

REPORT

A study on chemical composition and detection of chemical adulteration in tetra pack milk samples commercially available in Multan

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Abstract: The aim of this study was to analyze and compare the chemical composition of 8 tetra pack milk samples, Olpers (S1), Haleeb (S2), Good milk (S3), Everyday (S4), Milk Pack (S5), Dairy Queen (S6), Dairy Umang (S7), Nurpur (S8) available in local markets and to detect the presence of various chemical adulterants in tetra pack milk samples in Southern Punjab (Pakistan). Density, pH, solid not fat, total solids, lactometer reading, specific gravity and fat contents were analyzed to determine the chemical composition of milk samples. Our results revealed that all the studied parameters had statistically non significant differences ($P>0.05$) except total fat in milk samples which was significantly different ($P=0.03$) among the 8 studied milk samples. Presence of a number of chemical adulterants, formalin, cane sugar, starch, glucose, ammonium sulphate, salt, pulverized soap, detergents, skim milk powder, benzoic acid, salicylic acid, borax, boric acid and alkalinity were also detected in milk samples following standard procedures. Results indicated that formalin, cane sugar, glucose, alkalinity and benzoic acid were present in all samples while salt test was positive only for Olper milk. All other studied adulterants were not detected in 8 milk samples under study. % fat was the only significantly different feature among the studied milk quality parameters with S8 containing lowest while S5 having the maximum % fat.

Keywords: Tetra pack milk, chemical composition, chemical adulterants, Southern Punjab

INTRODUCTION

Milk is the lacteal secretion produced from the mammary glands of the mammals and an exclusive healthy food for both the infants as well as for the adults (Nickerson, 1999). The varieties of milk differ in the chemical composition, odor and taste but they all contain the essential elements which are required for the maintenance of life. The nutrients in milk are the building materials necessary for growth and cannot be replaced by any other food (Talwar and Srivastava, 2003). Despite of the socio-economic problems faced by the dairy industry, Pakistan comes 7th among world's top milk producing countries (Shahnawaz *et al.*, 2011). Buffalo and cattle are producing 26.4 million tones of milk in Pakistan. Per capita annual availability of milk is 82.4 kg (Sarwar *et al.*, 2002).

Due to the overpopulation and rapid urbanization, the demand of milk production is rapidly increasing. Almost 97% people use raw milk in Pakistan which is in poor hygienic conditions. Raw milk is not only of poor keeping quality than heat treated but also carries the risk of

microbial pathogens causing variety of diseases in man. For example, Q fever is the rickettsial disease transmitted to man through the raw milk (Sutherland *et al.*, 1986). On the other hand, tetra pack milk is being supplied by the companies after processing in different ways. Currently there are fifteen major companies operating tetra packed milk plants in country i.e Nestle Pakistan, Engro Foods, Haleeb Foods, Nur Pur, Millac, Vita, Halla, Prime, Nirala, Dairy Crest, K & K, Butt Dairies, Karachi Dairies, Munno Dairies, and Military Dairy Farms. These plants mostly manufacture ultra high temperature (UHT) treated milk (Associates, 2006).

A large number of adulterants are used in milk for the purpose of preservation and to enhance the quality of milk, to increase the quantity, to attract the customer, to improve the lactometer reading. Glucose, cane sugar, urea and ammonium sulphate and other substances have been encountered as additives for the purpose of masking the effects of dilution with water (Farani, 1983). Little information is available, till now, about the chemical adulterants present in tetra pack milk. The aim of this study was to analyze and compare the chemical composition of various tetra pack milk samples available in local markets and to detect the presence of various

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chemical adulterants in tetra pack milk samples in Southern Punjab (Pakistan).

