

CHARACTERIZATION AND STORAGE STABILITY OF KHOA (MILK CONCENTRATE) AS RELATED TO WATER ACTIVITY

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ABSTRACT

Investigation was conducted to establish relationship between water activity (A_w) and sorption characteristics of khoa and to evaluate its chemical and microbiological stability during storage at 40 °C. Changes in weight were measured after placing the samples at 40°C over various A_w levels (0.11 to 0.89 A_w) till the attainment of apparent equilibrium. Equilibrium moisture contents were determined and plotted against respective A_w levels. A sigmoid type of sorption isotherm was obtained with 5-8 % moisture at monolayer matching 0.17 to 0.52 A_w and estimated A_w of 0.88. The quality in terms of acidity, peroxide and browning declined rapidly during storage by 1.5, 3.0 and 1.5 times respectively on increasing A_w from 0.1 to 0.75 whereas microbial growth limited the shelf life to 4 days at 0.83 A_w .

INTRODUCTION

Milk plays important role in human diet, and its 4-5 folds concentrated product is known as "khoa" in this subcontinent. This is made from whole milk comprising on 68-75 % total milk solids and appears as a dough mass. The khoa is used for direct consumption and also forms the base for different dairy products of significant economic values, like "gulabjaman", "burfi", ice cream, etc. It has been estimated that as much as 2.8×10^6 tonnes of whole milk, about 6% of the total production in the subcontinent is converted into khoa annually (Adhikari, 1993). Khoa is used almost in every part of the country on all occasions and has significant market value. Khoa has very high food value containing fairly large amount of high quality milk protein (19-20 %), fat (30 to 31 %), lactose (15 to 16 %) and ash (3 %). In addition, it provides high amount of bone forming and other nutritionally important minerals including

calcium (650 mg/ 100 g) and phosphorus (420 mg/ 100 g), and furnishes high quality energy (401 Kcal/ 100 g).

Since khoa is prepared under unhygienic handling and processing conditions, and has high moisture level, it is highly perishable (Shah *et al.* 1995). The stability of khoa as affected by water activity has been little explored and limited information on moisture sorption characteristics of khoa are available in the literature. Sawhney and Cheryan (1988) reported that fresh khoa with 75 % total solid had 0.925 A_w and that addition of sugar increased its potential shelf-life.

The present investigation was focussed on the characterization of khoa in terms of moisture sorption isotherm, and to find out optimum water activity for maximum shelf life. Such valuable information collected is likely to be helpful in

devising a novel technique for the preparation of highly nutritious and shelf stable khoa milk product.

MATERIALS AND METHODS

Khoa procured from the local market was mashed with (0.1 %) sodium benzoate to form uniform dough. However, material required for the study of microbial stability was treated with benzoate. Saturated salt solutions of different A_w values were prepared for water equilibration studies (Shahzada *et al.* 1997).

EQUILIBRATION OF MOISTURE

Uniform khoa sample was divided into different lots of 2 g each, and kept inside desiccators each containing saturated salt solutions of different water activity (0.11 to 0.89 A_w) and allowed to attain moisture equilibration at 40 °C. During equilibration it was assured that the salt solutions remained saturated. Each sample was weighed after every two hr, and weighing continued till no further gain or loss in weight was observed. Equilibrium moisture content of samples at each water activity was then determined. Sorption isotherm was produced by plotting equilibrium moisture content (EMC) against respective water activity. Monolayer moisture content of khoa was then calculated using Brunauer-Emmett-Teller (B.E.T) modified equation (Sawhney and Cheryan, 1988). Water activity was also determined by plotting weight gain/ loss of each sample against respective water activity using Harvard Graphic software package, and the water activity imparting no change in weight is reported.

STABILITY STUDIES

The khoa sample (450 g) was divided into three equal parts, equilibrated inside separate desiccators containing saturated salt solutions corresponding to 0.11, 0.43 or 0.75 A_w and incubated at 40 °C for 63 days. The sample (20 g) was taken out after every 10 days and analyzed for moisture, acidity, peroxide value and browning index. Moisture content expressed as percentage

weight loss on dry basis, was estimated by oven method and acidity and peroxide values were determined by the methods of A.O.A.C. (1975). The browning was measured by taking absorbance at 470 nm (Baloch *et al.* 1997). Microbial stability of khoa was assessed by observing slime formation in the samples.

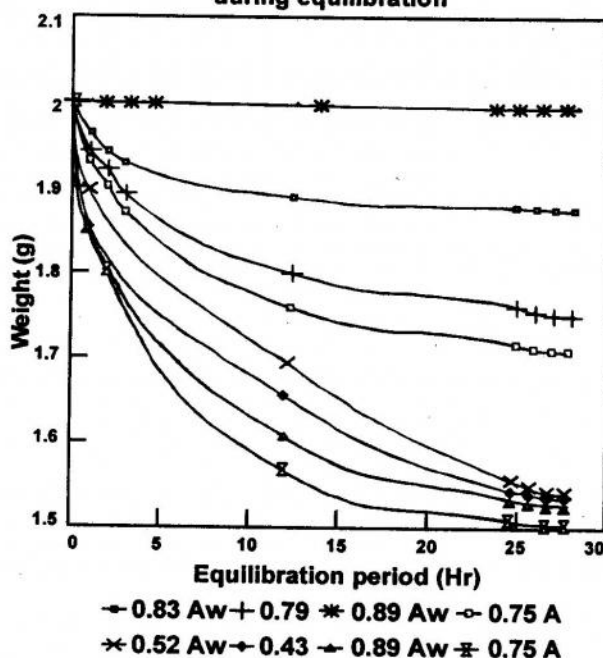
RESULTS AND DISCUSSION

Sorption Isotherm.

Effect of Incubation on Weight Changes

In order to examine the trend in weight changes, loss or gain in weight of samples during incubation was plotted against equilibration time (Fig. 1), with the exception of the sample at 0.89 A_w in which there was slight increases in weight, all other samples in the range of 0.11 to 0.83 A_w had shown various degrees of weight loss on equilibration. Initially changes in weight were rapid followed by a slow change and subsequently the weight became almost constant (after 27 hours equilibration period).

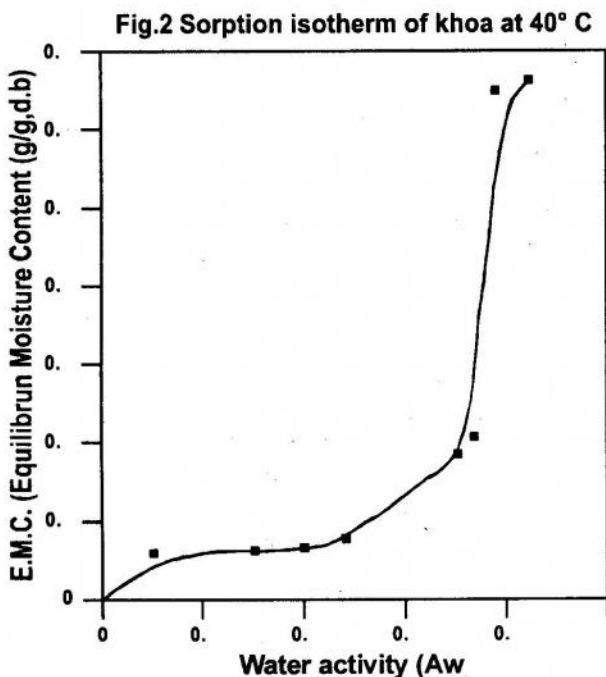
Fig.1 Gain/ loss in weight of Khoa during equilibration



Characterization of Sorption Isotherm

The graph plotted between the equilibrium

moisture content against water activity is represented as sorption isotherm at 40 °C (Fig. 2). The isotherm is sigmoid in shape with variable ratio of moisture to water activity at the food surface (Sawhney and Cheryan, 1988). The figure apparently has at least 4 following segments of moisture ranges covering the whole isotherm:



Region 1. It covers the section of the isotherm with 0 to 5 % moisture content and 0 to 0.17 A_w values. There was a small increase in the moisture with relatively noticeable increment in water activity. This is a region of the lowest moisture content where the moisture is expected to be tightly bound on food surface. The texture of the khoa sample at 0.11 A_w was hard and dry.

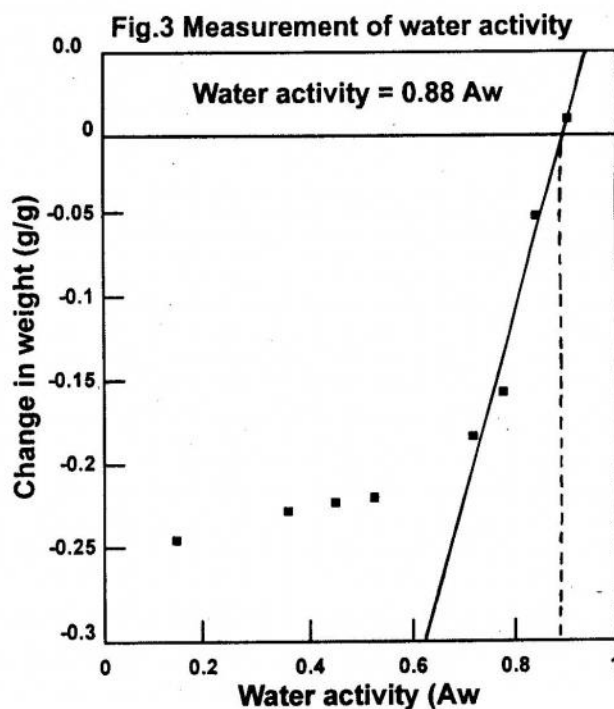
Region 2. This region spreads up to 8 % moisture, which shields the food surface to the extent of monolayer coverage conforming with 0.52 A_w . There appears to be little increase in moisture content and water activity marking almost parallel line with the abscissa of the coordinates.

Region 3. A gradual rise in moisture content approaching to 18 % is noticed on extending water activity to 0.73 A_w . The moisture remains loosely bound to the surface as multi-layers. The texture of the khoa appeared as firm and flexible.

Region 4. This is a high moisture region where there was a rapid build up of moisture exceeding to 20 % with small increment in water activity (0.73 A_w). The moisture remains loosely bound to the surface as multi-layers. The texture of the khoa appeared as firm and flexible.

Establishment of Water Activity

Overall change in weight of the equilibrated samples determined at each A_w level is plotted in Fig. 3. The level of A_w at which there



appeared no change in weight after equilibration is taken as the A_w of the khoa sample as 0.88 A_w . For determining the A_w value of khoa only those points were given due consideration which had water activity close to that of khoa sample exhibiting insignificant changes in weight, while ignoring the remaining distant points. Sawhney and Cheryan (1988) had reported the A_w of khoa as 0.9 at 25 °C. The difference in the result most likely is due to the variation in storage temperature and the sample composition. It may be pointed out that in the present study, the sample was purchased from the market and was not prepared in the laboratory. The A_w of the sample is therefore, subjected to variation due to varying amounts of sugar which is normally added during

its preparation. Reduction of A_w on addition of different amounts of sucrose to khoa product had been reported by Prajapati *et al.* (1986) and Sawhney and Cheryan (1988).

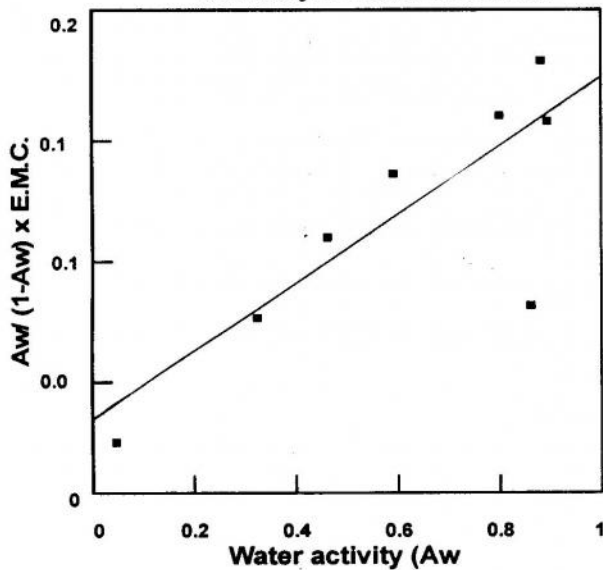
Monolayer Moisture Determination

The following Brunauer-Emmett-teller (B.E.T) equation as modified by Sawhney and Cheryan (1988) is adopted for determining the monolayer moisture content of the sample:

$A_w / (1-A_w) \times E_{mc} = C - 1/M_m \times C + 1/M_n \times C$;
 where: A_w is water activity; E_{mc} is equilibrium moisture content (g/100 g solids), M_m is moisture at monolayer surface (g/100 g solids) and C is the constant.

A linear regression line is drawn between $A_w / (1-A_w) \times E_{mc}$ and A_w (Fig. 4), where slope of

Fig.4 Linear regression line fo monolayer moisture conten



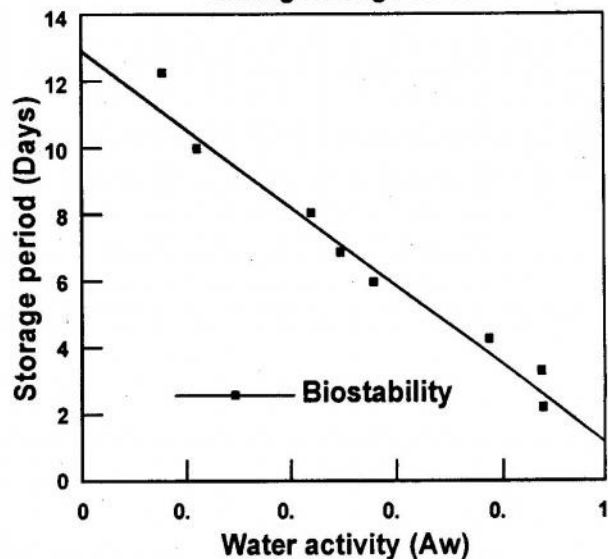
the line being $C - 1/M_m$. C is 0.1491 and intercept of the line being $1/M_n$. C is 0.0278. From these two equations the moisture content at monolayer (M_m) is calculated as 5.7 g/ 100 g. The results are in consistent with the findings of Sawhney and Cheryan (1988) who had reported 4.48 g/ 100 g as monolayer moisture at 25 °C of khoa containing 30 % added sugar.

Stability Studies

Stability of khoa was determined keeping in view the stability as affected by the growth of microorganisms and chemical deterioration causing rancidity and browning development.

Microbial Stability. The samples were observed at least twice a day for unusual appearance of slime formation caused by the growth of microorganisms. The sample kept beyond 0.83 A_w showed a rapid sign of deterioration within 4 days of the storage. Where as it was delayed to 5, 6, 7 and 8 days in samples placed at 0.75, 0.58, 0.52 and 0.44 A_w respectively. Similarly samples stored at 0.11 and 0.23 A_w afforded protection till 12 and 10 days respectively. Kumar *et al.* (1975) reported that shelf life of khoa was 5 days. However, its storage life was extended by the addition of 50% sugar with reduced A_w (0.78) (Prajapati *et al.*, 1986). The graph between A_w and apparent limiting life (days) exhibited a straight line (Fig. 5). The rate of deterioration was more rapid

Fig. 5 Microbial stability of kho during storage at 40°C

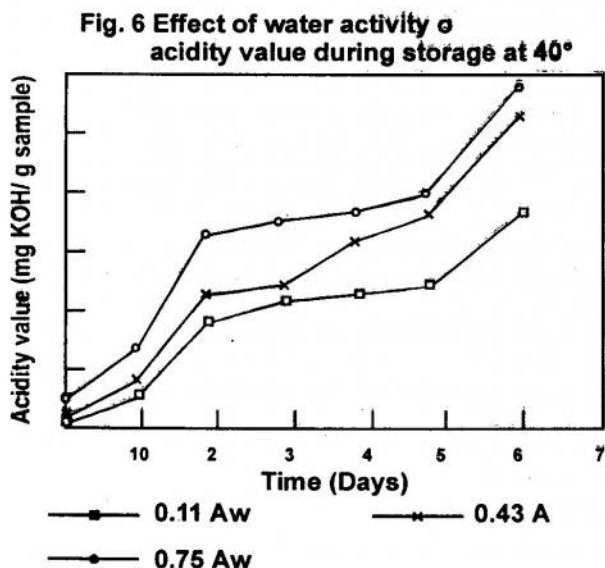


at high A_w levels, and then it became slow at lower A_w levels. A very low storage life for the samples kept below 0.8 A_w levels seems to be illusive. According to Kumar *et al.* (1975) most of the microbes stop growing below 0.8 A_w . In the present study however, several hours were

required to attain complete moisture equilibration. During that long equilibration period it is speculated that much growth has taken place prior to storage, and continued further with a speed governed by the respective A_w levels during storage thus indicating reduced shelf - life.

Chemical Stability. For this study a wide range of A_w levels were selected in order to impart the food a certain degree of microbial stability with acceptable texture. These are 0.11 A_w close to dry end, a medium range at 0.43 A_w and above 0.75 A_w located to upper sides of the isotherm with soft and moist textured food.

Acidity Value. The overall acidity level increased quite rapidly with increase in storage time for all the A_w levels (Fig. 6) representing a non-linear



tendency. However, the rate was further increased with proportionate increases in A_w and became maximum with acidity value of 5.67 mg potassium hydroxide/g in the sample equilibrated at maximum A_w of 0.75 and vice versa.

In order to compare the effect of A_w quantitatively the overall rate of acidity formation was calculated and tabulated by subtracting the value for zero storage period from that at the end of storage and the difference obtained was divided by total storage period (63 days) (Table - 1).

