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Determination of chemical composition of milk marketed in Quetta, Pakistan

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Abstract

Huge part of the population consumed milk because of its nutritional values. It is used in all different periods of life i-e child hood, adolescence, pregnancy and the elderly. It is a sole natural food for first few months of life and it is chiefly valuable as a source of high quality nutrients like protein, lactose, fat, minerals and vitamins. Consumers certainly need wholesome, clean and nutritious milk free from pathogens. Quality milk means, milk with normal chemical composition, low bacterial count, free from adulterants and toxic substances, low degree of titerable acidity, good taste and ample in keeping quality. The quality of fresh milk sold at Quetta for public consumption was investigated through chemical composition. 100 milk samples were collected from shops of ten randomly selected areas of two towns of Quetta. The Chemical composition of milk was determined by different parameters like Protein%, Fat%, Total Solid%, Solid not fat%, Acidity% and Specific Gravity. The results for raw milk sample showed highest mean% of protein 3.43% ±0.62, fat 2.23% ±0.45, total solid 9% ±1.91, solid not fat 6.82% ±1.68, acidity 0.21% ±0.08 and specific gravity 1.025 ±0.00. Statistically the mean percentages of protein, total solid, solid-not-fat, acidity and specific gravity of milk samples were found non-significantly different ($P>0.05$) while the mean percentages of fat of milk samples were found significantly different ($P<0.05$). The major constituents of milk like fat, protein, total solids and solid not fat of milk marketed in Quetta was much lower than the pure milk which indicated the poor nutritional quality of milk.

Keywords: Milk, physical properties, chemical composition, quality, market, Quetta.

Introduction

Milk is the product of biological progression. It is a biochemical complex which appears to be the only material to function as a source of complete food. It is consumed by people of all age group (Hoppe *et al*., 2006) and is an absolute food because it contains carbohydrates (lactose), protein, fat, minerals and vitamins required for the growth (Adam, 2009).

Huge part of the population consumed milk because of its nutritional values. It is used in all different periods of life i-e child hood, adolescence, pregnancy and the elderly (Nicolaou *et al*., 2011). Milk of different animals like cattle, cow, buffalo, goat, sheep, camel etc contains almost same but different concentration of the chemical components. Milk differs in composition due to different factors like species of animal, variety, individuality, lactation's stage, incidence of milking, age, feed, disease, administration of hormones and drugs (Ensminger, 1993).

Milk is an absolute food, readily digested and absorbed. It is a sole natural food for first few months of life and it is chiefly valuable as a source of high quality nutrients like protein, lactose, fat, minerals and

vitamins. Protein in milk supply the amino acids required for repairs of tissues in adults. Buffalo milk contains 3.8% protein, 7.6% fat, 4.9% lactose, and 17% total solid while cow milk have 3.8 % protein, 4.5% fat, 4.9% lactose and 14% total solids (Khan *et al*., 2005).

The quality milk should be available for the consumers to maintain their health and growth. The term quality for milk means absence of harmful bacteria, dirt, antibodies, bad flavors, abnormal numbers of body cells, chemical analysis to check presence of sufficient amounts of nutrients, removal of fat and other adulterants, verification of hygiene through microbial investigation (Singhal *et al*., 1997).

Consumers certainly need wholesome, clean and nutritious milk free from pathogens. Quality milk means, milk with normal chemical composition, low bacterial count, free from adulterants and toxic substances, low degree of titerable acidity, good taste and ample in keeping quality. Quality assessment of milk is thus vital (Khan *et al*., 2008). The present study was therefore, designed to assess the quality of fresh milk marketing in Quetta through chemical composition.

Materials and Methods

Samples Collection

The research was conducted in Quetta city. Quetta is divided in to two towns namely Chiltan and Zarghoon towns. The fresh milk samples were collected from ten randomly selected areas. Collection points include bazaars, markets, sale points and dairy farms. Samples were collected in the sterilized glass bottles and immediately brought to the laboratory for analysis. About 100 fresh milk samples of 500ml each were collected. The sampling areas selected from two towns were Brewery road, Satellite Town, Jail road, Sabzal road, Arbab Karam Khan road, Quary road, Sirki road, Kasi road, Alamdar road and Cantonment designated by letters L1, L2, L3, L4, L5, L6, L7, L8, L9 and L10 respectively. The Chemical composition of milk was determined by different parameters like Protein %, Fat %, Total Solid %, Solid Not Fat %, Acidity % and Specific Gravity.