MATERIALS AND METHODS

Eight different tetra pack milk (250 ml) samples were collected from local markets in Multan city and were brought to the Laboratory of Department of Zoology at Institute of Pure and Applied Biology, Bahaiddin Zakariya University, Multan for further analysis. These milk samples are available under trade marks of Olpers (Karachi), Good milk (Lahore), Dairy Umung (Karachi), Nestle Milkpack (Lahore), Nurple (Bhalwal), Haleeb (Lahore), Haleeb Dairy Queen (Lahore) and Nestle Everyday (Lahore). Each sample was divided into two parts: one to determine the chemical composition (density, pH, Solid not fat, Total solids, Lactometer reading, specific gravity and fat contents in milk samples) and other to study the chemical adulterants (formalin, cane sugar, starch, glucose, ammonium sulphate, salt, pulverized soap, detergents, skim milk powder, benzoic acid, salicylic acid, borax, boric acid and alkalinity) in the

milk samples following the methods of Lateef *et al* (2009).

Statistical package Mini Tab (Version 16) was used for statistical analysis. Each parameter of chemical composition of milk was compared between various milk samples by using one way analysis of variance (ANOVA).

RESULTS

Upon comparison of various parameters, pH, LR test, density, specific gravity, fat test, solid not fats, total solid, associated with chemical composition/quality of milk, our results revealed that all the studied parameters had statistically non significant differences ($P>0.05$) with one another indicating that these parameters has almost the same values among all milk samples. The only exception was the fat test for which ANOVA results revealed that the 8 milk samples significantly ($P=0.03$) differed from each other. The maximum fat value (3.2%) was observed in Milk Pack (S5) while minimum fats (2%) were detected in Nurple (S8) tetra pack milk sample (table 1).

Table 1: Chemical composition of various tetra pack milk packs included in this study, Last column shows ANOVA results following comparison of each parameter between various milk samples

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	P- Value
pH	6	6	6	6	6	6	6	6	$p>0.05$ (NS)
Fat (%)	3	3	3.1	3.1	3.2	3.1	3.1	2.	0.033 *
LR test	1.003	1.007	1.006	0.992	1.007	0.993	1.001	1.008	0.726 (NS)
Density (Unit)	1.429	1.413	1.431	1.389	1.434	1.169	1.186	1.423	0.287 (NS)
Specific Gravity	1.387	1.371	1.389	1.348	1.382	0.00113	0.00115	1.382	0.245 (NS)
SNF (%)	1.1	1.12	1.12	1.11	1.12	1.11	1.12	1.12	0.352 (NS)
Total Solid (%)	4.1	4.1	4.2	4.2	4.3	4.2	4.1	3.92	0.315 (NS)

$P>0.05$ NS or non significant, $P<0.05$ least significant *, $P<0.01$ significant**, $P<0.001$ highly significant***

Where S1= Olpers, S2=Haleeb, S3=Good milk, S4=Everyday, S5=Milk Pack,

S6=Dairy Queen, S7=Dairy Umung, S8=Nurple

Table 2: Detection of various chemical adulterants in the tetra pack milk samples, '+' indicates the presence while '-' shows the absence of specific chemical in the sample

Adulterant	S1	S2	S3	S4	S5	S6	S7	S8
Formalin	+	+	+	+	+	+	+	+
Cane sugar	+	+	+	+	+	+	+	+
Starch	-	-	-	-	-	-	-	-
Glucose	+	+	+	+	+	+	+	+
Ammonium Sulphate	-	-	-	-	-	-	-	-
Salt	+	-	-	-	-	-	-	-
Pulverized Soap	-	-	-	-	-	-	-	-
Detergent	-	-	-	-	-	-	-	-
Skim Milk Powder	-	-	-	-	-	-	-	-
Benzoic Acid	+	+	+	+	+	+	+	+
Salicylic Acid	-	-	-	-	-	-	-	-
Borax/Boric Acid	-	-	-	-	-	-	-	-
Alkalinity Test	+	+	+	+	+	+	+	+

S1=Olpers, S2=Haleeb, S3=Good milk, S4=Everyday, S5=Milk Pack,

S6=Dairy Queen, S7=Dairy Umung, S8=Nurple

Detection of chemical adulterants in 8 tetra pack milk samples revealed that formalin, cane sugar, glucose, alkalinity and benzoic acid were present in all samples. Salt test was positive only in the sample 1 (Olper Milk) while it was negative in rest of samples. Starch, ammonium sulphate, pulverized Soap, detergent, skim milk powder, salicylic acid and borax/boric acid test showed negative results in all milk samples (table 2).