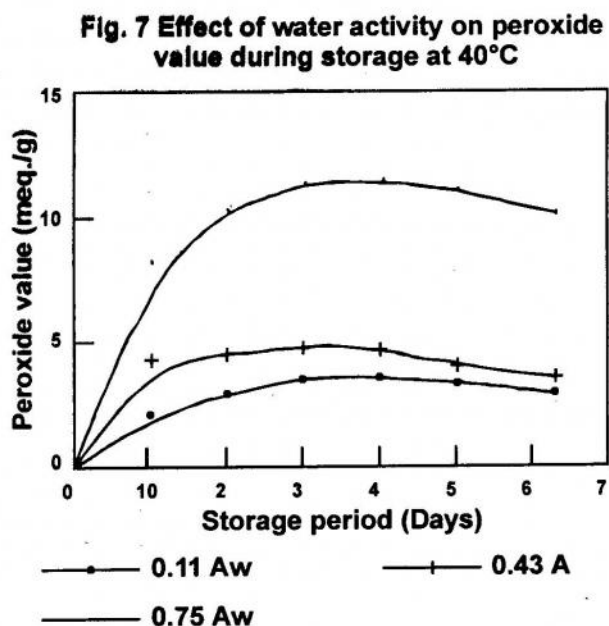
The overall liberation rate of acid at 0.11, 0.43 and 0.75 A_w were 5.3×10^{-2} /day, 7.9×10^{-2} /day and 8.2×10^{-2} /day respectively, and the rate

Table 1: EFFECT OF THE LEVEL OF WATER ACTIVITY ON THE OVERALL RATE OF CHEMICAL DETERIORATION.

| Overall rate of deterioration | Water activity (A_w) | | |
|-------------------------------|--------------------------|-----------------------|-----------------------|
| | 0.11 | 0.43 | 0.75 |
| Acidity value | 5.3×10^{-2} | 7.9×10^{-2} | 8.2×10^{-2} |
| Peroxide value | 5.7×10^{-2} | 7.6×10^{-2} | 17.0×10^{-2} |
| Browning value | 9.5×10^{-4} | 11.7×10^{-4} | 14.3×10^{-4} |

at 0.11 A_w was about 1.5 times slower as compared to that for the sample equilibrated at 0.75 A_w . It also appears that the rate at early period of storage (till 15 days) was relatively slow and then it increased rapidly. This trend was prominent in samples stored at higher A_w levels. It seems that some mechanism other than peroxidation is likely to operate which somehow, contributes towards acidity. The phenomena became pertinent for samples that were stored at higher A_w levels. Shahzada *et al.* (1997) also indicated a decrease in pH which is a measure of acid formation and was caused by production of browning during storage. It is most likely that the reactions leading to the non-enzymic browning may also contribute to the acidity during storage.

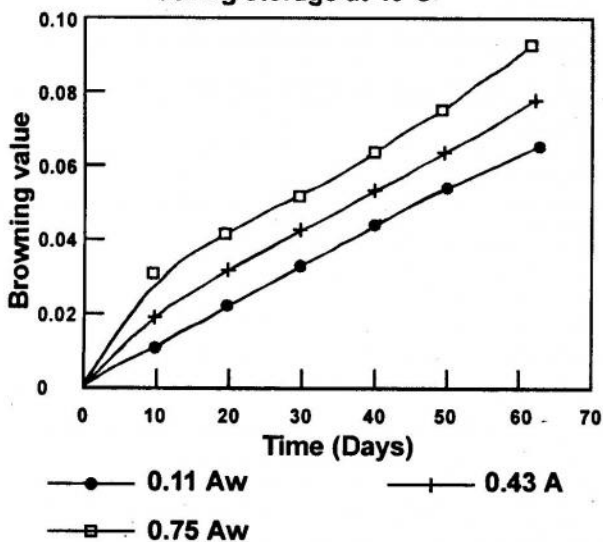
Peroxide Value. Initially the peroxide values for all samples were insignificant (till 5 days of storage). However, the values increased rapidly



and were maximum after 40 days but again declined till the end of the storage (Fig. 7). Similar findings had been reported by Baloch (1976). It further appeared that total peroxide values were influenced by A_w of the samples. The maximum peroxide value was 10.0 meq/g for sample equilibrated at 0.75 A_w , whereas the minimum value (3.0 meq/g) was found in sample stored at critically, the overall rate of oxidation is tabulated (Table-1). The overall oxidation rate of samples which were stored at 0.11, 0.43 and 0.75 A_w were 5.7×10^{-2} /day, 7.6×10^{-2} /day and 17.0×10^{-2} /day and the rate at 0.11 and 0.43 A_w was about 3.0 and 2.2 folds lower respectively than that of the sample equilibrated at 0.75 A_w . Apparently deterioration of khoa during storage at 40 °C proceeded through several routes producing compounds of varied nature which may further interact with each other causing retardation in oxidative reactions, or may form some compounds destroying components contributing for the increase in peroxide value thus showing decrease in peroxide values.

Browning Value. It is evident from the plot (Fig 8) that browning advanced during 63 days

Fig. 8 Effect of water activity on browning during storage at 40°C



storage at all A_w levels. However, the extent of the rise was proportionately higher with increase in the levels of A_w employed. The sample offered

highest stability at the lowest A_w levels. Initially the value was zero for all the samples, which was ultimately elevated to 0.06, 0.074, and 0.09 absorbance index at the end of the storage at 0.11, 0.43, and 0.75 A_w respectively. Although browning remained on the increase in all the samples but the extent of the rise was minimum for the sample placed at 0.11 A_w , while maximum at 0.75 A_w .

The overall rate of browning for samples which were maintained at 0.11, 0.43, and 0.75 A_w was found to have 9.5×10^{-4} /day, 11.7×10^{-4} /day 14.3×10^{-4} /day respectively, and the rate at 0.11 and 0.43 was about 1.5 and 1.2 folds slower than that at 0.75 $10^{-4}/A_w$ respectively, while the samples at lower A_w levels were more stable.

Loncin *et al.* (1968) reported that browning strongly depended on A_w and reached a maximum rate at 0.6-0.7 A_w values for milk powder kept at 40 °C for 10 days. Labuza *et al.* (1970) reported that browning reactions usually became slow at low humidity and increased to maximum at higher humidity levels. In the present investigation the rate of browning was minimum in sample with lowest A_w values and maximum for sample having maximum A_w . According to the above findings microbial as well as chemical stability increased on reducing A_w during storage.

It is to conclude that both microbial and chemical factors are accountable for reducing shelf life of the khoa sample. Although, during the course of khoa preparation most of the microorganisms are likely to be killed by heat treatment, it is expected that the product should remain stable for a considerable period near its own water activity (0.88 A_w) as microbe cannot grow easily at this A_w . In order to extend its shelf life the product must be prepared and packed hygienically. Addition of approved preservative might be advantageous to extend its shelf life further without impairing its organoleptic quality.

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SUITABILITY OF LOCAL WHEAT VARIETIES FOR THE PRODUCTION OF PIZZA

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ABSTRACT

Eleven Pakistani commercial wheat varieties collected from three different provinces of Pakistan, were evaluated for various physico-chemical characteristics. It was observed that physical characteristics, chemical values of whole wheat flour and straight grade flour, wet and dry gluten content, SDS-sedimentation value, pelshenke value and falling number differed among different wheat varieties. Physical dough properties were also affected significantly due to differences in wheat varieties. Sensory evaluation of pizza before baking and after baking revealed that Pasban-94 and Inqulab-91 ranked higher for shelf-life of pizza dough base and over-all acceptability of pizza. Results of this investigation suggested that flour of different wheat varieties grown in the province of Punjab were comparatively better for pizza production than wheat cultivars grown in other provinces of Pakistan.

INTRODUCTION

Wheat (*Triticum aestivum*) occupies a pivotal position in human diet. It ranks first with respect to area and production amongst the other food grain crops on global basis. Wheat is a staple food and contributes more than 60% of the total calories and protein requirements in the daily average diet of Pakistan. Mainly it is consumed for the production of an unleavened flat bread locally known as "chapati" while the remaining wheat is used for the production of other bakery products like breads, cookies, cakes, pastries, etc. The chapati requires medium hard wheat with protein content ranging from 10.5 to 12.5% (Moss, 1973).

Pizza can be traced back to the Persian Empire of 500 B.C. but the pizza like product developed in 1700s when peasant families of Naples used tomatoes as a part of topping. In late 1800s pizza was introduced to America by Italian immigrants and first pizzeria was established in New York City during 1940-50s. The pizza became an increasingly popular food in American

diet and its sale over the world increased at a rapid speed (Lehmann and Dubios, 1980).

Pizza has recently been introduced in Pakistan by Pizza Hut International and MCR (Pvt.) Ltd. has got the franchise of Pizza Hut in Pakistan. The Pizza Hut in Pakistan is importing flour of hard red winter wheat from Australia for pizza preparation because Australian wheats possess higher protein content which can tolerate fermentation for a longer time as compared to Pakistani wheats.

The project of this research was sponsored by MCR (Pvt.) Ltd. a franchise of Pizza Hut International. The mandate for the project was to achieve the following objectives:

- i. To evaluate different wheat varieties available in Pakistan for various physico-chemical and rheological characteristics in order to assess their suitability for the production of pizza on commercial scales.
- ii. To study the shelf-life of pizza dough in terms

of its gas retention in a retarder maintaining a temperature at 2 to 4°C.

MATERIALS AND METHODS

Eleven wheat varieties were procured from different research institutes of Punjab, Sindh, and NWFP provinces grown during 1997-98. Physical characteristics like thousand kernel weight, test weight and particle size index were determined according to method described in AACC(1983). Chemical characteristics such as moisture, ash and protein of whole wheat flour and straight grade flour were estimated according to the methods described in AACC(1983). The wet and dry gluten content for all the wheat varieties were determined by following the procedure described in AACC(1983). Pelshenke value and falling number values were determined according to their respective methods in AACC(1983). SDS sedimentation value was determined by following the procedure outlined by Williams *et al.*(1986). The grains of each wheat variety were milled through Quadrumate Senior Mill according to the procedure described in AACC(1983). Dough characteristics such as farinographic and mixographic characteristics of all wheat varieties were determined according to the procedure described in AACC(1983). Pizza from the flour of each wheat variety was prepared by following the recipe and procedure provided by Pizza Hut International. The pizzas prepared from all wheat varieties were evaluated for parameters like, clean-up stage, mixing time, proofing time, retarding time, surface smoothness, holes at bottom and shelf-life prior to baking and baked pizzas by a panel of judges for sensory characteristics like colour, flavour, after-taste, aroma, texture and overall acceptability by using the hedonic scale as described by Larmond (1977). Finally the data obtained for each parameter were subjected to statistical analysis by using appropriate techniques as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

In Pakistan the pizza restaurants have recently been established in big cities like Karachi

and Lahore. The flour is one of the major ingredients for pizza production which accounts for maximum weight in dough base. The pizza is prepared from common wheat possessing higher protein content and strong quality.

Eleven Pakistani commercial wheat varieties (Table-1) were collected from three different provinces of Pakistan. The

Table-1: LIST OF WHEAT VARIETIES COLLECTED FROM DIFFERENT RESEARCH INSTITUTES

| Variety | Location |
|-------------|--|
| Pasban-90 | Ayub Agricultural Research Institute, Faisalabad. |
| Inqilab-91 | Ayub Agricultural Research Institute, Faisalabad. |
| Parwaz-94 | Ayub Agricultural Research Institute, Faisalabad. |
| Punjab-96 | Ayub Agricultural Research Institute, Faisalabad. |
| Kohistan-97 | Ayub Agricultural Research Institute, Faisalabad. |
| MH-97 | Ayub Agricultural Research Institute, Faisalabad. |
| Kirn-95 | Atomic Energy Agricultural Research Centre, Tandojam |
| Sarsabz | Atomic Energy Agricultural Research Centre, Tandojam |
| Sughat | Atomic Energy Agricultural Research Centre, Tandojam |
| Nowshera-96 | Cereal Crops Research Institute, Nowshera, Peshawar |
| Suleman-96 | Cereal Crops Research Institute, Nowshera, Peshawar |

wheat varieties were subjected to physico-chemical analysis, rheological properties and pizza baking qualities. The results obtained from different quality attributes are reported below:

The physical characteristics such as 1000-kernel weight, test weight and particle size index showed significant variation among different wheat varieties. The mean values for thousand kernel weight, test weight and particle size index were found to vary from 32.53 to 45.57 grams, 68.07 to 78.10 kg/hl and 6.14 to 18.19, respectively among different wheat varieties (Table-2).

Table-2: ANALYSIS OF VARIANCE FOR DIFFERENT TESTS CONDUCTED FOR DIFFERENT WHEAT VARIETIES

| Parameters | | d.f. | S.S. | F-value |
|-------------------------|----------------------|------|-------------|--------------------|
| 1000-kernel weight | | 10 | 570.372 | 299.326** |
| Test weight | | 10 | 358.675 | 1881.17** |
| Particle size index | | 10 | 423.372 | 15.93** |
| Moisture content | Straight grade flour | 10 | 0.9320 | 3.39* |
| | Whole wheat flour | 10 | 20.8964 | 1.13 ^{ns} |
| Protein content | Straight grade flour | 10 | 24.5735 | 162.90** |
| | Whole wheat flour | 10 | 21.6335 | 95.88** |
| Ash content | Straight grade flour | 10 | 0.0633 | 40.98** |
| | Whole wheat flour | 10 | 1.1086 | 23.41** |
| Wet gluten content | Straight grade flour | 10 | 184.2849 | 49.17** |
| | Whole wheat flour | 10 | 235.5746 | 565.01** |
| Dry gluten content | Straight grade flour | 10 | 18.9882 | 139.25** |
| | Whole wheat flour | 10 | 13.0230 | 139.25** |
| Pelshenke value | | 10 | 104759.3333 | 296.25** |
| SDS-sedimentation value | | 10 | 1377.4939 | 268.82** |
| Falling number values | | 10 | 638988.0000 | 442.16** |

The variations among the values of 1000 kernel weight, test weight and particle size index

may be due to environmental conditions prevailing during growing period of wheat. The results regarding these physical parameters are comparable with the earlier findings of Anjum (1991), Ahmad (1993) and Butt (1997). The results indicated that the chemical composition such as moisture, ash, protein and gluten contents for whole wheat flour and straight grade flour differed significantly among different wheat varieties (Table-2). The variation in protein, ash and dry gluten contents for straight grade flour among different wheat varieties ranged from 9.03 to 11.80%, 0.35 to 0.50% and 9.04 to 11.40% respectively, which were found to be significantly different (Table-3). The highest protein and gluten

medium to strong gluten and may be used for yeast raised products. The pelshenke value, SDS value and falling number values ranged from 57.33 to 250.00 minutes, 18.33 to 40.50 mL and 193.33 to 671.00 seconds respectively (Table-3).

Except Nowshehra-96 and Suleman-96 all the wheat varieties tested exhibited falling number values exceeding 400 seconds which indicated that Pakistani wheats were low in amylase activity which demanded that their flour must be supplemented with malt or with any other source of amylase in order to get optimum potential of wheat varieties for the production of yeast raised product like pizza. The farinographic characteristics such as water absorption, dough development time and dough stability varied from 49.0 to 62.5%, 1.5 to 6.5 minutes and 3.0 to 14.1 minutes, respectively (Table-4), among different wheat varieties. Cultivar Sarsabz showed the highest value for water absorption and Pasban-90 gave the highest dough development time. Variety Sughat yielded maximum stability. The results regarding the farinograms of different wheat varieties were in consistent with the earlier findings of many research workers (Anjum, 1991, Ahmad, 1993 and Butt, 1997).

