companies in Pakistan engaged in the manufacturing of biscuits, wafers, toffees and candies with the brand name of "Swiss".

Dr. Sakhawat Ali promoted

Dr. Sakhawat Ali, a Professional Member and Scientific Officer in Biotechnology and Food Research Centre, PCSIR Laboratories Complex, Lahore has been promoted in Grade 18 as Senior Scientific Officer. Dr. Sakhawat Ali obtained his B.Sc. (Hons.) in Animal Husbandry in 1981 and M.Sc. (Hons.) in Nutrition in 1983 from the University of Agriculture, Faisalabad. He was awarded Ph.D. degree in 1992. Dr. Sakhawat's research comprises of the utilization of agro-industrial wastes for the production of food and feed. He has completed a Pakistan Science Foundation sponsored project with late Dr. F.H. Shah and co-authored a book in Urdu on Quail Farming.

Syed Saeed Gilani retires

Syed Saeed ur Rehman Gilani, a Professional Member and Research Officer Grade I, Armed Forces Institute of Nutrition, Lahore Cantt. retired on December 2, 1993 after meritorious service of 33 years. After his retirement, he performed Haj and visited a number of holy places in Saudi Arabia.

Congratulations!

CONFERENCES ATTENDED

Dr. Wasim A. Farooqi (presently working in Food and Agriculture Organization of the United Nations as Postharvest Expert in Quetta) participated in the following Conferences:

1. International Conference on Postharvest Handling of Tropical Fruits held at Chiang Mai, Thailand from July 19 to 23, 1993. During the Conference Dr. Farooqi presented a paper entitled "Postharvest studies on some tropical and sub-tropical fruits in Pakistan". He also had the honour to preside over one of the technical sessions.

2. International Symposium on Postharvest Physiology, Pathology and Technologies for Horticultural Commodities, held at Agadir, Morocco from January 12 to 16, 1994. Dr. Farooqi presented two papers in this Symposium: "Physiological and biochemical changes in fruit during refrigerated storage with reference to chilling-injury" and "Postharvest physiology of Kinnow mandarin (Citrus reticulate Blanco)". He also had the honour to Co-Chair the 1st session of this Symposium with Dr. M. Sedrati, Director General, IAV Hassan II, Rabat.

Mr. Hamid Ahmad, Chairman PSFST Lahore Chapter, PSO, Biotechnology and Food Research Centre, PCSIR Laboratories Complex, Lahore was invited to attend a WAAP-FAO International Symposium on "Supply of Livestock Products to Rapidly Expanding Urban Population" from May 16 to 20, 1995 at Hoam Faculty Club, Seoul National University, Seoul, Korea. Mr. Ahmad presented a paper on "Meat supply in Pakistan"

CHAPTER NEWS

FORMATION OF PSFST LAHORE CHAPTER

A meeting of the members of the Society residing in the Lahore Division was held on Tuesday, January 24, 1995 at PCSIR Laboratories Complex, Lahore. Dr. Muhammad Hussain Chaudhry, Chief Executive, Punjab Agricultural Research Development Board, was chief guest, while Dr. Ehsan Ali, Director General, PCSIR Labs. Complex, Lahore presided the function. Dr. Muhammad Shafiq Chaudhry, President, Pakistan Society of Food Scientist and Technologists was also present on the occasion. About 50 members of the Society attended the meeting. Proceedings started with the recitation from the Holy Quran. The President PSFST briefed the house about the purpose of meeting and invited proposals for election to the Executive Council of the PSFST Lahore Chapter. The following nominations were received:

Chairman	1. Mr. Hamid Ahmad (PCSIR) 2. Dr. Saeed Iqbal Zafar (PCSIR)
Secretary	1. Mr. Muhammad Sultan Mehmood (Industry) 2. Dr. Muhammad Sabir Ali (Industry)
Treasurer	1. Mr. Mansoor Ahmad (Industry) 2. Mr. Muhammad Yasin (PCSIR)

Dr. Saeed Iqbal Zafar, Dr. M. Sabir Ali and Mr. Muhammad Yasin withdrew in favour of Mr. Hamid Ahmad, Mr. Sultan Mehmood and Mr. Mansoor Ahmad, respectively. Hence, the following were elected unanimously:

1. **Chairman**: Mr. Hamid Ahmad Principal Scientific Officer, Biotech. Food Res. Center., PCSIR Laboratories Complex, Lahore
2. **Secretary**: Mr. Muhammad Sultan Mehmood, Director Technical Services, Standard Manufacturing Co. (Pvt) Ltd., 4 Dayal Singh Mansion, Shahrah-e-Quaid-e-Azam, Lahore
3. **Treasurer**: Mr. Mansoor Ahmad, Director, Paper Chem. (Pvt) Ltd., Lahore.

The oath taking ceremony of the newly elected office bearers of the PSFST Lahore Chapter was performed immediately. Prof. Dr. M. Shafiq Chaudhry, President Pakistan Society of Food Scientists and Technologists, administered the oath. The meeting was disbursed with a vote of thanks.