Protein %

Protein % was determined by formol titration. 10ml milk was taken in to Erlenmeyer flask. To it 1ml of phenolphthalein and 0.4ml of neutral potassium oxalate solution was mixed and kept for two minutes. This procedure eliminated the disturbing effect of soluble calcium salts, as reacted calcium oxalate was insoluble. The mixture was titrated against 0.1N NaOH using phenolphthalein as indicator. Faint pink color was the end point. Then 2ml of 40% formalin solution was added. This mixture was again titrated as above with 0.1N NaOH using phenolphthalein as an indicator. The volume of the NaOH used was recorded. The first titration value was not required but the second value was noted. This must be corrected with blank. The correction for the slight acidity of formalin was determined by titrating 2ml 40% formalin added to 10ml of distilled water. The percentage of protein in milk was obtained by multiplying the volume of 0.1N NaOH (already corrected for slight acidity of formalin) by the formol factor. The formol factor for Buffalo and cow is 1.9 and 1.7 respectively. This factor was obtained by the Kjeldahl method (Davide, 1977).

Fat %

In the present study the Gerber's method was used for the determination of fat % of milk. Acido butyrometer was used for determination of fat %. In a butyrometer of 22ml capacity, 10ml of sulfuric acid and 11ml of milk was taken carefully. The two liquids must not be mixed. Finally 1ml of amyl alcohol was taken in the butyrometer in such a way that the three distinct layers were formed. The three liquids were mixed after inserting the cork. A perfect clear solution was obtained through mixing. It was centrifuged for four minutes at the rate of 1100rpm. After centrifugation the test bottles were heated in water bath at 60°C. The fat was separated in the neck of the butyrometer and measured directly through the main division of the scale (Khan *et al*., 2005).

Total Solid %

Total solid contents of milk were determined by oven dried method. Fresh milk was taken in pre-weighed china dish and evaporated on steam bath. After evaporation milk was dried in an oven at 101°C. Dried milk samples were kept for 1 hour in desiccators in the presence of silica gel and weighed. The process was repeated until constant weight was obtained. Total solids % was calculated by the following formula (AOAC, 1990).

$$\text{Total solid \%} = \frac{\text{Weight of dried sample}}{\text{Weight of milk sample}} \times 100$$

Solids Not Fat %

Solid not fat was determined by the following formula (Harding, 1995).

Solid Not Fat (%) = Total Solid (%) – Fat (%)

Acidity %

The acidity of milk can be determined by acid base titration. The milk was taken in a beaker and measured. Few drops of phenolphthalein indicator were added in to the milk. Then NaOH (N/10) was added drop by drop from a burette. Volume of base was recorded on the appearance of pink color and calculation was made as follows.

$$\text{Acidity \%} = \frac{\text{No of ml of N/10 alkali used} \times 0.009}{\text{Weight of milk in gm}} \times 100$$

Specific Gravity

Lactometer was used for the determination of specific gravity of milk. Lactometer consists of a long narrow graduated glass stem ranged from 10 to 40 degrees and a bulb filled with lead. Milk samples were heated to bring the temperature between 10°C and 21°C. Samples were then poured in to glass cylinder and the lactometer was slowly dipped in to the milk until it floats. After some time, the scale reading and temperature was recorded. Added or subtracted 0.1 for each Fahrenheit degree to the lactometer reading, if the temperature of milk was high or less than 60°F. After correction the lactometer reading is called Corrected Lactometer Reading (CLR). Calculation was made as follows.

$$\text{Specific Gravity} = \frac{\text{Corrected lactometer reading (CLR)}}{1000} + 1$$

Results and Discussion

Milk is a good source of different nutrients and considered as complete diet. The major constituents of milk like protein, fat, total solid, solid not fat, acidity and specific gravity were determined. The results are given in Table 1.