Table-2 MEAN VALUES OF DIFFERENT PARAMETERS STUDIED FOR DIFFERENT WHEAT VARIETIES

| Varieties | Moisture (%) | | Ash (%) | | Protein (%) | | Dry gluten (%) | | Pelshenke value (Min) | SDS sedimentation value (mL) | Falling number value |
|--------------|--------------|--------|---------|-----------|-------------|--------|----------------|---------|-----------------------|------------------------------|----------------------|
| | SOF | WWF | SOF | WWF | SOF | WWF | SOF | WWF | | | |
| Pasban-90 | 13.73 a | 8.99 a | 10.25 c | 12.24 cde | 0.40 a | 1.57 g | 10.13 c | 10.93 d | 180.33 b | 29.83 cd | 518.00 c |
| Inqulab-91 | 13.76 a | 8.93 a | 11.13 b | 12.03 a | 0.44 d | 1.61 f | 10.86 b | 10.24 e | 155.67 a | 29.50 cd | 579.33 c |
| Parwaz-94 | 13.58 a | 8.86 a | 11.80 a | 13.50 a | 0.41 f | 1.51 i | 11.41 a | 11.84 a | 153.00 d | 28.67 d | 516.33 a |
| Pb-96 | 13.51 a | 8.31 a | 10.26 c | 12.45 bc | 0.43 d | 1.53 h | 1.14 c | 11.26 c | 70.00 f | 22.13 f | 469.00 f |
| Kohistan-97 | 13.54 a | 8.66 a | 11.18 b | 12.59 bc | 0.46 c | 1.74 e | 10.69 b | 11.12 c | 163.33 cd | 26.33 e | 529.67 e |
| Kim-95 | 13.66 a | 8.96 a | 9.80 d | 10.23 b | 0.38 f | 1.69 d | 9.72 d | 10.09 e | 153.00 d | 21.00 f | 408.33 g |
| MH-97 | 13.57 a | 8.74 a | 0.03 f | 11.24 bc | 0.48 ab | 1.66 e | 9.04 e | 10.06 f | 57.33 f | 18.33 g | 671.00 b |
| Sarsabz | 13.76 a | 8.84 a | 9.10 f | 12.33 bcd | 0.38 f | 1.53 h | 9.06 e | 11.54 b | 179.33 b | 30.50 c | 647.67 b |
| Sughat | 13.76 a | 8.76 a | 9.51 e | 11.49 c | 0.35 g | 1.50 i | 9.15 e | 11.13 c | 250.00 a | 40.50 b | 277.67 h |
| Nowshehra-96 | 13.83 a | 8.66 a | 10.29 a | 12.54 b | 0.50 a | 2.05 a | 10.17 c | 11.91 a | 167.67 c | 38.50 b | 193.33 i |
| Suleman-96 | 13.20 b | 8.66 a | 11.98 b | 12.31 bc | 0.46 bc | 2.03 b | 10.74 b | 11.15 c | | | |

CONTINUE

| Varieties | 1000 kernel weight (g) | | Test weight (kg/6l) | PSI (%) | DT (Min) | DDT (Min) | DS (Min) |
|--------------|------------------------|-------------------|---------------------|---------|----------|-----------|----------|
| | 1000 | kernel weight (g) | | | | | |
| Pasban-90 | 34.69 fg | 76.76 d | 7.96 de | 10.00 | 6.5 | 8.5 | |
| Inqulab-91 | 44.61 b | 77.70 bc | 18.19 a | 9.50 | 4.5 | 7.75 | |
| Parwaz-94 | 45.57 a | 75.40 f | 8.46 e | 8.50 | 2.5 | 5.25 | |
| Pb-96 | 33.94 g | 73.75 g | 7.92 de | 10.00 | 4.2 | 8.6 | |
| Kohistan-97 | 32.53 h | 73.59 g | 11.85 bc | 9.90 | 5.3 | 8.3 | |
| Kim-95 | 39.63 c | 77.47 c | 12.79 c | 12.7 | 3.0 | 11.3 | |
| MH-97 | 39.62 c | 75.10 f | 6.14 e | 7.00 | 1.5 | 5.5 | |
| Sarsabz | 35.05 ef | 77.77 b | 16.62 b | 4.5 | 2.5 | 3.0 | |
| Sughat | 38.64 d | 78.10 e | 9.16 cde | 15.2 | 4.7 | 14.1 | |
| Nowshehra-96 | 34.45 fg | 68.07 i | 9.52 cd | 14.6 | 3.5 | 13.5 | |
| Suleman-96 | 31.54 h | 69.07 h | 10.60 cd | 12.1 | 5.7 | 10.9 | |

content were found in Parwaz-94, and Inqulab-91. The values for protein, ash and gluten contents were lower for straight grade flour as compared to whole wheat flour. The differences in protein and gluten content are ascribed due to the difference in the genetic make up of wheat varieties tested, variation in climatic condition and differences in cultural practices. The wheat varieties with higher protein and gluten content gave better results for pizza shelf-life. The pelshenke value and SDS-value were also affected significantly by wheat varieties. Nowshehra-96 gave significantly higher values for pelshenke and SDS tests. The wheat varieties which showed high values for pelshenke value and SDS sedimentation test, were grouped as wheats with

Table-4 ANALYSIS OF VARIANCE FOR DIFFERENT TESTS CONDUCTED TO EVALUATE PIZZA PREPARED FROM DIFFERENT WHEAT VARIETIES

| Parameters | d.f. | S.S. | F-value |
|--|------|----------|--------------------|
| Clean-up stage | 10 | 16.1818 | 6.68** |
| Colour of the dough base | 10 | 29.5758 | 4.44** |
| Proofing time of the pizza dough | 10 | 634.1818 | 12.10** |
| Shelf-life of dough base | 10 | 73.8788 | 27.09** |
| Surface smoothness for pre-baked pizza | 10 | 26.8485 | 8.05** |
| Evenness of holes at bottom of pizza | 10 | 44.90.91 | 8.88** |
| Colour of baked pizza | 10 | 12.52 | 3.41* |
| Flavour of baked pizza | 10 | 10.70 | 2.23* |
| Aroma of baked pizza | 10 | 10.52 | 2.56* |
| Texture of baked pizza | 10 | 8.36 | 1.74 ^{ns} |
| After-taste of baked pizza | 10 | 12.36 | 4.43** |
| Overall acceptability of pizza | 10 | 245.17 | 9.73** |

Sensory characteristics of pizza such as colour, flavour, aroma, after-taste and over-all acceptability except texture were found to be affected significantly due to variation in wheat varieties. The mean scores for sensory evaluation varied from 6.71 to 8.00, 6.86 to 8.14, 6.86 to 8.14, 6.71 to 8.00 and 33.86 to 40.57 for colour, flavour, aroma, after taste and overall acceptability respectively (Table-5), among different wheat varieties. While texture of pizza depicted non-

significant results. The dough of wheat such as Parwaz-94, Inqulab-91 and Pasban-90 yielded maximum shelf-life while Sughat yielded poor results with respect to shelf-life.

Table 5. MEAN VALUES OF DIFFERENT PARAMETERS STUDIED FOR DIFFERENT WHEAT VARIETIES

| Varieties | Clean up Colour stage | Proofing time (Min) | Shelf life (Hours) | Flavour | Aroma-taste | Overall acceptability | Water absorption (%) | Dough development | |
|-------------|--------------------------|------------------------|-----------------------|---------|-------------|--------------------------|-------------------------|-------------------|--------------------------|
| | | | | | | | | time (Min) | Dough stability (Min) |
| Parwaz-94 | 3.00a | 8.50a | 48.87a | 7.57a | 7.37a | 7.21abc | 57.57b | 55.5 | 6.5 |
| Inqulab-91 | 2.67cd | 8.57a | 79.06cd | 7.67a | 7.21abc | 7.16a | 57.31b | 62.9 | 4.5 |
| Pasban-90 | 1.67b | 8.00a | 76.67cd | 8.00a | 8.14a | 8.00a | 66.57c | 52.5 | 2.5 |
| Ph-96 | 1.00bc | 8.00a | 81.67bc | 6.67b | 6.86 | 7.00cd | 55.96cd | 55.0 | 4.2 |
| Kohistan-97 | 2.67cd | 8.11a | 76.15cd | 7.33a | 7.29b | 7.14bcd | 55.41cd | 55.0 | 3.3 |
| Kinn-95 | 2.67cd | 8.67a | 77.00cd | 4.33d | 7.14b | 6.86cd | 54.86cd | 61.6 | 5.0 |
| M11-97 | 2.00bc | 7.67a | 73.33c | 6.33b | 6.86b | 6.71d | 53.86d | 49.0 | 1.5 |
| Sughat | 1.67b | 6.00b | 77.7cd | 7.33a | 7.43ab | 7.29bcd | 54.43bc | 62.3 | 5.5 |
| Suleman-96 | 2.67cd | 8.00a | 85.11ab | 7.00c | 6.86b | 6.71d | 55.00cd | 56.8 | 4.7 |
| Suleman-96 | 1.67b | 8.00a | 81.67c | 6.67b | 7.00c | 6.86cd | 54.86cd | 55.6 | 3.5 |
| Suleman-96 | 1.67b | 8.00a | 87.00a | 7.33a | 7.43ab | 7.43abc | 54.16bc | 57.4 | 5.7 |

On the basis of the characteristics of the flour of different wheat varieties assessed in the present study, it may be concluded that the flour of wheat varieties grown in Punjab was better for pizza production as compared to the wheats grown in other provinces of Pakistan.

The results regarding subjective evaluation of pizza prepared from different wheat varieties suggested that variation existed in the quality of the baked pizza due to the wheat varieties. However, on the basis of sensory scores assigned by different judges it may be recommended that wheat varieties Pasban-90, Inqulab-91, Parwaz-94 and Suleman-96 were suitable for pizza production in Pakistan.

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HEAVY METAL CONTAMINATION OF SEWERAGE, CANAL AND DRINKING WATERS

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ABSTRACT

Water is indispensable to life and hence plays vital role in the environment. Analysis of cadmium (Cd), lead (Pb) and copper (Cu) in sewerage, canal and drinking waters by potentiometric stripping analysis (PSA) was conducted. Samples were collected from different locations in the Peshawar area. The data indicated wide variation in the concentration of these heavy metals among various water samples. The ranges of Cd, Pb and Cu in drinking water lie between 0.023-2.75, 0.025-1.88 and 0-0.67 mg/l respectively. Similarly the results of sewerage water showed the concentration of Cd and Pb in the ranges of 0.036-1.25 and 0.004-11.50 mg/l while copper concentration was below detection limit in all samples. The highest levels of Cd and Pb in the canal water were 0.38 and 2.08 mg/l respectively. The results thus obtained were compared with the guidelines recommended for drinking water.

INTRODUCTION

Environmental pollution is a matter of great concern world-wide. Rapidly increasing industrialisation and motorization have greatly polluted the environments and consequently raised the native heavy metal levels in water and food materials. Water is an essential component of the human environment into which toxic metals may easily be increased from various sources of pollution. Water is one of the most abundantly available and widely distributed substance in nature (James, 1949). The determination of heavy metals in various types of water samples has become an important part of most studies concerned with environmental pollution and occupational health hazards. Contaminated drinking water has direct effect on human beings while sewerage, canal waters and industrial effluents have indirect effect on crops, vegetables and fruits irrigated with polluted waters which become harmful to humans and animals. Heavy metals include both essential and toxic mineral elements. It is well known that an essential metal

becomes toxic at sufficiently high intakes (Khurshid and Qureshi, 1984). Lead (Pb) and cadmium (Cd) are dangerous environmental pollutants (Haider, 1997). Excess amount of copper in drinking and irrigation water has a distinctly harmful effect on many crops and other living organisms (James, 1949). Heavy metals can be determined by several techniques however, potentiometric stripping analysis (PSA) is an electrochemical approach for the assay of trace metals and is particularly well suited in liquid samples since normally no pre-treatment is required (Jagner, 1979., Satzger *et al.* 1984, Benzo *et al.* 1986, Jagner and Westerlund 1980). Finding of an other study also shows similar results for drinking and irrigation waters (Sattar *et al.* 1990). Bangash (1995) determined pollution parameters of some drinking water resources of NWFP and observed significant variation in the values of pH, EC and other metals. The principal aim of this study was to quantify the presence of selected heavy metals and pH in some drinking, canal and sewerage waters and subsequently to comment on the radiological implications, if any, of their intake through different routs of entry.

MATERIALS AND METHODS

Sample collection and preparations. Samples of drinking, canal and sewerage waters were collected from different places in the Peshawar area. All the water samples were taken to the laboratory in plastic bottles immediately after collection. After measurement of pH, all water samples were acidified by addition of 0.5 ml of HCl to a pH 2.0 for conservation.

Analysis of different water samples. The drinking, canal and sewerage waters were assayed for pH measurement, and heavy metals according to the methods given below:

i) pH measurement: The pH meter was switched on and allowed to warm for 3 minutes. Standardised with buffer solution of 4.00 and 9.12 for acidic and alkaline ranges respectively and the pH of the water samples was measured using Fisher automatic titrimeter Model 36 pH meter.

ii) Determination of selected heavy metals: Simultaneous determination of Cd, Cu and Pb was carried out by the potentiometric stripping technique (Danielsson *et al.* 1983) using the Tecator striptec system (Model 1069-001) comprising glassy carbon electrode, saturated calomel electrode (SCE) and platinum wire as counter electrode. Detailed procedure has been given elsewhere (Sattar *et al.* 1990).

RESULTS AND DISCUSSION

Global demand for fresh water is increasing every year. At present, renewable water resources available per person are roughly half what they were in 1960, a value that is expected to drop by half again by the year 2025. Growing demand is compounded by pollution wherever fresh water is used for agricultural, industrial and domestic purposes. Hence, if water resources are not better managed and protected, shortages and contamination will present major dangers to health and the environment (IAEA, 1998).

Keeping in view hazardous impact of Pb, Cd and Cu on human beings, animals and plants,

it is necessary to establish occurrence of these toxic heavy metals in the environment. Lead is one of the non-essential trace elements extensively studied because of its various toxic effects in human at low dose (Haider, 1997). The typical symptoms of lead poisoning are cholic, anaemia, headaches, convulsions, chronic nephritis of the kidneys, brain damage and central nervous system disorders (Greenwood and Earnshaw, 1986). It is mainly released to the environment from motorization. Its permissible level is 0.05 ppm for drinking water according to WHO. Another heavy metal called cadmium may enter to water as a result of industrial discharges, automobiles tires, motor oils, plastic, coal and galvanised pipes. Cadmium is extremely toxic and accumulates in humans and damages mainly the kidneys and liver. Its permissible level is 0.01 ppm (ASTM, 1971; US, 1962).

Electrical conductors and alloys, discharge of mine tailings, disposal of industrial wastes, and municipal wastes are the sources of Cu releases into lake water. Copper treated water be used for irrigation but it has a distinctly harmful effect on many crops (James, 1949). Copper is essential to humans, the adult daily requirement has been estimated at 2.0 mg. The maximum permissible level for Cu in drinking water is 1.0 ppm (Health Services, 1962).

Selected heavy metal concentrations in drinking water are presented in Table-1. Twenty samples were taken from different locations. The results showed wide deviation for cadmium and lead. The concentration of cadmium and lead in all the samples were higher compared to the values in guideline for the quality of drinking water. While copper was below detection limit in majority of the samples. The ranges of Cd, Pb and Cu lie between 0.023-2.75, 0.025-1.88 and 0-067 mg/l respectively. Mximum level of Cd (2.75) was observed in the sample collected from Rahatabad while the maximum Pb concentration (1.88) was detected in Peshawar University drinking water. Copper was detected only in two samples.

Table 1: THE pH AND HEAVY METAL CONCENTRATION OF DRINKING WATER.

| S. No. | Location | pH | Cd Pb Cu | | |
|--------|-------------------------|-----------|------------|------------|--------|
| | | | (mg/l) | | |
| 1. | Bara Hand Pumps | 6.97 | 0.094 | 0.043 | * |
| 2. | New Adah, Peshawar | 8.29 | 0.042 | 0.085 | 0.144 |
| 3. | Khazana Sugar Mills | 6.95 | 0.060 | 0.025 | 0.500 |
| 4. | Peshawar Board Well | 7.00 | 0.028 | 0.096 | * |
| 5. | Din Bahar Colony | 7.30 | 0.054 | 0.462 | * |
| 6. | Dabgari | 7.40 | 1.00 | 0.800 | * |
| 7. | Tehkal Payan | 7.36 | 0.150 | 0.116 | * |
| 8. | Speen Jamaat | 7.80 | 0.167 | 0.219 | * |
| 9. | NWFP Agri. Univ. | 7.75 | 0.107 | 0.250 | * |
| 10. | Sufaid Dheri | 7.70 | 0.525 | 0.235 | * |
| 11. | Hashtnagri Hotel | 8.18 | 0.688 | 0.180 | * |
| 12. | Bakshu Pull | 7.84 | 0.750 | 0.050 | * |
| 13. | Chamkani Well | 8.25 | 0.313 | 0.068 | 0.670 |
| 14. | Rahatabad | 7.45 | 2.750 | 0.167 | * |
| 15. | Shah Alam Mosque Well | 7.73 | 0.630 | 0.056 | * |
| 16. | Gul Bahar Mosque | 7.19 | 0.023 | * | * |
| 17. | Peshawar-Charsadda Road | 7.45 | 0.600 | 0.500 | * |
| 18. | NIFA | 8.09 | 1.750 | 0.160 | * |
| 19. | Nothea | 7.76 | 0.750 | * | * |
| 20. | Peshawar Univ. Hostel | 7.80 | 0.050 | 1.880 | * |
| Range | | 6.95-8.25 | 0.023-2.75 | 0.025-1.88 | 0-0.67 |
| Mean | | 7.60 | 0.526 | 0.270 | 0.066 |
| S.D. | | 0.429 | 0.684 | 0-4.428 | 0.182 |
| C.V. | | 5.64 | 130.04 | 158.52 | 275.76 |

1. Values are means of 2-3 independent determination.

2. S.D. standard deviation

3. C.V. (coefficient of variability) = $\frac{S.D. \times 100}{\text{Mean}}$

* Below detection limit.

The results of sewerage water are given in Table-2. It was observed that highest amount of Cd (1.250) was in the drainage of Bacha Khan Chowk and the least (0.036) in the sample obtained from Peshawar Dental College. Similarly the maximum amount of Pb (1.50) was detected in the sample collected from effluents of Khazana Sugar Mills while the least (0.004) was observed in the sample of Tehkal Payan. It was interesting that copper concentration was below detection limit in all samples.

Table 2: THE pH AND HEAVY METAL CONCENTRATION OF SEWERAGE WATER.

| S. No. | Location | pH | Cd Pb Cu | | |
|--------|---------------------|-----------|------------|-------------|---|
| | | | (mg/l) | | |
| 1. | Tehkal Payan | 7.40 | 0.223 | 0.004 | * |
| 2. | Abid Fluor Mills | 8.69 | 0.144 | * | * |
| 3. | Nothea | 8.09 | 0.670 | 0.196 | * |
| 4. | Dental College | 3.99 | 0.036 | 0.298 | * |
| 5. | Bacha Khan Chowk | 8.22 | 1.250 | 0.438 | * |
| 6. | Khazana Sugar Mills | 7.22 | 0.091 | 1.500 | * |
| 7. | Railway Colony | 7.68 | 0.318 | 0.030 | * |
| Range | | 3.99-8.69 | 0.036-1.25 | 0.0040-1.50 | * |
| Mean | | 7.33 | 0.390 | 0.350 | * |
| S.D. | | 1.555 | 0.433 | 0.532 | * |
| C.V. | | 21.22 | 111.02 | 152.00 | * |

1. Values are means of 2-3 independent determination.

2. S.D. standard deviation

3. C.V. (coefficient of variability) = $\frac{S.D. \times 100}{\text{Mean}}$

* Below detection limit.