PSFST LAHORE CHAPTER ACTIVITY

The inaugural scientific activity of the Chapter was organized in collaboration with PCSIR Laboratories Complex Lahore on Thursday, Feb. 2, 1995 with a seminar by Prof. Dr. L. Leistner, Ex-Director, German Meat Research Centre, Kulmbach in the auditorium of PCSIR Laboratories Complex, Lahore. The function was presided over by Dr. Ehsan Ali, Director General of the Laboratories. Scientists from the PCSIR Laboratories Lahore and members of the Society attended the seminar. The topics of two different deliberations by Prof. Dr. Leistner were:

1. Hurdle Technology, Application in Food Preservation.
2. Intermediate Moisture Meats (IMF) Worldwide.

Each lecture lasted about an hour and people took keen interest in the subject.

Award of Commemorative Shields

Some organisations/individuals who were awarded the PSFST commemorative shields at the 5th AGM held at Peshawar could not receive the same at that time. Hence they were invited to receive them at the end of the seminar. The citations for the award were read by Dr. Javaid Aziz Awan, Secretary, PSFST. The following organizations and individuals received the shields:

1. M/s Tetra Pak Ltd. Lahore received by Mr. Rashid Rahi
2. M/s Shezan International Ltd., Lahore received by Ch. Tahir Ahmad.
3. Mr. Mansoor Ahmad, Lahore

The proceedings concluded with a vote of thanks by Dr. S.I. Zafar, Head, Biotechnology and Food Research Centre, PCSIR Labs. Complex, Lahore.

FORTHCOMING EVENTS

The Lahore Chapter of the Society is organizing a one-day seminar on "Fortification in Foods" June 29, 1995. Those interested to participate should please contact:

Mr. Muhammad Sultan Mehmood
Secretary Lahore Chapter,
Director Technical Services,
Standard Manufacturing Co. (pvt) Ltd.,
4 Dayal Singh Mansion, Lahore.

FORMATION OF PSFST FAISALABAD CHAPTER

A meeting of the members of the Society residing in the Faisalabad Division was held on March 21, 1995 in the Department of Food Technology, University of Agriculture, Faisalabad. It was presided by Dr. Javaid Aziz Awan, Secretary, Pakistan Society of Food Scientists and Technologists. About 30 members of the Society attended the meeting. Proceedings started with the recitation from the Holy Quran. The Secretary, PSFST briefed the house about the purpose of meeting and invited proposals for election to the Executive Council of the Faisalabad Chapter. The followings were elected unanimously:

1. **Chairman:** Mian Abdul Malik, Food Technologist, Food Technology Section, Ayub Agricultural Research Institute, Faisalabad.

2. **Vice Chairman:** Dr. M. Ismail Siddique, Associate Professor, Department of Food Technology, University of Agriculture, Faisalabad.

3. **Secretary:** Mr. Muhammad Mukhtar, Head Department of Food Technology, Government College of Technology, Faisalabad.

3. **Treasurer:** Syed Muhammad Nassar Abbas, Assistant Research Officer, Food Technology Section, Ayub Agricultural Research Institute, Faisalabad.

On behalf of the newly elected office bearers, Mian Abdul Malik thanked the house for entrusting them the responsibility and assured them of his continued efforts towards the advancement of the cause of Food Scientists and Technologists.

OBITUARY

Dr. Farrukh Hassan Shah, a founder and active member of Pakistan Society of Food Scientists and Technologists and former Director General of PCSIR Laboratories Complex, Lahore, breathed his last during the last hours of 1994. He died with his boots on as he was still actively engaged in supervising projects at the PCSIR after his retirement in 1992. Dr. Shah joined PCSIR Laboratories Lahore in 1956 as a Technical Assistant and rose to the highest post by dint of hard labour, diligent efforts and singleness of purpose. He was a devoted Muslim. When advised a by-pass in 1987, he preferred to spend his hard-earned money to perform *'Haj'*

As a scientist, he was recognized nationally and internationally. He was an FAO consultant during 1983-84 and was appointed as a foreign expert to First Meeting of Indian Association of Food Scientists and Technologists. He was a Fellow of the Pakistan Academy of Sciences and acted as member of Advisory Councils of many universities. He supervised/guided 150 M.Sc. and 34 Ph.D. students for their degrees. He was a very versatile scientist and developed various facilities at the PCSIR Laboratories, Lahore by acquiring nearly 100 million rupees from international agencies. He completed several projects sponsored by USDA, UNDP, FAO, and NSF (USA). His research interests were multifarious concentrating actively in the development of cheap sources of proteins for food and feed purposes, biogas production, tissue culture, human and animal nutrition, mycotoxins, etc. He published 12 books and monographs. Two of his books were published by Urdu Science Board. More than one hundred research publications in local and foreign journals of international repute have been published by him.

Dr. Shah represented Pakistan in 12 international meetings. He was awarded *Tamgha-e-Imtiaz* by the Government of Pakistan and received gold medals and Certificates of Appreciation. He was a patriotic Pakistani and a devoted scientist. In his demise Pakistan has lost one of her most loving sons.

The Executive Council and members of the Society share the grief with the family of the bereaved. May his soul rest in peace. *Amen!*