Protein %

The data showed that the mean % of protein of milk from locations L1 to L10 was 2.57, 3.34, 2.69, 2.55, 3.43, 3.01, 3.01, 3.30, 2.92 and 2.75% respectively. Statistically the mean percentages of protein of milk samples were found non-significantly different ($P>0.05$).

The protein content of pure milk was 4.10% and in accordance with normal value. The protein % of milk samples was found much lower when compared with the protein % of pure milk. Protein is considered as one of the best in quality for human health. Protein in milk is in balance ratio to satisfy human amino acid requirements. The low values of protein in analyzed milk samples may be resulted from adulteration of milk with water thus the end consumers are cheated and deprived of a valuable nutrient.

Fat %

The data revealed that the mean % of fat of milk from locations L1to L10 was 2.01, 1.92, 1.89, 2.08, 2.18, 2.01, 2.09, 2.23, 1.50 and 1.64% respectively. Statistically the mean percentages of fat of milk were found significantly different ($P<0.05$).

The fat content of pure milk was 6.30% and in accordance with normal value. The fat % of milk samples was found much lower when compared with the fat % of pure milk. Fat is a valuable component of milk. It is extensively used in dairy products. The low values of fat in analyzed milk samples may be resulted from adulteration of milk with water it also pointed out the extent to which skimming of milk was done.

Total Solid %

The data depicted that the mean % of Total Solid (TS) of milk from locations L1 to L10 was 7.55, 7.98, 7.73, 8.81, 9.0, 8.13, 7.98, 8.21, 7.89 and 7.34% respectively. Statistically the mean percentages of TS of milk were found non-significantly different ($P>0.05$).

The TS % of pure milk was 15.36% and in accordance with normal value. The TS % of milk samples was found much lower when compared with the T.S % of pure milk. When water is removed from milk the remaining constituents are called total solid. Total solid of milk comprises the fat, protein, lactose and minerals. The low values of total solids may be resulted from adulteration of milk with water it also pointed out the extent to which skimming of milk was done.

Table 1: Chemical Composition and Physical Properties of milk samples collected from different areas of Quetta

Sources of milk samples	Protein		Fat		Total solid		Solid not fat		Acidity		Specific gravity	
	Mean (%)	Range (%)	Mean (%)	Range (%)	Mean (%)	Range (%)	Mean (%)	Range (%)	Mean (%)	Range (%)	Mean (%)	Range (%)
L1	2.57 ±0.80	1.5-4.0	2.01 ±0.33	1.4-2.4	7.55 ±1.92	3.9-10.6	5.54 ±1.64	2.3-8.2	0.21 ±0.08	0.13-0.37	1.020 ±0.00	1.008-1.033
L2	3.34 ±0.65	1.9-4.0	1.92 ±0.37	1.2-2.4	7.98 ±2.08	5.1-11.5	6.06 ±1.74	3.8-9.1	0.12 ±0.07	0.04-0.27	1.022 ±0.00	1.014-1.034
L3	2.69 ±0.79	1.5-3.8	1.89 ±0.29	1.5-2.5	7.73 ±1.69	5.5-11.6	5.84 ±1.40	4.0-9.1	0.18 ±0.06	0.11-0.31	1.021 ±0.00	1.015-1.034
L4	2.55 ±0.72	1.5-3.6	2.08 ±0.22	1.6-2.3	8.81 ±1.27	5.9-10.1	6.73 ±1.07	4.3-7.8	0.14 ±0.07	0.06-0.32	1.025 ±0.00	1.016-1.029
L5	3.43 ±0.62	2.2-4.0	2.18 ±0.31	1.8-2.8	9.0 ±1.91	6.1-11.7	6.82 ±1.68	4.2-8.9	0.18 ±0.05	0.09-0.26	1.025 ±0.00	1.015-1.033
L6	3.01 ±0.68	2.2-4.3	2.01 ±0.20	1.7-2.3	8.13 ±1.23	6.4-10.2	6.12 ±1.14	4.6-7.9	0.14 ±0.07	0.04-0.31	1.022 ±0.00	1.016-1.030
L7	3.01 ±0.69	2.1-4.0	2.09 ±0.58	1.2-2.9	7.98 ±2.62	3.4-11.2	5.89 ±2.08	2.2-8.3	0.20 ±0.07	0.06-0.28	1.021 ±0.00	1.008-1.030
L8	3.30 ±0.58	2.2-4.0	2.23 ±0.45	1.5-2.8	8.21 ±1.92	5.2-10.8	5.98 ±1.59	3.6-8.0	0.12 ±0.05	0.07-0.23	1.022 ±0.00	1.013-1.030
L9	2.92 ±0.89	1.0-3.8	1.5 ±0.38	0.8-2.0	7.89 ±2.48	3.4-10.9	6.39 ±2.13	2.6-8.9	0.15 ±0.08	0.01-0.28	1.023 ±0.00	1.010-1.034
L10	2.75 ±0.93	1.0-4.0	1.64 ±0.37	1.2-2.2	7.34 ±2.52	4.3-12.0	5.70 ±2.17	3.1-9.9	0.24 ±0.04	0.08-0.24	1.021 ±0.00	1.011-1.038
Control	4.10 ±0.38	3.6-4.6	6.30 ±0.45	5.8-6.8	15.36 ±0.80	14.2-16.4	9.06 ±0.45	8.4-9.2	0.15 ±0.01	0.14-0.16	1.031 ±0.001	1.029-1.033