The results of canal water, mainly used for irrigation are presented in Table-3. The levels of Cd, Pb and Cu were in the ranges of 0.008-0.38, 0.031-2.50 and 0.0025-0.50 mg/l respectively. The highest level of Cd (0.38) was noticed at Speen Jamaat while Pb (2.08) was observed in the sample collected at NWFP Agricultural University, Peshawar.

Table 3: THE pH AND HEAVY METAL CONCENTRATION OF CANAL WATER.

| S. No. | Location | pH | Cd Pb Cu | | |
|--------|----------------------------|-----------|------------|------------|-------------|
| | | | (mg/l) | | |
| 1. | Peshawar-Charsadda Road | 8.05 | 0.070 | 0.065 | * |
| 2. | Bukshu Pull | 7.49 | 0.008 | 0.031 | 0.500 |
| 3. | NWFP Agric. Univ. Peshawar | 7.58 | 0.100 | 2.080 | 0.400 |
| 4. | Faqirabad | 7.87 | 0.054 | 0.330 | * |
| 5. | Speen Jamaat | 7.51 | 0.380 | * | 0.250 |
| 6. | Bara (Tarnab) | 5.95 | 0.013 | 0.043 | * |
| 7. | Naguman river | 6.80 | 0.048 | 2.50 | 0.263 |
| Range | | 5.95-8.05 | 0.008-0.38 | 0.031-2.50 | 0.0025-0.50 |
| Mean | | 7.32 | 0.096 | 0.721 | 0.202 |
| S.D. | | 0.721 | 0.129 | 1.084 | 0.207 |
| C.V. | | 9.85 | 134.38 | 134.44 | 102.48 |

1. Values are means of 2-3 independent determination.

2. S.D. standard deviation

3. C.V. (coefficient of variability) = $\frac{S.D. \times 100}{\text{Mean}}$

* Below detection limit.

Determination of means and CV of all the waters indicated wide variation in the heavy metal contents in each case. However, mean concentration of Cd, was highest in drinking water while mean level of Pb was highest in canal water. Maximum mean value of Cu was observed in sewerage water. Monitoring of heavy metals level of different waters in Peshawar has not been widely conducted. Elemental concentration of industrial effluents from few industries has been reported in few studies (Ahmad *et al.* 1982).

The hydrogen ion concentration of water is expressed by its pH value. This term is universally used to express the intensity of acidic or alkaline conditions of solution. The experimental data (Tables-1 to 3) indicate that majority of samples were in the permissible pH range given for drinking water standards (6.5-8.5). Only one drinking water sample collected from New Bus Addah was of slightly higher value (8.69). Another sewerage water sample obtained from Dental College was found on acidic side (3.99).

CONCLUSION

It is essential that the supply of water for

human consumption and irrigation should be free from unpleasant or harmful impurity and for this reason is subjected to various methods of treatment to render it safe for use. The present study indicates that background values for heavy metals should be monitored regularly in order to evaluate the toxic logical significance of commonly used water samples. The levels of toxic metals in majority of samples were higher as compared to recommended limits. Hence it is suggested that some pre-treatments be given prior to drinking or other uses.

Acknowledgment

We are grateful to Dr. M. Mohsin Iqbal, Director, NIFA for permitting to use the NIFA facilities during the research work. We are also thankful to Mr. Amir Nawas Khan for typing this manuscript.

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EFFECT OF COMMERCIAL SANITIZERS ON BROILER MEAT

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ABSTRACT

Four disinfectants employed for this study are TH₄, Prophyl, Beloran and Fourtedes. Their application was carried out according to the normal prevalent commercial practice. This phased study was completed in 45 days. Statistical analysis of results of the broiler growth obtained have been compared with the blank group. Possible growth stimulatory role of these sanitizers have been discussed. The stimulating effect shows considerable variability in all the four disinfectants. The mean values of feed conversion ratios of the experimental groups were better than the control group. Gross pathological study of trachea, lungs and liver was also carried out. Application of all the four sanitizers was found to be safe as no toxic effects were recorded. Chemical analysis of meat derived from these chickens showed non-significant variations within a narrow range. Except for the fat and moisture content other parameters tested showed non-significant differences ($P>0.05$).

INTRODUCTION

Poultry production remains the most efficient method of procuring high quality dietary proteins. Present day intensive poultry farming is confronted with different stress factors like extreme environment, poor hygiene and diseases. To overcome the poor hygienic conditions and as a precautionary measures against spread of diseases, periodic sprays of different types of sanitizers are undertaken. Some disinfectants can be used and considered safe even in the presence of birds.

The quaternary ammonium compounds are powerful germicidal compounds and one of the most useful antibacterial weapons applied in those industries where sterilization is of paramount importance. These are mostly effective at high dilutions and are relatively non-toxic, non-irritating and inexpensive. Their marked surface active properties increase their general utilization

(Adelson and Sunshine, 1952). These compounds are recommended especially for disinfection of eggs and for general use around hatcheries (Calnek *et al.* 1991).

Balloun (1955) presented data to show that 4-alkyl quaternary ammonium derivatives tested, consistently improved efficiency of feed utilization. Similarly another commercial detergent, sod. alkyl aryl sulphonate was studied by Almqvist and Merrit (1955). It was found that in a turkey growing mash, it had very slight effect on growth but improved efficiency of feed utilization in all comparisons.

Other researchers who have contributed notable work in this area are Dhillon *et al.* (1982), Ruitter (1985), Deichmann (1994) and Einstein *et al.* (1994). Some other detergents used in poultry industry include benzalkonium chloride and phenolic compounds. The former has strong antibacterial activity for skin sterilization, mucous

membrane and deep wounds whereas the commercial phenolic compounds find still wide use, being cost effective bacteriostatic preservative (Brander *et al.* 1991). In Pakistan poultry farmers and practitioners are confronted with the major problem in controlling outbreaks of infectious diseases in spite of the fact that they are using high doses of antibiotics due to contaminated surroundings of the flock.

For complete sanitization of poultry sheds in the presence of birds, highly effective and innocuous disinfectants are needed. At present a number of sanitizers are in use. The present study was undertaken to collect data on safety and efficacy of four of the common sanitizers used in the presence of birds namely, TH₄ of Sogvel of France, Fourtedes of Alveton GmbH of Germany, Prophyl of Merial Labs, France and Beloran of Ciba Geigy, Switzerland. The results provide sound basis for selecting a good sanitizer for the poultry industry.

MATERIALS AND METHODS

This study was conducted in January to February 1996 to determine the pathological effects of four commercially available disinfectants in broiler chickens (Table-1).

Table - 1: DISINFECTANTS AND CHICKEN GROUPS.

| Name of Product | Company | Composition | Dosage | Groups of Chickens |
|-----------------|-----------------------------|---|------------------------------|--------------------|
| TH ₄ | Sogeval, France | Didecylidimethyl ammonium chloride Alkyl dimethyl, benzyl ammonium chloride Dioctylidimethyl ammonium chloride Glutaraldehyde, Pine oil, Terpeneol | 5ml/L 1L/10m ² | A |
| Prophyl | Merial Laboratories, France | Chloro 4 methyl 3 Phenol 2 Benzyl 4 Chloro Phenol | 4ml/L 1L/4m ² | B |
| Beloran | Ciba Geigy, Switzerland | Benzalkonium chloride | 2ml/L 1L/10m ² | C |
| Fourtedes | Alvetra, Germany | Alkyl-dimethyl-dichloro benzyl ammonium chloride | 2ml/L 1L/10m ² | D |
| Control | - | - | - | E |

All groups were reared in different sheds to avoid the cross contamination by another disinfectant. Disinfectants were sprayed on weekly basis in the sheds of experimental groups in the presence of birds from 1st week to 5th week of the experiment according to the doses recommended by their

manufacturing companies.

EXPERIMENTAL CHICKS AND DESIGN

One hundred and twenty five broiler chicks procured from local market were divided equally into 5 groups, named A, B, C, D and E as given in the Table-1. They were reared under standard conditions of management and on balanced ration ad-libitum. The birds were vaccinated according to following schedule: (Table-2).

Table - 2: VACCINATION SCHEDULE

| Age | Vaccine | Company | Route | Dose |
|----------|------------------|-------------------------|----------------|-------------------|
| 7th Day | LaSota | Biotek, Italy | Eye drop | 1 vial/1000 birds |
| 12th Day | Gumboro D-78 | Intervet, Holland | Drinking water | 1 vial/1000 birds |
| 17th Day | Hydropericardium | Bio. Vet Lab., Pakistan | S/c injection | 1 vial/500 birds |
| 21st Day | LaSota | Biotek, Italy | Drinking Water | 1 vial/1000 birds |
| 28th Day | Gumboro D-78 | Intervet, Holland | Drinking water | 1 vial/1000 birds |

Experimental Determinations. The following parameters were studied/measured after slaughtering of the chicken under normal commercial practice:

1. Weight gain by birds
2. Feed intake
3. Feed conversion ratio (FCR)
4. Gross carcass examination
5. Proximate analysis of meat

Gross Carcass Examination (GCE). The birds were slaughtered on the 45th day of the experiment and trachea, lungs, liver and kidneys from all birds were eviscerated. The organs were thoroughly observed for any gross pathological lesion by adopting the following parameters:

- i. Size (normal, hypertrophy, atrophy).
- ii. Colour (normal, discolouration/congestion [focal, diffused], pale).
- iii. Texture (normal, soft, hard).
- iv. Any unusual growth.
- v. Deposition/covering of any material (fibrin/urates/pigments, etc).

Statistical Analysis. The data of all groups were compared by analysis of variance and statistical difference among various treatment means were determined using Least Significant Difference (LSD) test at 5% level of probability as described by Steel and Torrie (1980).

Sensory Evaluation. A ten members consumer panel was constituted to evaluate meat derived from birds of each group. Panel members were experienced persons, well versed with food science and terminology, and drawn from workers of PCSIR Labs. Familiar dish of chicken curry was prepared from breast meat of birds of each group. These samples were served in a randomized manner to the panellists along with plain water, standard wheat flour chapati and condiments. The panelists were instructed to use these according to their routine eating habits.

They were asked to indicate as to what extent they liked or disliked each product on a nine (9) point hedonic scale. The eating quality parameters observed were colour, flavour, juiciness, tenderness and over - all acceptability. The first two characteristics were judged by comparing with normal domestic preparation of meat in chicken curry of excellent quality. For tenderness and juiciness the panellists were advised to record their comments.

Score Scale: Dislike, extremely.....1
Like, extremely.....9

RESULTS

The results of the experimental work are summarised in Tables-3 to 7.

Table - 3: MEAN WEIGHT GAIN OF EXPERIMENTAL AND CONTROL GROUPS

| Group | Treatment | Grams (Mean ± SD) | | |
|-------|-----------------|-----------------------------|-------------------------------|------------------------------|
| | | 15 Days | 30 Days | 45 Days |
| A | TH ₁ | 283.4 ± 16.13 ^{bc} | 958 ± 55.06 ^{abc} | 1761.2 ± 57.07 ^c |
| B | Propyl | 293.6 ± 21.03 ^{bc} | 938 ± 73.00 ^{abc} | 1839.8 ± 61.52 ^{bc} |
| C | Beloran | 305.8 ± 11.0 ^{bc} | 1002.2 ± 27.31 ^{abc} | 1957.6 ± 68.54 |
| D | Fourtedes | 319.8 ± 16.81 ^b | 977.6 ± 87.62 ^{abc} | 1910 ± 93.00 ^{bc} |
| E | Control | 280.2 ± 14.87 ^c | 895 ± 56.86 ^{abc} | 1753 ± 89.41 ^c |

SD : Standard Deviation.

abc : Any two means carrying the same superscripts in a column are non significant between each other and that carrying the different superscripts are significant between each other at 5% level using LSD.

NS : Non-significant.

Table - 4: MEAN FEED CONSUMPTION OF EXPERIMENTAL AND CONTROL GROUPS

| Group | Treatment | Grams (Mean ± SD) | | |
|-------|-----------------|----------------------------|----------------------------|------------------------------|
| | | 15 Days | 30 Days | 45 Days |
| A | TH ₁ | 408 ± 5.83 ^{abc} | 1688 ± 28.63 ^{bc} | 3939 ± 121.26 ^b |
| B | Propyl | 414 ± 22.63 ^{bc} | 1683 ± 42.63 ^{bc} | 3963.6 ± 119.98 ^b |
| C | Beloran | 426 ± 23.03 ^{abc} | 1718 ± 21.35 ^b | 4274.4 ± 61.47 ^b |
| D | Fourtedes | 430 ± 20.84 ^{abc} | 1715 ± 16.04 ^b | 4143 ± 167.03 ^b |
| E | Control | 423 ± 23.07 ^{abc} | 1662 ± 56.35 ^c | 3961 ± 137.25 ^c |

SD : Standard Deviation.

abc : Any two means carrying the same superscripts in a column are non significant between each other and that carrying the different superscripts are significant between each other at 5% level using LSD.

NS : Non-significant.

Table - 5: MEAN FEED CONVERSION-RATIO (FCR) OF EXPERIMENTAL AND CONTROL GROUPS

| Group | Treatment | Grams (Mean ± SD) | | |
|-------|-----------------|----------------------------|----------------------------|--------------------------|
| | | 15 Days | 30 Days | 45 Days |
| A | TH ₁ | 1.45 ± 0.08 ^{abc} | 1.76 ± 0.11 ^{abc} | 2.23 ± 0.03 |
| B | Propyl | 1.41 ± 0.21 ^{abc} | 1.79 ± 0.15 ^{abc} | 2.15 ± 0.04 ^b |
| C | Beloran | 1.39 ± 0.11 ^{abc} | 1.78 ± 0.16 ^{abc} | 2.16 ± 0.05 ^b |
| D | Fourtedes | 1.34 ± 0.08 ^{abc} | 1.75 ± 0.17 ^{abc} | 2.17 ± 0.06 ^b |
| E | Control | 1.5 ± 0.09 ^{abc} | 1.82 ± 0.01 ^{abc} | 2.25 ± 0.04 ^b |

SD : Standard Deviation.

abc : Any two means carrying the same superscripts in a column are non significant between each other and that carrying the superscripts are significant between each other at 5% level using LSD.

NS : Non-significant.

Table - 6: MEAN VALUES OF PROXIMATE ANALYSIS OF MEAT OF EXPERIMENTAL AND CONTROL GROUPS

| Group | Treatment | pH | Grams (Mean ± SD) | | | |
|-------|-----------------|---------------------|----------------------|----------------------|---------------------|----------------------|
| | | | Moisture (%) | Protein (%) | Fat (%) | Ash (%) |
| A | TH ₁ | 5.81 ^{abc} | 69.38 ^{abc} | 23.17 ^{abc} | 7.01 ^{abc} | 1.16 ^{abc} |
| B | Propyl | 6.11 ^{abc} | 72.9 ^{abc} | 20.90 ^{abc} | 7.73 ^{abc} | 1.03 ^{abc} |
| C | Beloran | 5.98 ^{abc} | 72.66 ^{abc} | 22.53 ^{abc} | 6.23 ^{abc} | 1.18 ^{abc} |
| D | Fourtedes | 5.67 ^{abc} | 72.83 ^{abc} | 21.36 ^{abc} | 8.18 ^{abc} | 1.102 ^{abc} |
| E | Control | 5.95 ^{abc} | 71.45 ^{abc} | 24.73 ^{abc} | 8.48 ^{abc} | 1.00 ^{abc} |

SD : Standard Deviation.

NS : Non-significant

Table - 7: MEAN VALUES OF TASTE PANEL SCORES OF EXPERIMENTAL AND CONTROL GROUPS (SENSORY EVALUATION)

| Group | Treatment | Colour | Flavour | Juiciness | Tenderness | Overall acceptability |
|-------|-----------------|--------|---------|-----------|------------|-----------------------|
| A | TH ₁ | 7 | 6 | 7 | 8 | 7 |
| B | Propyl | 6 | 7 | 8 | 8 | 8 |
| C | Beloran | 7 | 8 | 7 | 7 | 8 |
| D | Fourtedes | 8 | 9 | 8 | 6 | 7 |
| E | Control | 8 | 8 | 8 | 7 | 8 |

DISCUSSION

The study on the use of four different disinfectants, in the presence of birds, shows that all the carcasses were found normal, no cuts or bruises were observed. There was sufficient fat on the breasts and legs to prevent a distinct appearance of flesh through the skin. All the carcasses were well fleshed. Bones were normal and not disjointed or broken. Fat deposits on the heart crowns were found normal. Examination of frozen carcasses revealed that there were no freezing defects in the birds of any group.