DISCUSSION

Milk being a complete natural food has lot of nutritional as well as economical value. The major problem in the milk supplied by milkman system in Pakistan, from the customer point of view, is its poor quality and dirty adulteration (Tipu *et al.*, 2007). Several studies has focused on the milk composition and adulterant detection (chemical and biological) in raw milk, which is primarily considered as unhygienic and heavily contaminated with adulterants (Lateef *et al.*, 2009; Khan *et al.*, 1999; Khan *et al.*, 1991). UTH treated milk is considered, generally, as high quality, hygienic milk but no published literature is available regarding the chemical composition and especially the chemical adulterants in tetra pack milk available commercially in local markets. During this study, chemical composition was determined and detection of various chemical adulterants was carried out in 8 UTH treated tetra pack milk samples available in Multan city.

The quality of all the tetra pack milk samples was better than various previously reported milkman supplied milk samples. Fat (%), specific gravity, solid not fat (SNF) and total solids had higher values for all 8 tetra pack milk samples (Table 1) as compared to milk samples collected from canteens of various hospitals in Faisalabad and Peshawar reported by Lateef *et al.* (2009) and Khan *et al.* (1999) respectively. Our reported values for the above mentioned parameters are lower than those reported by Kanwal *et al.* (2004) from untreated Mithun (*Bos frontalis*) cow's milk during early, mid and late lactation stages and by Mirzadeh *et al.* (2010) who has reported the composition of raw milk provided by dairy forms in Iran indicating that dairy product providers process this raw milk by various means, dilution and/or extraction of milk fat as cream, to increase their margins from milk sale and fat, SNF, total solid and specific gravity values in tetra pack milk are far lower than those observed in untreated cow or buffalo milk (Khan *et al.*, 1999). These results confirm that the quality of tetra pack milk is better than milk supplied by milkmen but the raw milk milked from large ruminants is of best quality.

All UHT treated milk samples were positive for the presence of formalin, cane sugar, glucose, alkalinity and benzoic acid. Similar results were reported by Lateef *et al.* (2009) and Khan *et al.* (1999). Alkalinity measures the

ability of a solution to neutralize acids to the equivalence point of carbonate or bicarbonate. Rideout *et al.* (2008) has reported that high amounts of carbonates and bicarbonates disrupts hormone signals that regulate development and reproduction. Levels of carbonates and bicarbonates must be kept in milk samples as higher alkalinity values can cause milk alkali syndrome resulting in systemic alkalosis, renal failure, high blood pressure, hypertension, cardiac failure and edema (Troy, 2005). Benzoic acid is a natural component of milk but if its concentration in preserved milk exceeds 2000 mg/kg it can be dangerous for health (Wibbertmann, 2000). Formalin is added to milk as preservative but may cause vomiting, diarrhea, abdominal pain, increased body temperatures, shallow respiration, weak irregular pulse, unconsciousness, blindness and it is also a potent carcinogen (Gwin *et al.*, 2009).

Chemical adulterants like starch, ammonium sulphate, pulverized Soap, detergent, skim milk powder, salicylic acid and borax/boric acid were not detected in any of the sampled tetra pack milk (Table 2). These results are in accordance with the findings of Lateef *et al.*, (2009) and Mabrook and Petty (2003).

It is concluded from our study that % fat was the only significantly different feature among the studied milk quality parameters with S8 containing lowest while S5 having the maximum % fat. Rest of the chemical composition parameters, studied in this project, were statistically indifferent from one another so probably the differences among the prices are due to commercial publicity and promotion of the product. It was also observed that similar type of chemical adulterants were detected in all 8 milk samples, A qualitative study may provide an idea about the concentration of these adulterants to differentiate the milk quality in all tetra pack samples.

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