Solid not fat %

The data revealed that the mean % of Solid Not Fat (SNF) of milk from locations L1 to L10 was 5.54, 6.06, 5.84, 6.73, 6.82, 6.12, 5.89, 5.98, 6.39 and 5.70% respectively. Statistically the mean percentages of SNF of milk were found non-significantly different ($P>0.05$).

The SNF % of pure milk was 9.06% and in accordance with normal value. The SNF % of milk samples was found much lower when compared with the SNF % of pure milk Solid not fat of milk represents the all constituents of milk except water and fat. The low values of SNF may be due to extraction of milk fat, watering and debasement of milk.

Acidity %

Titer able acidity of milk is a measure of freshness of milk. High quality milk must have acidity less than or equal to 0.14% reported by Popescu and Angel (2009). The data showed that the mean % of acidity of milk from locations L1 to L10 was 0.21, 0.12, 0.18, 0.14, 0.18, 0.14, 0.20, 0.12, 0.15 and 0.24% respectively. Statistically the mean percentages of acidity of milk were found non-significantly different (P>0.05).

The acidity % of pure milk was 0.15% and in accordance with normal value. The acidity % of milk samples of L1, L3, L5, L7 and L10 was found higher when compared with the acidity % of pure milk. High values of acidity than normal indicate the poor quality of milk regarding its freshness. While acidity values close to normal indicate the better quality of milk regarding freshness.

Specific gravity

The data revealed that the specific gravity of milk from locations L1 to L10 was 1.020, 1.022, 1.021, 1.025, 1.025, 1.022, 1.021, 1.022, 1.023 and 1.021 respectively. Statistically the mean percentages of specific gravity of milk were found non-significantly different (P>0.05).

The specific gravity of pure milk was 1.031 and in accordance with normal value. The specific gravity of milk samples was found much lower when compared with the specific gravity of pure milk. Lower values indicated the dilution of milk with water and skimming practices.

Milk is considered as complete food. However the current analysis of physico-chemical composition revealed that the milk available for the consumers of Quetta could not be considered as complete food. The results indicated that the fresh milk has lost its nutritive values due to poor quality. By consuming such type of milk the consumer remains deprived of valuable nutrients of milk. Different authors reported the low quality of market milk in Pakistan. Javaid *et al*. (2009) reported the physical and chemical quality of fresh milk available in markets of Tandojam, Pakistan. All the attributes of physical and chemical quality of milk were significantly lower than pure milk. Faraz *et al*. (2013) reported that the milk supplied to canteens of educational institutes and public places in Faisalabad, Pakistan did not confirm legal standards and had poor physical appearance.

Conclusion

Historical evidences shows that the nations which use pure milk and got more calories from milk are more civilized and having sound supervision and administration. It was concluded that the major constituents of milk like fat, protein, total solid and solid not fat of milk marketed in Quetta was much lower than the pure milk which indicated the poor nutritional quality of milk.

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