The primary concern in the 45 days study is effect of using some commercial disinfectants/sanitizers on growth rate. The mean values of weight gained by birds of treated groups as shown in Table-3 were more than the mean values of control ones. Statistical analysis shows that, except for the group A birds, the mean values of weight gain of group B response varies with the type of disinfectant used, as observed by Ely and

Schott (1952). They conducted a study on seven synthetic detergents, of which four were found to be active growth stimulators. In their study, the activity of the rest of the three varied from mild to zero. Lillie (1958) further singled out blends of Quaternary Ammonium compounds (QAC) as growth improvers. Whitehill *et al.* (1950) and Mariakulandai (1952) have suggested that antibiotics improved growth rates of chickens possibly by increasing the intestinal absorption of vitamins. According to Almquist and Merrit (1955) the detergents improved the efficiency of feed utilization. The results of the present study are in line with the findings of these researchers.

The improvements in weight gain by treated birds can be ascribed to two reasons: Firstly the disinfectants sprayed in the chicken houses during this study may have stimulatory effect on hormonal balance and the metabolic reactions in broiler chicken, Secondly improvement of hygiene of the environment acts as a conducive factor for improved growth. Considerable variability, observed, in stimulating effect of four disinfectants, is perhaps due to the different percentage and type of the active ingredients in these.

The mean values of F.C.R. (Feed Conversion Ratio) measured at the end of 45 days of study were better for the experimental groups of birds than for the control ones (Table-5). However, the poorest values amongst the experimental birds were shown by group A birds. Statistical analysis (Table-5) of the mean F.C.R. values show that the values of groups B, C and D were significantly different ($P < 0.05$) from experimental group A and control group E.

Experimental group C chickens were best performers in terms of weight gain and feed consumption (Table-3 and 4). During early growth period, upto 30 days of age, Beloran treatment (C group) have been found to be more effective for promotion of growth. However, at the last stage of growth period (30 - 45 days), group B has exhibited some sort of "compensatory effect" and F.C.R. value of chickens of this group has

come out to be slightly better (Table-4) at the termination of study.

The birds of C group by all quality standards were healthful; lungs, kidneys and liver were found to be normal as also were of the groups D and E. Kidneys of A and B group birds were found to be slightly increased in size and urates were found deposited in them. Moreover livers of the birds of these groups were also atrophied. However, lungs of all the birds were of normal size and shape.

This study indicates that there is no significant difference between the meats derived from chickens of treated and control groups with regard to chemical composition (Table-6) and sensory characteristics on eating quality of meats (Table-7).

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EFFECT OF STORAGE CONDITIONS ON THE VISCOSITY AND MINERAL CONTENTS OF TOMATO CONCENTRATE

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ABSTRACT

Effect of storage conditions on the viscosity and mineral contents of tomato concentrate were investigated. A gradual decrease in the viscosity of tomato concentrate was observed during storage whereas amount of minerals in the samples remained unchanged.

INTRODUCTION

In Pakistan, processors obtain tomato pulp through hot or cold break methods, concentrate it to 3-4 folds and store under conditions available in their premises. It has been observed that temperatures varying from as high as 20 - 40 °C, refrigeration (4 to 10 °C), to as low as -20 °C are employed for storage purposes. High temperatures are detrimental to the product quality, while lower temperatures add cost to the product.

Deterioration of nutritional qualities of tomato paste when stored at elevated temperatures had been reported by many workers (Horubala and Kusmierz, 1980; Eckerle *et al.*, 1984; Villari *et al.*, 1994). Ahmed (1997) while investigating the effect of chemical preservatives on the storage stability of tomato concentrate reported that viscosity decreased during storage. Jamil (1990) observed that low temperature (-18 °C) storage of tomato concentrate resulted in a better quality product. It had been reported that mineral constituents of tomato concentrate did not change much during storage at various temperatures (Ramesh *et al.*, 1984 and Farooq, 1993).

Present studies were carried out to investigate the effect of storage time and temperature on the viscosity and mineral contents of tomato concentrate. These characteristics of concentrate are important to assessing the quality

and acceptability of the stored tomato concentrate for commercial utilization purposes.

MATERIALS AND METHODS

Fully matured tomatoes (Roma cultivar) were procured from local vegetable market. Tomato pulp was prepared (Shah and Zafar, 1975), concentrated to 65° Brix in a steam-jacketed kettle and packed in 250 ml pre-sterilized glass bottles, processed in boiling water for 10 minutes, and stored at:

- (i) ambient temperature (18-22 °C),
- (ii) refrigerated temperature (6 °C), and
- (iii) frozen storage (-18 °C).

The samples were analyzed just after processing and at 30 days intervals upto a storage period of 180 days.

Viscosity Measurement. Viscosity was measured by taking 200 gm sample (at 20 °C) in a beaker using rotor spindle No. 3 in a Tokimec Viscometer (Model-BM 6238) (appropriate for concentrated samples). The speed of the spindle was adjusted at 6 revolution per minute (rpm). The reading thus obtained was multiplied with factor 200 which is meant for rotor 3 at a speed of 6 rpm. The figure thus obtained was viscosity of the sample in "centipoise (cps)", which was then converted into "poise".

Mineral Estimation. Calcium, magnesium and phosphorus were estimated using standard

methods of AOAC (1980).

Statistical Analysis. The statistical analysis of the results was carried out according to Steel and Torrie (1980) methods.

RESULTS AND DISCUSSION

Viscosity. The data showing the effect of storage temperatures on the viscosity of tomato concentrate is presented in Table-1. There was a gradual decrease in viscosity during storage at different temperatures. Maximum decrease (19.51%) was observed in samples stored for six months at ambient temperature ($20 \pm 2^\circ\text{C}$), while minimum (10.98%) decrease was noted in samples stored at -18°C , which appears scientifically logical. Statistical analysis of the data indicated highly significant effect of storage temperature, storage time and their interaction on the viscosity ($P < 0.01$). Decrease in viscosity during storage is associated to depolymerization of pectic substances. This fact had been supported by earlier findings of Stire *et al.* (1956). The present study substantiated these findings by indicating a significant effect of high storage temperature on depolymerization of pectic substances ($P < 0.01$). Observations of Shaheen (1995) and Ahmad (1997) also confirm the depolymerization phenomenon in case of tomato concentrate storage.

Table 1: EFFECT OF STORAGE TIME AND TEMPERATURE ON VISCOSITY (POISE)* OF TOMATO CONCENTRATE**

| Storage Time (Days) | Storage Temperature | | |
|---------------------|--------------------------------|-------------------|---------------------|
| | $20^\circ \pm 2^\circ\text{C}$ | 6°C | -18°C |
| 0 | 41.0*** | 41.0*** | 41.0*** |
| 30 | 39.5 | 40.0 | 40.2 |
| 60 | 37.5 | 39.1 | 39.8 |
| 90 | 35.0 | 38.0 | 39.0 |
| 120 | 34.5 | 37.5 | 38.5 |
| 150 | 33.5 | 36.5 | 37.5 |
| 180 | 33.0 | 35.5 | 36.5 |

*: Poise - a unit of viscosity measurement

** : Differences were highly significant ($P < 0.01$)

*** : Average of triplicate readings

Minerals (Ca, Mg and P). Mineral contents as affected by storage conditions are presented in Table-2. It was observed during these studies that mineral contents (Ca, Mg and P) remained unchanged irrespective of storage temperature and time. This may be due to the fact that most of the

calcium is bound to pectic material and in the cell walls within insoluble solids, while magnesium is associated with the tomato pigments (Hulme, 1975). Statistical analysis of data on minerals showed non-significant effects ($P > 0.05$).

Table-2: EFFECT OF STORAGE TIME AND TEMPERATURE ON MINERAL CONTENTS (mg/100*) OF TOMATO CONCENTRATE**

| Storage Time Days | Storage Temperature | | | | | | | | |
|-------------------|--------------------------------|-------|-------|-------------------|-------|-------|---------------------|-------|-------|
| | $20^\circ \pm 2^\circ\text{C}$ | | | 6°C | | | -18°C | | |
| | Ca | Mg | P | Ca | Mg | P | Ca | Mg | P |
| 0 | 26.11 | 24.90 | 64.22 | 26.11 | 24.90 | 64.22 | 26.11 | 24.90 | 64.22 |
| 30 | 26.10 | 24.93 | 64.21 | 26.11 | 24.89 | 64.22 | 26.10 | 24.90 | 64.21 |
| 60 | 26.08 | 24.89 | 64.21 | 26.11 | 24.85 | 64.20 | 26.10 | 24.89 | 64.22 |
| 90 | 26.11 | 24.89 | 64.21 | 26.10 | 24.90 | 64.19 | 26.11 | 24.90 | 64.21 |
| 120 | 26.10 | 24.89 | 64.20 | 26.11 | 24.89 | 64.22 | 26.11 | 24.89 | 64.18 |
| 150 | 26.11 | 24.90 | 64.21 | 26.11 | 24.89 | 64.22 | 26.11 | 24.90 | 64.21 |
| 180 | 26.10 | 24.89 | 64.21 | 26.11 | 24.89 | 64.22 | 26.11 | 24.89 | 64.22 |

* : Average of triplicate readings

** : Differences were non-significant ($P > 0.05$)

Ca : Calcium, Mg: Magnesium, P: Phosphorus

The observations on calcium, magnesium and phosphorus contents in tomato concentrate in respect of storage temperature as well as time confirmed the earlier investigations of Ramesh *et al.* (1984) and Farooq (1993).

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CHEMICAL AND SENSORY EVALUATION OF STRAWBERRY CULTIVARS GROWN UNDER PLASTIC GREEN HOUSE

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ABSTRACT

Twelve strawberry cultivars viz; Tioga, Humigent, Peshawar Local, Gorella, Bellrubi, Turft, Sequoia, German Origin, W-72110, Red Countlet, Korona and Chandler were cultivated in a plastic green house at Agricultural Research Institute, Tarnab, Peshawar and their performance for acidity, total soluble solids and ascorbic acid was evaluated. Under green house conditions Korona had maximum acidity (1.440%) while Turft showed minimum (0.704%). Chandler cultivar had maximum total soluble solids contents (10.7) whereas Korona contained the least (8.63). Ascorbic acid contents of Korona were maximum (104.46 mg/100 gm) whereas German Origin had the least (80.99 mg/100 gm). Organoleptically Turft, Chandler and Red Countlet lead all the other cultivars.

INTRODUCTION

Strawberry belongs to family Rosaceae. Various wild species of strawberry are grown all over the world. But cultivated strawberry belongs to two species viz; *Fragaria cholerensis* and *Fragaria virginia*. In Pakistan commercial cultivation of strawberry is rare, and there are people who even haven't seen this fruit. There are some hilly areas in N.W.F.P. like Swat and Hazara, where this species is cultivated on small scale, but some varieties can be grown even in sub-tropical conditions. From nutritional point of view 100 gm of fruit contains 60 mg vitamin C, 0.70 mg protein, 5 mg vitamin A, 28 mg calcium and mineral elements like phosphorus, potash, iron and magnesium etc. The fruit contains very low amount of sugar. Due to high nutritive value, the fruit is consumed in a variety of ways. It is eaten fresh as well as in canned or preserved form. It is also used in different medicines and cosmetics. Paraskevopoulon *et al.* (1971) noted the performance of five strawberry cultivars namely Brighton, Douglas, Fern, Pajaro and Toro under plastic green house. Brighton and Toro had

the highest percentage of total soluble solids and Pajaro the lowest acidity. Reitmerier and Nonnecke (1991) compared five neutral strawberry varieties i.e. Tristar, Tribute, Mark, Volo and Selevo. Tristor and Tribute fruits were red and more sour, juicy and had higher titratable acidity than fruits of other neutral cultivars.

MATERIALS AND METHODS

This study was conducted under the plastic tunnel at Agricultural Bio-Technology Center and Food Technology Section, Agricultural Research Institute, Tarnab, Peshawar during the year 1995-96. Fruits from twelve cultivars of strawberry namely Tioga, Humigent, Peshawar Local, Gorella, Bellrubi, Turfts, Sequoia, German Origin, W-72110, Red Countlet, Korona and Chandler were collected and analysed chemically and organoleptically. Following procedures were adopted for carrying out the research work as detailed below:

A. Chemical Analysis.

For chemical analysis fruits were selected from each species randomly. Juice was extracted and samples were analyzed for the following:

1. Titratable acidity. 10 ml. of the juice from each sample was taken and diluted with distilled water to make the volume 100 ml. 10 ml sample was taken and titrated against N/10 NaOH using 2 to 3 drops phenolphthalene as indicator (Hortwitz, 1960). The results were expressed in percentage.

2. Total soluble solids. Total soluble solids were directly observed by using hand refractometer as described by Hortwitz (1960).

3. Ascorbic acid. Indophenol titration method of Ruck (1961) was employed to determine ascorbic acid contents.

B. Sensory Evaluation

A hedonic test was conducted to determine consumers degree of liking and disliking for 12 varieties (treatments) of strawberry using 9 points category scale (Larmond, 1977).

RESULTS AND DISCUSSION

1. Titratable acidity. It is evident from the Table-1 that higher percent acidity (1.91%) was observed in Korona. This was followed by Humigent (1.351%) and Bellrubi (1.293%). Both these cultivars are statistically at par with each other. The least percent acidity of 0.8350% was observed in Turft. Reitmerier and Nonnecke (1991) also observed similar results.

Table - 1: Percent acidity, total soluble solids, Vitamin C contents (mg/100 gm), and sensory evaluation of different strawberry cultivars under plastic tunnel conditions.

| S. No. | Cultivars | Acidity (%) | T.S.S. (°Brix) | Vitamin C (mg/100 gm.) | Sensory evaluation |
|--------|----------------|-------------|----------------|------------------------|--------------------|
| 1. | Tioga | 1.6200 EF | 9.33 CDE | 90.84 BC | 3.60 |
| 2. | Humigent | 1.3510 AB | 9.40 CD | 95.56 B | 3.20 |
| 3. | Peshawar Local | 1.0140 F | 9.40 CD | 87.10 CD | 5.20 |
| 4. | Gorella | 1.2800 BC | 9.03 EF | 91.58 BC | 4.02 |
| 5. | Bellrubi | 1.2930 AB | 9.56 C | 87.31 CD | 5.60 |
| 6. | Turft | 0.8350 G | 9.50 C | 81.32 E | 7.20 |
| 7. | Sequoia | 1.1470 DE | 9.16 DEF | 83.76 DE | 5.20 |
| 8. | German Origin | 1.006 F | 9.00 F | 91.00E | 4.40 |
| 9. | W-72110 | 1.470 DE | 9.03 EF | 87.25 CD | 4.20 |
| 10. | Red Countlet | 1.1780 CD | 10.27 B | 89.35 C | 6.60 |
| 11. | Korona | 1.3910 A | 8.63 G | 104.50 A | 2.80 |
| 12. | Chandler | 1.0150 F | 10.70 A | 82.69 DE | 7.20 |
| | ISD Valu | 0.1029 | 0.3088 | 5.403 | 0.6348 |

Mean followed by different letters are significantly different from each other at 1% level of significance.

2. Total soluble solids. It appears from the Table 1, that quality-wise Chandler variety had exceeded

other cultivars significantly, it contained 10.7 T.S.S. This was followed by Red Countlet (10.3). Gorella and Bellrubi, which were statistically identical, resulted in 9.6 and 9.5 total soluble solid contents respectively. Minimum total soluble solids of 9.0 were observed in German Origin. Paraskevopoulon *et al.* (1971) also reported similar results.

3. Ascorbic acid. It may be observed from the Table -1 that cultivar Korona contained maximum (104.5 mg/100 gm) amount of vitamin C, surpassing all other cultivars. This was followed by Humigent (95.95 mg/100 gm) which showed better vitamin C contents than the remaining cultivars. The other groups of cultivar were similar like Tioga (90.84 mg/100 gm), Gorella (91.58 mg/100 gm), Peshawar Local (87.10 mg/100 gm), Bellrubi (87.31 mg/100 gm) and W-72110 (87.25 mg/100 gm). The cultivars which showed the least quantity of vitamin C, were German Origin (81.00 mg/100 gm) and Turft (81.32 mg/100 gm). Both of these were equal from statistical point of view.

4. Sensory evaluation. Sensory evaluation indicated that Turft, Chandler and Red Countlet were liked much as compared to all others, followed by Bellrubi, Sequoia and Peshawar Local. Korona ranked the lowest (Table-1).

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HEAVY METAL CONTAMINATION OF VEGETABLES GROWN ON SEWAGE AND IRRIGATED WATERS

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ABSTRACT

Over the past several years, increasing amounts of sewage water and other wastes have been applied to agricultural land to provide nutrients for food crops. Beside the essential plant nutrients, such wastes also contain some toxic heavy metals. It was, therefore, considered important to determine heavy metal content of vegetables grown with sewage water. For this purpose vegetable samples were collected from two locations receiving sewage water. Highest concentrations of Pb (14.25 $\mu\text{g/g}$) and Cd (3.08 $\mu\text{g/g}$) were found in spinach. The contents of Cu ranged from 2.65 to 13.15 $\mu\text{g/g}$. The results revealed that the leafy vegetables grown on sewage water absorbed the highest levels of heavy metals.

INTRODUCTION

Biological and chemical contamination of foods due to the use of contaminated irrigation water, pesticide and fertilizer, and air pollution is proving to be a serious hazard in Pakistan (Khan, 1986). Peer and Rosen (1977) reported higher level of heavy metals in vegetables from urban gardens than those from rural areas due to greater contamination of urban soil and air than rural areas. Similar observations were reported (Jelinek, 1982) for several fresh vegetables.

The quality of water has been reported to deteriorate due to the use of sewage waters having chemical constituents of undesirable concentration (Varshney, 1985). The pollutants (heavy metals) enter the food supply chain by direct contact or by irrigation of growing plants with contaminated water (Najib, 1991). The composition of certain food, feed and fodder for essential trace elements have been reported (Akhtar *et al.* 1997, Jan *et al.* 1985, Sabir *et al.* 1982, Sandhu *et al.* 1981, Sattar *et al.* 1984). However variation in the environment (soil and water) and agronomic factors, could exert significant effects on the concentration of various

metals in foods and feeds. Keeping in view the hazardous effects of heavy metals on human health, the concentration of such metals in vegetables irrigated with sewage water as well as with canal water were determined.

MATERIALS AND METHODS

The samples of different vegetables were obtained from two different locations i.e. Gulbahar and Charsadda Road Peshawar. The samples were sorted, cleaned and dried in an oven. The dried vegetables were ground in Willy Mill to pass through a 40 mesh sieve. The ground samples were stored in plastic bottles for further analysis. For heavy metal assay, wet digestion of the samples was done according to the method of Sattar and Chaudry (1978) in a mixture of HNO_3 and HClO_4 . Simultaneous determination of cadmium, copper and lead was carried out by the potentiometric stripping technique (Jagner and Aren, 1979) using Tecator Striptec System comprising of glassy carbon electrode, saturated calomel electrode (SCE) and platinum wire as counter electrode. The stripping curves were measured at potential -1.1 volt vs SCE and 180 seconds plating time for cadmium, copper and lead. The concentration of these metals was determined by means of normal equations

employing standard addition method (Danielsson *et al.* 1981).

RESULTS AND DISCUSSION

Heavy metal contents of different vegetables were determined and the results are shown in Tables 1, 2 and 3. The data in Table 1 relate to locations I, Charsada Road where the highest amount of lead was found in spinach (11.32 $\mu\text{g/g}$) followed by coriander (9.33 $\mu\text{g/g}$), turnip (3.59 $\mu\text{g/g}$) and others. The concentration of cadmium in these vegetables varied from 0.29 to 3.08 $\mu\text{g/g}$. The copper content was found to range between 1.88 to 18.00 $\mu\text{g/g}$. Table 2 shows the results of vegetable obtained from location II, Gulbahar which gave a similar pattern. The highest concentration of Pb (14.25 $\mu\text{g/g}$) and Cu (10.52 $\mu\text{g/g}$) was found in spinach and coriander respectively. The content of Cu ranged from 2.65 to 13.15 $\mu\text{g/g}$, the highest amount was in spinach and the lowest in turnip. Cadmium varied from 0.29 to 1.67 $\mu\text{g/g}$ in these vegetables. The data in Table 3 show the concentration of heavy metals in vegetables irrigated with canal water. It was interesting to find that spinach contained the highest level of Pb (9.72 $\mu\text{g/g}$) and Cu (10.75 $\mu\text{g/g}$), while the other vegetables had intermediate levels.

Table 1: HEAVY METAL CONTENT ($\mu\text{g/g}$) OF VEGETABLES GROWN WITH SEWAGE WATER.

| Location-I, Charsadda Road. | | | |
|-----------------------------|------------------|------------------|------------------|
| Material | Cadmium | Lead | Copper |
| Tinda | 0.29 \pm 0.01 | 1.91 \pm 0.23 | 1.88 \pm 0.19 |
| Potatoes | 0.35 \pm 0.02 | 2.35 \pm 0.20 | 9.22 \pm 0.51 |
| Spinach | 3.08 \pm 0.20 | 11.32 \pm 0.83 | 18.00 \pm 1.01 |
| Turnip | 2.50 \pm 0.19 | 3.59 \pm 0.011 | 2.23 \pm 0.06 |
| Tomatoes | 0.25 \pm 0.006 | 0.97 \pm 0.023 | 4.50 \pm 0.10 |
| Corriander | 0.32 \pm 0.02 | 9.35 \pm 0.33 | 10.02 \pm 0.66 |
| Mean | 1.13 | 4.92 | 7.64 |
| Coefficient of variability | 114.7 | 88.04 | 80.2 |

Table 2: HEAVY METAL CONTENT ($\mu\text{g/g}$) OF VEGETABLES GROWN WITH SEWAGE WATER.

| Location-II, Gulbahar Road. | | | |
|-----------------------------|------------------|------------------|------------------|
| Material | Cadmium | Lead | Copper |
| Tinda | 1.67 \pm 0.02 | 9.71 \pm 0.18 | 3.33 \pm 0.01 |
| Potatoes | 0.52 \pm 0.01 | 4.71 \pm 0.13 | 7.53 \pm 0.01 |
| Spinach | 2.95 \pm 0.02 | 14.25 \pm 0.22 | 13.15 \pm 0.05 |
| Turnip | 1.23 \pm 0.04 | 2.98 \pm 0.02 | 2.65 \pm 0.006 |
| Tomatoes | 0.35 \pm 0.01 | 2.30 \pm 0.016 | 6.52 \pm 0.06 |
| Corriander | 0.29 \pm 0.005 | 10.52 \pm 0.1 | 8.75 \pm 0.009 |
| Mean | 1.17 | 7.41 | 6.99 |
| Coefficient of variability | 88.04 | 64.6 | 54.97 |

Table 3: HEAVY METAL CONTENT ($\mu\text{g/g}$) OF VEGETABLES GROWN WITH IRRIGATION WATER.

| Material | Cadmium | Lead | Copper |
|----------------------------|-------------------|-----------------|------------------|
| Tinda | 0.020 \pm 0.002 | 1.97 \pm 0.02 | 1.35 \pm 0.21 |
| Potatoes | 0.19 \pm 0.005 | 0.25 \pm 0.01 | 3.52 \pm 0.06 |
| Spinach | 0.018 \pm 0.003 | 9.72 \pm 1.20 | 10.75 \pm 0.98 |
| Turnip | 0.034 \pm 0.02 | 1.43 \pm 0.09 | 0.55 \pm 0.77 |
| Tomatoes | 0.19 \pm 0.002 | 0.67 \pm 0.09 | 2.23 \pm 0.22 |
| Corriander | 0.05 \pm 0.004 | 7.53 \pm 0.02 | 6.5 \pm 0.06 |
| Mean | 0.094 | 3.43 | 4.17 |
| Coefficient of variability | 81.73 | 119.7 | 92.07 |

The data were statistically analysed by measuring means and determining CV which revealed highest variation in cadmium, followed by lead and copper, in vegetables irrigated with sewage water, while the highest variation in lead, followed by cadmium and copper were in canal irrigated samples. It was found that spinach and coriander being leafy vegetables contained highest level of lead. Similar results have also been reported by other workers (Sattar *et al.* 1990). Furr *et al.* (1981) worked on two successive crops of pepper, kohirabi, lettuce, spinach, sweet potatoes and turnip, which were grown in pot of control and municipal sludge amended with acid and neutral soils. They found that Cd, Ni, Cu and Zn were high in sludge grown crops. Copper was higher in the vegetables grown on neutral soil sludge mixture. Results from studies conducted by Thomas *et al.* (1984) suggested that the uptake of heavy metals by growing plants generally decreased as soil pH increased. Lag and Elsokkar (1978) analysed edible parts of 5 different plant crops (potatoes, carrot, cabbage, barley, parsley and lettuce) grown in polluted soils for Cd, Pb and Zn.

Lead is generally known to persist on materials even at large distances from the road a consequence of the transport of aerosol matter whereas cadmium pollution is an environmental concern only for leafy crops in close proximity to the edge of a road (Marletta *et al.* 1986). Concentration of essential trace elements such as copper and zinc, and toxic metals like Cd and Pb in biological materials vary depending upon the origin, type of food and places of production (Benzo *et al.* 1986, Prasad *et al.* 1976, Wolhik *et al.* 1985). Sattar *et al.* (1993) determined the concentration of Cd, Cu, Pb and Zn in commonly consumed biological material. Over the last

several years, increasing amounts of sewage sludge and other waste has been applied to agricultural land to provide plant nutrients for food crops. From these results it is concluded that owing to high content of heavy metals and other toxic elements and organics, sewage water should never be used for irrigation purpose.

The normal (background) concentration of the toxic elements, such as Pb and Cd must be known to develop limitations on the intake of these elements from foods. The Joint FAO/WHO Expert Committee (1972) had set tolerable weekly intake limits for lead and cadmium at 3 mg and 315-330 mg respectively per person. It was concluded from these studies that the leafy vegetables absorb highest concentration of Pb. Sewage water contains high levels of toxic metals and so did the vegetables grown with this water.

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REDUCTION IN POST HARVEST LOSSES OF WHEAT IN DIFFERENT CONTAINERS BY ACTIVATED CLAY AND CARBON DIOXIDE

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ABSTRACT

Effect of modified environment (carbon dioxide gas and activated clay) on infestation of wheat in jute bags, clay, tin and plastic containers, after adding *Tribolium castaneum* was studied over a period of seventy-two days under laboratory conditions. Maximum mortality of added insects was recorded in case of wheat stored in tin containers saturated with carbon dioxide gas atmosphere and minimum mortality was observed in clay containers.

INTRODUCTION

Wheat being the staple food occupies more farmland than all other grains. Wheat production is still insufficient to meet the needs of rapidly increasing population. The main hope, therefore, lies in intensive cultivation, use of improved varieties, proper input of fertilizers and maximum protection of the crop raised, harvested and stored. According to a rough estimate about 10% of the wheat produced in Pakistan is lost (Chughtai, 1977). But the fact is that one fourth of all the total food grain produced does not reach the consumer due to crop diseases, insects, fungi and insufficient storage facilities in Pakistan (Aziz *et al.* 1983).

The farmers usually store grains in bulk in different types of storage structures constructed from locally available materials such as bamboo, mud, bricks, reeds, jute bags, etc. (Agnihotri *et al.* 1980, Birewar *et al.* 1980). The disadvantage of these structures were that there was no protection against rodents and insects, no moisture proofing and thus not suitable for long period of storage. The present investigation was

undertaken to study the effectiveness of activated clay and carbon dioxide against natural and induced infestation in different types of containers.

MATERIALS AND METHODS

Wheat (*Triticum vulgare*) was obtained from Pakistan Agriculture Storage and Supplies Corporation storage bins, Khanewal. Dust, stones and chaff was removed from the wheat before storage. Jute bags (26.0 cm length x 18.0 cm width) of 700 gm storage capacity were prepared for water proofing. Clay containers (14.5 x 11.0 cm) were prepared in the laboratory from a mixture of clay and hay (3:1). Lid of all the containers were fixed with a brass nozzle of 1.0 cm diameter for flushing the container with carbon dioxide gas. Some of the clay containers were coated with bitumen for water proofing. Tin and plastic containers of the specified size were also used.

Introduction of Beetles. *Tribolium castaneum* (beetles) were collected from a local general provision store. All the jute bags and containers

were filled with 500 gm wheat and stored after various treatments along with control. There were four replicates in each case. Twenty-five insects were introduced in each of the replicates except the control. All the containers were sealed, evacuated and purged with carbon dioxide gas at five pounds pressure for ten seconds. Leakage of gas was checked and the sound containers were placed at ambient temperature ($28.2 \pm 1.5^\circ\text{C}$) for seventy-two days. The grains were examined at the termination of the experiment.

Visual Examination. Wheat samples were taken out from the jute bags and containers, sieved by using a ten mesh standard sieve. The alive and dead insect population was recorded and their stages were identified as alive, adults, larvae, pupae and dead adults. Infected grains were taken out from the sample and weighed. After sieving, weight of the dust (flour) was also recorded. Hidden infestation was detected by "Sirinath Staining Method" (Sirinath, 1973).

RESULTS AND DISCUSSION

Wheat was stored in four types of containers for seventy-two hours storage period, without any pretreatment, to find out the initial non-detectable infestation. Maximum infestation was found in clay containers. This appeared to be due to the porosity, permeability of the clay to moisture and minimum infestation was observed in screw top tin containers, which were impervious to the outside atmosphere. Infestation was reduced to 50% in the clay containers and 90% in the tin containers when the atmosphere inside the containers was saturated with carbon dioxide gas. Heavy damage to the grains was observed when wheat with induced infestation was stored in clay containers and jute bags. This appeared to be due to exchange of air and moisture in clay containers and jute bags. This was confirmed by the results of wheat stored in tin containers. Purging the containers with carbon dioxide also checked induced infestation. Maximum effect was observed in the tin containers and minimum in clay containers.

Use of activated clay has been practiced in Africa, India and Pakistan. In villages fine sand clay, ash, calcium, magnesium, etc are used. Mixing of dust in grains makes the entry of insects a difficult task and causes physical injuries. Activated clays i.e. Montmorillonite, Kaolinite are used in India. Table-1 shows that activated clay controlled the infestation, but did not check it completely. Mixing of activated clay with grains offered better protection than dusting on the surface. Sodium silicate coated bags proved slightly more effective than uncoated ones. Combined effect of activated clay and sodium silicate proved to be the best (Table-1). Mujumdar (1973) reported that the insecticidal activity was related to the degree of activation of the clay. Effectiveness of the dusts increased with decreasing particle size down to 1 or 2 microns. Krishnamurthy and Mujumdar (1962) reported that Kaolinic types of clays were better suited for insecticidal purposes. The mode of activated clay revealed that primary action is the removal of lipids from the cuticle which is the principal barrier for water loss and thus the insect dies of desiccation.

Table - 1: EFFECT OF ACTIVATED CLAY ON WHEAT INFESTATION BY *T. CASTANEUM* IN JUTE BAGS.

| Observation | Wheat | Jute Bags | | | Sodium silicate coated jute bags |
|---------------------|-----------|------------------------|-----------------|----------------------------------|----------------------------------|
| | | Wheat + Activated Clay | Wheat + Beetles | Wheat + Beetles + Activated Clay | Wheat + Beetles + Activated Clay |
| Adults | 04.0±2.73 | 1.00±0.86 | 10.00±8.96 | 02.00±1.50 | 02.00±0.90 |
| Larve | 54.3±6.70 | 46.0±8.70 | 297.00±15.88 | 46.00±5.04 | 40.00±5.80 |
| Pupae | 7.0±1.58 | 07.0±2.12 | 15.00±6.40 | 01.00±0.70 | 02.10±0.30 |
| Dead adults | 03.0±1.04 | 09.0±1.93 | 1.00±1.11 | 07.00±2.50 | 08.00±0.60 |
| No. of eggs | 09.0±3.04 | 05.0±5.36 | 34.00±7.12 | 03.00±2.95 | 01.00±0.96 |
| Dust (gm) | 00.7±01.5 | 1.65±0.29 | 1.47±0.20 | 01.80±0.50 | 01.60±0.20 |
| Infected grain (gm) | 06.8±0.85 | 6.05±0.62 | 10.70±0.58 | 08.62±0.73 | 06.21±0.87 |

± Standard deviation.

Maximum infestation and heavy losses in terms of infected grains were observed in wheat samples kept for seventy-two days in the clay containers (Table-2). Prolonged storage period and porosity of the clay containers to moisture seems to be responsible for this increase. These results are in conformity with the findings of Howe (1965) who reported that insect population and the damage done by them tended to increase geometrically with rise in humidity and long storage period. A significant decrease in the

number of insects was observed in the carbon dioxide gas purged clay containers where infestation was reduced from 100% in untreated containers to 60% (Table-2). Thus elimination of air with an inert gas seems to result in suffocation of insects which ultimately effects their reproduction and multiplication. Ozer (1978) reported that gases enter the insects mainly through the respiratory system and increase or decrease their rate of respiration.

Table - 2: EFFECT OF CARBON DIOXIDE GAS ON WHEAT INFESTATION BY *T. CASTANEUM* IN CLAY CONTAINERS.

| Observation | Wheat | Clay Containers | | | Clay Containers (Bitumen coated) |
|------------------------|--------------|----------------------------------|--------------------|---|---|
| | | Wheat + Carbon dioxide Gas | Wheat + Beetles | Wheat -Beetles + Carbon dioxide Gas | Wheat +Beetles + Carbon dioxide Gas |
| Adults | 159.00±14.00 | 96.00±16.00 | 258.00±68.00 | 142.00±16.50 | 120.00±13.60 |
| Larvae | 27.00±9.00 | 17.00±9.00 | 19.00±6.00 | 12.00±3.00 | 9.00±7.80 |
| Pupae | 2.00±1.00 | 3.00±2.00 | 1.00±1.00 | 5.00±2.00 | 4.00±7.20 |
| Dead adults | 21.00±5.00 | 25.00±6.93 | 18.00±7.11 | 17.00±0.50 | 25.80±9.40 |
| No. of eggs | 34.00±8.00 | 32.00±13.00 | 39.50±8.12 | 20.00±8.00 | 20.00±6.10 |
| Dust (gm) | 14.35±3.08 | 2.65±0.97 | 24.47±4.50 | 4.35±1.11 | 3.10±2.00 |
| Infected grain (gm) | 23.15±2.73 | 11.32±3.28 | 35.70±5.20 | 11.32±3.28 | 9.80±5.30 |

± Standard deviation.

Analyses of tin containers data (Table-3) showed maximum (80-90%) mortality and minimum weight loss in the tin containers purged with the carbon dioxide. This seems to be due to the combined effect of the structural material and carbon dioxide gas on the metabolic and physiological activities of the insects as reported by Ozer (1978).

Table - 3: EFFECT OF CARBON DIOXIDE GAS ON WHEAT INFESTATION BY *T. CASTANEUM* IN TIN CONTAINERS.

| Observation | Wheat | Wheat + Carbon dioxide Gas | Wheat + Beetles | Wheat + Beetles + Carbon dioxide Gas |
|----------------------|------------|----------------------------------|--------------------|--|
| Adults | 14.00±5.00 | 12.00±1.00 | 97.00±8.00 | 12.00±2.00 |
| Larvae | 09.00±2.00 | 00.00±0.00 | 20.00±5.00 | 10.00±6.00 |
| Pupae | 06.00±3.00 | 00.00±0.00 | 08.00±3.00 | 01.00±1.00 |
| Dead adults | 03.00±1.00 | 11.00±3.00 | 07.00±3.00 | 20.00±4.00 |
| No. of eggs | 15.00±5.00 | 34.00±5.00 | 42.00±4.00 | 39.00±7.00 |
| Dust (gm) | 00.73±0.09 | 00.45±0.11 | 11.62±0.93 | 00.87±0.23 |
| Infected grains (gm) | 17.00±1.58 | 08.82±2.05 | 17.62±4.45 | 14.00±1.36 |

± Standard deviation.

Plastic container data (Table-4) showed 65-70% mortality in the treated wheat samples, it was 80-90% in case of tin containers (Table-3). Weight of infected grains was also more in the plastic containers than the tin containers. The plastic containers have minute pores and are permeable to the outside atmosphere. The

increased loss of weight and large number of eggs seem to be due to this factor.

Table - 4: EFFECT OF CARBON DIOXIDE GAS ON WHEAT INFESTATION BY *T. CASTANEUM* IN PLASTIC CONTAINERS.

| Observation | Wheat | Wheat + Carbon dioxide Gas | Wheat + Beetles | Wheat + Beetles + Carbon dioxide Gas |
|-------------------------|------------|----------------------------------|--------------------|--|
| Adults | 34.00±9.00 | 18.00±10.00 | 59.00±9.00 | 27.00±3.00 |
| Larvae | 14.00±2.00 | 01.00±01.00 | 11.00±6.00 | 03.00±2.00 |
| Pupae | 04.00±2.00 | 02.00±01.00 | 08.00±3.00 | 02.00±1.00 |
| Dead adults | 19.00±1.00 | 35.00±05.00 | 27.00±8.00 | 31.00±5.00 |
| No. of eggs | 19.00±7.00 | 20.00±12.00 | 30.00±8.00 | 32.00±4.00 |
| Dust (gm) | 00.72±0.12 | 00.78±00.15 | 10.83±0.75 | 00.31±0.08 |
| Infected grains (gm) | 12.50±2.72 | 06.00±02.15 | 18.50±4.85 | 02.78±1.30 |

± Standard deviation.

Comparison of the results of three types of containers indicated that carbon dioxide gas has maximum insecticidal effect in the tin containers and minimum in case of clay containers. Plastic containers also proved to be good storage structures. Thus, at commercial level, tin containers seem to be the best and their efficiency will further improve on flushing with carbon dioxide. Results of present investigation are in accordance with the findings of Jay (1971), Heckal (1985) and Novano *et al.* (1986) who reported that 60% concentration was suitable for complete insect eradication.

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THE MARKET MILK SCENARIO IN PAKISTAN

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Milk Processing, Why?

Whatever is nutritionally good for humans is as good for other living things, bacteria included. Therefore the villain of its own spoilage is the nutrient richness of the milk itself. It contains all that most bacteria need for their growth. Milk when secreted in udder is sterile but as its journey moves through udder ducts and teat canal, bacteria are carried into it. The bulk of bacterial load, however, enters during milking and post-production stages of transportation and holding, primarily on account of poor hygiene. Some of these bacteria may, in humans, cause such diseases as dysentery, diarrhoea, aflatoxicosis of liver, tuberculosis, typhoid, food poisoning, cholera. Not only are these disease-causing bacteria dangerous to human health, these and the remaining non-disease causing bacteria, present within, also affect the quality of milk. As the time after milking prolongs, these bacteria multiply bringing about spoilage of milk. The rate at which this spoilage occurs depends upon the post-production bacterial load, the hygiene, the temperature and the length of time at which it is held. Among other qualitative changes that occur during spoilage is the conversion of lactose to lactic acid. This increases the milk acidity, or in simple words turns the milk sour. Proteins, which in the normal milk occur in the suspended or colloidal state, can no longer stay so as the milk acidity increases due to bacterial activity. These proteins then coagulate causing the milk to curdle on heating. Bacteria, indeed, render the milk highly perishable. The milk of commerce therefore must be processed so that it is able to withstand spoilage on the kitchen or shop shelves and when it reaches the end user it is safe for consumption.

Milk Processing, the Traditional Way

Bacteria get killed when heated. Ancient societies not aware of the why in most matters were guided by their experiences. Milk, in one of such cases, has been traditionally heated soonest after milking and then kept in cooler corners. This not only saves the milk from spoilage but the consumer is also prevented from contracting serious diseases. The why of heating is now well known, which has provided the basis of development and evolution of milk processing technologies. The wisdom behind the cultural practice of drinking warm to hot milk in the sub-continent is the same as in the various categories of heat-treated market milks. However, the uncontrolled and prolonged heating, as done on the cooking range of the kitchen or at the open hearth of the corner-shop milkman, is too harsh on the milk nutrients. Therefore, heat if we must the milk, it needs only be just enough to kill the bacteria and yet save the nutrients. This very is the guiding principle that various commercial milk technologies exploit. The industrially developed societies, since long ago, have discarded the commerce of unheated loose milk in favour of partially sterilized, commonly termed as pasteurized milk, which is now further gradually shifting to the fully sterilized ultra-heat treated (UHT) milk.

The Market Milk

According to the International Commission on Microbiological Specifications for Foods (ICMSF), market milks are the heated fresh milk intended for consumption in liquid state. The market milk, within the scope of this definition, is produced by pasteurization, sterilization and UHT. These are duly regulated

by national and international food laws in respect of their production procedures and the composition of finished products. The quality of finished product, nevertheless, will depend on how good the starting raw material was. The milk to be heat processed must, therefore, conform to certain minimum standards.

Bacteriological Quality. Since it is not possible to produce good quality market milk from bad quality raw milk, it is necessary that the bacteriological and hygienic quality of milk to be processed conforms to some minimum standards. The European Economic Community (EEC) "Milk and Milk Product Quality" directive accordingly requires that bacterial load in the raw milk intended for the production of heat-treated drinking milk must not exceed 100,000 colony forming units (CFU) of bacteria per ml of milk. The United States regulations prescribe that the raw milk to be pasteurized shall not have more than 300,000 CFU of bacteria per ml milk and it must be kept cool at 10 °C or less until pasteurized at all times except within two hours after milking. The milk must, further, be derived from herds free from brucellosis and tuberculosis. Indian standard for the same purpose is less than 200,000 CFU of bacteria per ml milk. There is no bacteriological standard for raw milks to be heat processed in Pakistan, except for the general statement that milk shall not be sold that is impure or unwholesome or drawn from animals suffering from contagious infections.

Standardized Milk. Composition of market milks is an information which the producers are expected to share with the consumers. It is usually expressed as percentages of fat and the non-fat milk solids (SNF). The food laws in Pakistan define standardized milk to contain not less than 12.4% total milk solids inclusive of 3.5% milk fat and at least 8.9% milk SNF provided the standardization relates only with fat. Standardized milk according to Indian standards must have minimum 4.5% fat and 8.5% milk SNF by adjustment of milk solids and shall be pasteurized.

Homogenized Milk. This is the milk that has

been treated in such a manner that the fat globules therein have been broken down to such an extent that no cream separation occurs after undisturbed storage of 48 hours. Merits of homogenization include no formation of the top cream layer thus the fat-soluble vitamins remain evenly distributed in the milk, the milk texture gets heavier rendering the mouthfeel better, milk becomes richer in flavour, and has better digestion owing to soft curdling hence recommended for infant feeding.

The Milks of Commerce. There are various kinds of fluid milks sold in Pakistan. Of course by far the largest is the unprocessed raw milk vending carried out door to door by *gowala* (the milkman who may be the owner of milch animals himself or may be a self-employed middleman) or at the corner milk shop. This kind of loose milk can be hazardous to human health owing to poor hygienic quality and adulteration of sorts. A kind of processed milk also vended loose is the boiled milk heated in open flat pans for prolonged hours, having thus lost substantial nutritional quality.

Included in the category of technology-based milk processing procedures are pasteurization, sterilization and UHT treatment. Heating is common to each of these, done at different temperatures for different periods yielding products of different characteristics. In addition to the usual standardized fluid milk produced in the heating process, the speciality products include flavoured milk, recombined (reconstituted from dried powder and other ingredients) milk and skimmed milk.

The Commercial Milk Processing

The modern milk processing technologies aim at producing, as economically as possible, at minimum damage to nutritional characteristics, a product that appeals to consumers and has a reasonable shelf-life. Heating is the principal operation in the commercial processing of market milk. It is, however, preceded and followed by numerous steps for the production of desired finished products from raw milk.

The Pre-Heating Steps. The raw milk on arrival

is sampled for laboratory testing and pumped into the main plant. Dust or debris, including any faecal matter or fodder pieces, are removed by filtration or through centrifugal clarification. Centrifugation additionally separates fat to the surface and partly removes bacteria along with the debris sludge. The clarification step is followed by standardization of milk composition in terms of fat and SNF in accordance with the declared values of the finished product. The standardized milk is then mechanically homogenized whereafter the fat globules are reduced to the desired size and characteristics.

Heat Treatment. This is the main processing operation which aims at destroying the bacteria present in milk so as to render milk safe for human consumption and to increase its shelf-life. Heat treatment is carried out either in a process called pasteurization, or by sterilization, the principal type of which is the UHT method.

i. Pasteurization of Milk. It may be defined as the process of heating every particle of milk to such temperature and for such periods of time as are required to kill any disease-causing bacteria that may be present, whilst causing minimal changes in composition, flavour and nutritive value. The principal objective in pasteurizing milk is to prevent it acting as a carrier of human pathogens. The process ensures human health yet at the same time, by greatly reducing bacterial count, extends the shelf-life of milk. The commercial significance of doing so is to increase the keeping quality of milk thus making its supply possible from the sites of production in the rural areas to large centres of urban population. This may be achieved by heating milk to 63 °C for 30 minutes or 72 °C for 15 seconds or to any temperature-time combination which is equally efficient. The so pasteurized milk is then immediately cooled to 5 °C. Pasteurization is taken to be achieved when phosphatase enzyme test is negative. Various countries have their own standard regarding the maximum bacterial load in the pasteurized milk. The USFDA limits the bacterial count not to exceed 20,000 CFU of bacteria per ml and the coliforms to less than 10

counts per ml, which respectively in the case of Indian standard are 30,000 and 10, and the EEC directive 50,000 and 5, while the milk must be free of all pathogens. There is no Pakistani standard for maximum bacterial load except that the coliforms must not exceed 10 counts per ml at any time after pasteurization and before delivery.

ii. Ultra-High Temperature (UHT) Treatment of Milk. This is a kind of sterilized milk, which in respect of spoilage by bacteria at the prevailing atmospheric temperatures has an unlimited keeping quality. The UHT treatment is designed to confer a shelf-life of several months. In the production of UHT milk two distinct processes are involved: first, the heat treatment to kill bacteria, and second, aseptic packaging. The objective is to yield a product which is bacteriologically sterile but which retains the fresh milk characteristic values of nutrition, colour and organoleptic properties. Milk in this procedure is heated at 130-150 °C for a period ranging between 1-20 seconds. The heating to the very high temperature is rapid for brief exposure, done either directly or indirectly. The direct heating is done through heat exchangers which may be either plate or tubular in design. The indirect method involves injecting high pressure steam into the milk line. Water added to the product during both these operations is subsequently removed to the standard values through an evaporative cooling process. The ultimate objective of UHT treatment is to make milk a grocery item that may be picked up from the market shelf, that may be kept without deterioration for a sufficient period, and that may be free from harmful bacteria and their toxic products. According to EEC standards the UHT milk must not have more than 10 bacteria per 0.1 ml and no coliforms. The Indian standard requires UHT milk to be completely sterile with the maximum limit of 5 bacterial spores per ml. No standard of UHT milk is described in the Pakistani food laws.

There are, however, some general conditionalities in respect of sterilized milk, which require the milk to be filtered, homogenized, heated to 100

°C for such a period that it complies with prescribed turbidity test, and the treated product is sealed in air tight receptacles. Evidently, the international standards for UHT milk are different than that of the sterilized milk prescribed in Pakistan.

The Post-Heating Steps. Heat treatment is immediately followed by cooling to at least 10 °C but 4-5 °C. The pasteurized milk is packaged in glass bottles, plastic containers, or plastic pouches and appropriately capped or sealed. But for UHT milk both the packaging material and the packaging equipment are of critical importance. Not only must at all stages after UHT treatment, the milk remains under aseptic conditions, the containers used for packaging be given such treatment so as to render them completely sterile. This is achieved by using special containers, which are laminated with paper plastic and metal foils such as that used in the packaging technology developed by Tetra Pak.

Market Milk Scenario in Pakistan

Potential. Pakistan is one of the major milk producing countries in South Asia. Milk remains the highest cash yielding agricultural commodity in Pakistan, contrary to the common notion regarding such cash crops as cotton, wheat, rice and sugarcane. It is estimated that about 25% of the gross domestic product (GDP) derived from the agricultural sector is milk alone. Approximately 21.5 billion liters of milk is produced in Pakistan. The worth of this commodity even at the modest rate of Rs `5 per liter, at which it is retailed loose by the traditional bike riding *gowala*, mostly as the low quality milk under appalling unhygienic conditions, is nearly Rs 325 billion. It is a huge national wealth. However, contribution therefrom remains unreflected in the GDP for the simple reason that commerce of milk, almost all, is carried out in the unorganized sector. About 5.4 billion liters, 25% of the total produce, is consumed in the urban, while the remainder in the rural areas. Only 200 million liters is processed into various dairy products, the combined share of pasteurized and

UHT milk wherein is 105-110 million liters, which is a mere one-half percentage of the national milk yield. The per capita consumption is about 150 liters, which is, respectively, about twice and five times as much as in India and in Bangladesh. Evidently the potential of milk processing industry in Pakistan has remained unexploited. The processed milk while on the one hand offers significant commercial opportunities to the producers, it allows excess to the consumer quality milk product of international standards.

Impediments. Milk production sites are thinly scattered throughout the rural areas. Inadequacies in the communication network present the major hindrance in milk collection and transport to the processing facilities. In the developed countries, whenever daily milk deliveries fall below the level at which dairy plants can operate economically, it is customary to deep cool milk to 2 °C for the purpose for holding till enough is available for processing. Not only are such facilities lacking in Pakistan, refrigerated carriers are also not available. Awareness of the importance of hygiene, be it relevant to the milch animal itself or the milk pots and utensils or the personal cleanliness of those handling milk, renders the already perishable commodity even more vulnerable to spoilage. Though not as significant now, milk selling in some remote areas is a taboo for many.

Adulteration. Gone are the days when milk was adulterated (or rather diluted) with water, albeit dirty/unhygienic water, to increase the volume. The *gowala* has now become more innovative, innocently adding all sorts of materials not knowing how dangerously he is playing with the health of consumers. Adulteration with starch and reconstituted low quality powder milk for the purpose of increasing volume seems a minor offence compared with the rest. Since the *gowala* delivers milk from door to door in a time consuming delivery operation, the milk in summer is particularly liable to perish before it reaches the kitchen. Therefore in order to prevent bacterial spoilage unwittingly he adds bacteria-rich dirty ice, antibiotics, hydrogen peroxide, carbonates

and bicarbonates, even caustic soda and formalin. Some are also known to add detergent powders for the purpose of creating froth to impress upon the consumer deceptively on the quality of milk. All these chemicals can be serious health hazards. International milk commerce does not allow the addition of anything as a preservative to milk. Unfortunately there is no check in place in Pakistan since the current food laws in the country are not only vague and inadequate but are also not in touch with the realities of modern time status of food technologies and the strict international regulations on food safety. The situation will continue to worsen in the absence of updated food laws and lack of adequate laboratory facilities duly mandated to check the ongoing such spurious activities.

Loose Pasteurized Milk. A new category of market milk has recently emerged. It is claimed to be pasteurized yet all handling is done in a distribution system that cannot guarantee maintenance of the product to the quality characteristics that it must have. Studies carried out at PCSIR laboratories have indeed shown the phosphatase test to be positive, very high load of both coliform bacteria and colony forming units, and the presence of disease-causing bacteria, all of which contravene the accepted norms to which pasteurized milk must adhere. In fact it is only too naive to expect the product to do so. The reasons of failure may be attributed either to incomplete pasteurization to start with, or to post-pasteurization contamination for which the handling conditions are absolutely conducive. The such processed milk is transported in unrefrigerated trucks not sealed from exposure to the outside, the delivery hose conveniently dangling in the dirty atmosphere throughout its many-hour long journey from processing plant to the sale outlets, and the open vending system, besides a host of other contributory factors. During the summer months such pasteurized milk can simply not sustain.

Futuristic Options

From the foregoing it is evident that the potential of growth in the milk commerce is

plentiful. It only needs to be shifted from the unorganized to the organized sector. Both the public and private sectors have their respective roles to play to strengthen the milk processing industry on dimensions already adopted in the developed countries. The government must play its due role in the growth of the organized sector through appropriate steps and policies to remove the impediments, curb of wrong practices through effective food laws, and establishment of more processing units in various parts of the country. Capital investment by the private sector is sure to receive dividends if the available opportunities are properly exploited. Market milk is one area wherein the concept of cooperative movements need to be strongly built. Given the international trend and the prevalent climatic conditions particularly during the hot and humid summer, the best option for Pakistan is to go for technologies that fall within the ambit of UHT milk.

Acknowledgments

Financial support provided by Tetra Pak Pakistan Ltd., Lahore for a research study on the quality of vended milk is acknowledged with thanks.

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ISO 9000 IN FOOD INDUSTRY-CDL EXPERIENCE

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ABSTRACT

Customers are being offered shelves of food products in food sections of super markets on global basis. Pakistan is no exception. World trade pacts and removal of international barriers are giving greater choice to the customer. The customer will go for a product from certified system, if he has a choice. CDL did not have any such competitive threat at hand, but the sponsors decided to go for ISO 9002 Certification by the prestigious organization, BSI with full thrust and maintained it as a guide for a complete TQM system.

INTRODUCTION

In the world markets ISO 9000 has fame as a symbol of quality. All industries and business are going to be affected by ISO. This is considered the highest criterion of quality at world level.

In food industry, manufacturers are very conscious towards quality control and processing standards. There are HACCP (Hazard Analysis Critical Control Points), FSEP (Food Safety Enhancement Projects), GMP (Good Manufacturing Practice), QMP (Quality Management Programme) and TQM (Total Quality Management). In 1997 a new player entered in this field with the name of ISO 9000, which is a model for quality assurance.

Managing quality has been a big issue for many years, whole concept of managing quality is elaborated in four phases:

1. Quality inspection-In this approach quality is inspected after manufacturing of products.
2. Quality control-In this approach specifications are defined and non-conformities are detected and rectified during processing against the specifications.
3. Quality assurance-In this approach the main

theme is "RIGHT THE FIRST TIME" trying to make the quality products right the first time.

4. Total quality management-The main focus in this approach is "Customer Satisfaction" and involvement of everyone in the business.

For moving toward TQM there are many ways like ISO 9000, HACCP and Quality Circles, but it is clear that without establishing an effective system in the organization achieving TQM is not possible.

ISO 9000 is International Organization for Standards and this is a road map, which provides selection of Quality Assurance Model.

In ISO 9000. "Quality means that your product should be fit for its intended purpose" and this concept of quality is globally known that "Quality cannot be inspected in a product it must be manufactured in it."

ISO Models

Three models for ISO 9000 are:

ISO 9001. This model is used for those industries which design, produce and provide services for their products.

ISO 9002. This model applies to those industries which produce and provide services for the products servicing.

ISO 9003. This model relates to only inspection and supply.

For food industries, summary of the ISO elements are as under:

Management Responsibility

- Defines the company policy, which explains organizational goals and objectives, customer satisfaction whether internal or external.
- Defines organizational chart with authority and responsibility.
- Nominates management representative in the organization who is responsible for developing ISO system and ensuring implementation.
- Selection of senior executives for the management review for effectiveness of the systems at defined intervals.

Quality System.

Document all activities and define the level of documentation. Generally 4 levels of documentation are used, which are as follows:

Level I

Company Wide Manual-This describes how elements of ISO address in the organization and gives reference of written procedures relevant to the elements.

Level II

Quality System Procedures- This describes the procedures followed within the department.

Level III

Quality System Instructions-This defines the work instructions related to the specific activity.

Level IV

Quality Records Forms-Used to record the activities and present as objective evidence.

Contract Review.

As food products are generally sold through

distributor or dealer, written contract is required with specific authority for approval and changes resulting from review.

Design Control.

This involves the approval of design and its validation.

Document and Data Control.

- Write procedure on how documents and data are controlled in the organization so that the correct and current information is used in the production processes.
- Make a standard format that includes the identification number, writer name, approving authority, reviewing authority, issue date and also specify the change in document if any.

Purchasing.

- Procedure details according to the requirement for the company's purchases.
- Criteria for approving the vendors and subcontractors.
- Purchase specifications need to be defined.

Control of Customers Supplied Products.

If organization is providing facility to some other organizations for the packing of their products, then document all the procedures and critical control for those products.

Identification and Traceability.

Establish and document a system, which could identify the products at different stages of process and will effectively be used for traceability.

Process Control.

- Process control needing to be defined at all stages from raw material to final products.
- Identify environmental conditions affecting quality, like quality of water, presence of microbes in the processing area, unhygienic conditions, etc.
- Define process capability, preventive maintenance, cleaning processes and hygienic requirements for the machinery and personal environments.
- Ensure minimization of risk resulting from

cross contamination and include in the quality system procedure. In production department manual should also explain the way of identifying the product waste and scrap.

- For each product organization (production department) defines the quality plan, which includes the test, frequency of checking, and record number and also the calibration number of the equipment.

Inspection and Testing.

Document the procedure for the inspection & testing of incoming materials, in process, and release of final products.

Inspection, Measuring and Test Equipment.

- Organization identifies the equipment/instruments that affect the quality of product, and defines the acceptable measurement tolerance, method of calibration and frequency of calibration.
- Use unique identification number for each equipment/instrument.
- Tag the calibration equipment.

Inspection and Test Status.

Any material that have been tested will have either passed or failed the particular test. This must be identified by obvious means.

Control of Non-Conforming Products.

Organization defines the procedure for non-conforming products. This can be identified through customer complaints and internal quality audits. System should identify and segregate the non-conforming products and also the authority for the decision regarding non-conformance.

Corrective and Preventive Action.

This clause applies to storage conditions. Organization will write a procedure that ensures handling, storage, packing and delivery under the right conditions. This includes storage conditions, environmental factors (hygiene, shelf - life, storage and delivery temperatures).

Control of Quality Records.

There should be a system in place that describes

the retention period of the records. Records should have unique number and stored in a proper condition. At the time of audit, auditor asks for the records as objective evidence.

Internal Quality Auditing.

Organization selects and trains the auditors internally or from external institutions. Plan is made for the audits, which includes all the departments and selects independent auditors. The auditor conducts the audit and submits the report. Auditee department will take corrective action accordingly.

Training.

There should be a company wide procedure on training of staff that describes the procedure to identify the training needs of the staff. Annual training plan should be made by the department and implemented accordingly.

Servicing.

Organization providing "after sale service" is required to write the procedures.

Statistical Techniques.

Company will identify the statistical needs for the whole organization and arrange training on "how to apply the statistical tools".

CHAUDHRY DAIRIES LIMITED'S EXPERIENCE

Chaudhry Dairies (Ltd.) is the first food company and so far the only dairy company in Pakistan to get ISO 9002 Certification. CDL started work for ISO 9002 in 1994 and achieved ISO 9002 certificate (# FM 36699) on 17th April 1997.

Company Mission.

The Company is committed to:

- Providing nutritious and hygienically processed food products to customers at competitive prices.
- Enhancing reputation for quality in all operations.
- Promoting mutual trust with customers, suppliers, employees shareholders and the

- community being served.
- Providing safe and healthy environment to community.

Products.

- a- Haleeb standardized UHT Milk available in 1 L, 1/2 L, and 1/4 L pack sizes.
- b- Haleeb UHT Cream in 200 ml pack size.
- c- Asli Ghee (Butter Oil) in tin pack.
- d- Dairy Queen Loose Pasteurised Milk.
- e- Skimz-Skimmed Milk Powder in 200 g sachet pack.
- f- Dry milk powder and loose cream in bulk.

Sequence of Establishment and Implementation of ISO 9002 In CDL

1. Establishment of TQM Department. At CDL the project regarding ISO 9002 certification started with the establishment of TQM department that consisted of three persons, with sole responsibility of preparation of ISO related documents and monitoring the ISO system.

2. Allocation of Budget. Funds were also allocated to ensure uninterrupted establishment of ISO systems.

3. Introduction of ISO at All Levels of Staff. Initially TQM department arranged a training programme regarding awareness about ISO at all levels through Pakistan Institute of Quality Control and after that many trainings conducted for relevant employees internally as well as by different institutes.

4. Formation of Quality Council. Quality Council was formed within the organization that consisted of Senior Executives. Objectives were.

- a- Establishment of the system.
- b- Defining company policy.
- c- Deciding objectives.

5. Define Company Quality Policy.

- a- Mission statement.
- b- Vision.
- c- Concept of customer satisfaction.

d- Products.

6. Establishment of Taskforce in Each Department for Documentation.

- Employees from each department were nominated for the preparation of job description, quality system procedures, quality system instructions, quality system standards and methods.
- Holding of weekly meetings with Management Representatives and Task Force regarding documentation.
- Weekly meetings with task force were held for monitoring the system and discussing the matters regarding achievements, assignments for the next meeting and also the bottlenecks.

7. Draft of Company and Departmental Manuals. Company Manual was prepared that described how ISO 9002 elements apply in CDL. Departmental manuals were also prepared that included the organisation chart, departmental objectives, job description, procedures and work instructions.

8. Finalize and Issue of Manuals. Draft of Company Manual was compiled and was issued to Quality Council members for final review then approved by the Managing Director and issued by TQM department.

9. Internal Auditors Training. For this purpose Quality Council nominated two employees from each department and arranged training on Internal Quality Audits by SGS.

10. Implementation of ISO 9002. For Implementation of ISO 9002, TQM department made activity charts and monitored this on weekly basis. Announced a prize for the department completing implementation first.

11. Internal Audit Schedules and Implementation. TQM department prepares the audit plan according to the critical departments, implements and follows up the non-conformances.

12. Gap Analysis and Pre-assessment. TQM department arranged Gap Analysis and Pre assessment from SGS, Akida and BSI, and took action accordingly.

13. External Audit by Certification Body (BSI). On 17th April 1997, BSI conducted Certification audit and awarded ISO 9002 Certificate to CDL.

14. Surveillance. After every six months BSI visits the CDL for compliance and two surveillance audits have been conducted so far. Third surveillance audit is due in January 1999.

Difficulties Faced.

- Calibration of process and laboratory equipments. CDL faced problems regarding the calibration of the process instruments from external agency.
- Statistical techniques- People were not aware with the adoption and application of statistical techniques in the Organization. Interfaces between the departments.
- Interfaces were not clear- People were concerned about their own departments, whereas they were dependant on other departments as well. Writing procedures without the consent of other departments created conflicts and complication at times.

Resistance. People felt that they were over burdened, and that the system was not of much use for them.

Time Consuming Steps. Documentation. When CDL started there was no reference available so it took time.

Common Misunderstandings

- ISO Certification is only for one section or product - People thought that ISO is only for

one section but it was the whole system and certification is also for the system not for the product.

- ISO 9000 is basically TQM-ISO 9000 is basically a way towards TQM.
- It is the job of only Management-Representative-Everyone is responsible for the implementation of the ISO 9000 system.
- It takes very short time It takes almost one year for certification.
- It can be done without involving top management-ISO can only be established and implemented if top management is involved with full comitment.

PRACTICAL ADVANTAGES OF ISO IN CDL EXPERIENCE

- Development of system and guidelines available to everyone in the organization- People are aware of each other's problems and requirements.
- Job responsibility and clarity defined Everybody in the organization is clear about his role and responsibilities.
- Less chances of uncertainty due to system and ultimately losses go down.
- Quality as a way of life- Everyone feels that quality is his job not only of the Quality Manager.
- Initial market benefits- This gives edge to the market.
- Improved efficiency
- Management and team work due to involvement of everyone in the Company.
- Problem solving with quality system through CAR and PAR- CDL established corrective and preventive action system in the organization through involving concerned employees.

PROCEEDINGS

8th All Pakistan Food Science Conference :

The 8th All Pakistan Food Science Conference was held in the Auditorium of the National Agricultural Research Centre (NARC), Chak Shahzad, Islamabad on December 20, 1997. The Secretary, Dr. Javaid Aziz Awazn invited the President of the Society. Prof. (Retd) Dr. Muhammad Shafiq Chaudhry and the Chief Guest, Dr. Zafar Altaf, Chairman (PARC), on the stage. The Inaugural Session started by the recitation from the Holy Quran by Mr. Kashif Sarfraz. Mr. Muntizir Imam recited a Naat.

Dr. Muhammad Shahbaz Bhatti, Chairman Rawalpindi Chapter of The Food Scientists and Technologist Society welcomed the delegates. He briefly outlined the activities of the Rawalpindi Chapter of the Society and the Arid Agricultural University, Rawalpindi. Dr. Muhammad Aslam, Deputy Director General, National Agricultural Research Centre, Islamabad welcomed the delegates to the NARC. He briefly outlined the work being done at the NARC. Prof. (Retd) Dr. Muhammad Shafiq Chaudhry, President of the Society delivered his keynote address. This was followed by the Inaugural Address by Dr. Zafar Altaf, Chairman, Pakistan Agricultural Research Council, Islamabad.

The Technical Session started after the tea break. In this Session following papers on different aspects of food science and technology were presented:

1. Taufiq Ahmad, Abdus Sattar and Saeed A. Nagra. Plasma/liver lipids and lipoproteins in rats fed on red palm oil and other oils and fats.
2. Anwar Ahmad, Abdus Sattar, Muhammad Jan and Muhammad Zafar Iqbal. How to identify irradiated foods.
3. Salim-ur-Rehman, M. Akmal Raza Shahid and M.I. Siddique. Detoxification of

Lathyrus sativus.

4. Asghari Bano and Nadeem Khan. Nutritive value of *Brassica campestris* as affected by growth regulator treatments.

5. Waqar A. Baloch, Shahzada Arshad Saleem and Ahmad Khan Baloch. Stability of tomato powder at intermediate moisture levels.

Some other papers received from various parts of the country could not be presented due to the absence of the speakers. The Business Session started after the lunch and prayer break. This was chaired by Prof. Dr. Muhammad Saeed, Vice President who was assisted by Dr. Javaid Aziz Awan, Secretary, and Dr. Wazir Hussain Shah, Joint Secretary. The Secretary informed the house that except for one office, all the other office bearers had been elected unanimously. The only seat for which there were two contestants was the office of the President. The contestants were Sufi Bashir Ahmad Durrani, an industrialist from Peshawar and Mr. Hamid Ahmad, PSO from the PCSIR, Lahore. After heated debate, it was unanimously resolved that the two contestants would withdraw their nominations and the house would elect another person unanimously. After the withdrawal by the two candidates, the house unanimously elected Prof. Dr. Muhammad Saeed, the present Vice President, as President of the Society. Thus the new office bearers elected for the next two years, i.e. 1998 and 1999 are:

President-Prof. Dr. Muhammad Saeed, Peshawar
Vice President-Mr. Muhammad Haroon, Lahore
Secretary-Dr. Javaid Aziz Awan, Faisalabad
Joint Secretary-Dr. Wazir Hassian Shah, Lahore
Treasurer-Dr. Salim-ur-Rehman, Faisalabad

The house also unanimously decided as follows:

1. The new Editor in Chief of the Pakistan Journal of Food Sciences would be Dr. Faqir Muhammad Anjum, He replaces Dr. Javaid Aziz Awan who has served as the Editor in Chief since 1990.

2. There should be two Vice Presidents - one from the industrial sector and one from the university or research institutes.

3. The Food Science Conference and the Annual General Meeting should be held sometime during November when the weather is slightly mild.

At the end of the meeting all the registered delegates participated in the lucky draws offered by M/s Standard Manufacturing Co. Pvt. Ltd. Lahore and M/s National Scientific Corporation. The winners of these lucky draws were:

1. Mr. Muhammad Ashraf, Lahore
2. Mr. Muhammad Ilyas, Nowshehra
3. Mr. Ehsan Ullah, Peshawar
4. Mr. Adnan Ali, Faisalabad

5. Mr. Wasim Ahmad, Faisalabad

6. Mr. Munawar Hussain, Lahore

7. Dr. Abdul Haq, Faisalabad

8. Mrs. Shireen Iqbal, Peshawar

The meeting concluded by a vote of thanks by Dr. Javaid Aziz Awan, Secretary. He also acknowledged the financial and material contributions made by some of the following organizations:

1. Sihala Flour Mills, Islamabad
2. Islamabad Flour Mills
3. Standard Manufacturing Co. Pvt. Ltd., Lahore
4. Sakhawat Essence Mart, Lahore
5. Galaxy Foods, Faisalabad
6. University Grants Commission, Islamabad
7. Walls Ice Cream, Lahore
8. Shezan International, Lahore

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PROMOTIONS

The Executive Council and members of PSFST congratulate following members of the society and scientists of PCSIR Laboratories, Lahore on their promotion to the posts of Principal Scientific Officers:

1. Dr. Abdul Hamid Khan Niazi,
2. Dr. Allah Ditta Khan and
3. Dr. Zia-ur-Rehman

AWARD OF SHIELDS TO LIFE-MEMBERS OF THE SOCIETY

Following life-members of Pakistan Society of Food Scientists and Technologists have been awarded commemorative shields:

1. Dr. Rauf Ahmad, Senior Scientific Officer, PCSIR Laboratories, Lahore. He has the honour to become the first life-member of the society.
2. Mr. Naeemullah Choudhry, General Manager, Triple Em (Pvt.) Ltd., Lahore who followed Dr. Ahmad to get the life-membership of PSFST. Members of the Society welcome both the gentlemen for their admission as life-members and congratulate them for achieving this honour.

NEW ASSIGNMENTS

1. Mr. Asadullah Haider Bhatti, Vice Chairman, Pakistan Society of Food Scientists and Technologists, Lahore Chapter, has left M/s Bunny's (Pvt.) Ltd. and joined M/s Mayfair (Pvt.) Ltd., Lahore. Members of PSFST wish him every success in his new assignment.
2. Mr. Aizad Ahmad, M.Sc. (Hons.) Food Technology (Pakistan), MBA (England) has joined the Far Eastern Impex (Pvt.) Ltd., Lahore Office as Area Sales Manager (North)

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