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*Research Article*

# Chemical Analysis Of Fresh Milk Obtained From Different Sources

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## Abstract

Milk is the whole, fresh, clean lacteal secretion obtained by the complete milking of Dairy animals like Cow, Buffalo or Sheep or Goat etc. In present study fresh milk of buffaloes, cows and goats were analyzed for different parameters and compared with each other for fat, protein, lactose, total solids, solids nonfat, total nitrogen, non-protein nitrogen, total titratable acidity, pH, lactometer reading and trace metals contents. Significance level of essential nutrients and non-significance difference for these components within the samples analyzed was found. The level of fat in milk of buffalo was higher than goat and cow, whereas quantity of protein in milk of cow was higher followed by buffalo and goat. The percentage composition of lactose found in milk of goat was more as compared to cow and buffalo (3.9 %). The amount of Total nitrogen in buffalo milk (0.65 %), cow milk (0.62) and goat milk (0.58 %), whereas level of solid not fat in these milk samples was order of cow followed by buffalo and goat. Higher concentration level of Na in buffalo milk (40.5 ppm) followed by goat milk (39.2 ppm) and cow milk (38.1 ppm). Whereas concentration level of Ca in buffalo (19.8 ppm), goat (19.6 ppm) and cow (19.1 ppm) was observed along with lower concentration of other metals in the milk samples. Furthermore only slight differences were observed in nutrients contents of all milk samples analyzed. However, for storage of milk for long duration, is very important and safety measures are very necessary.

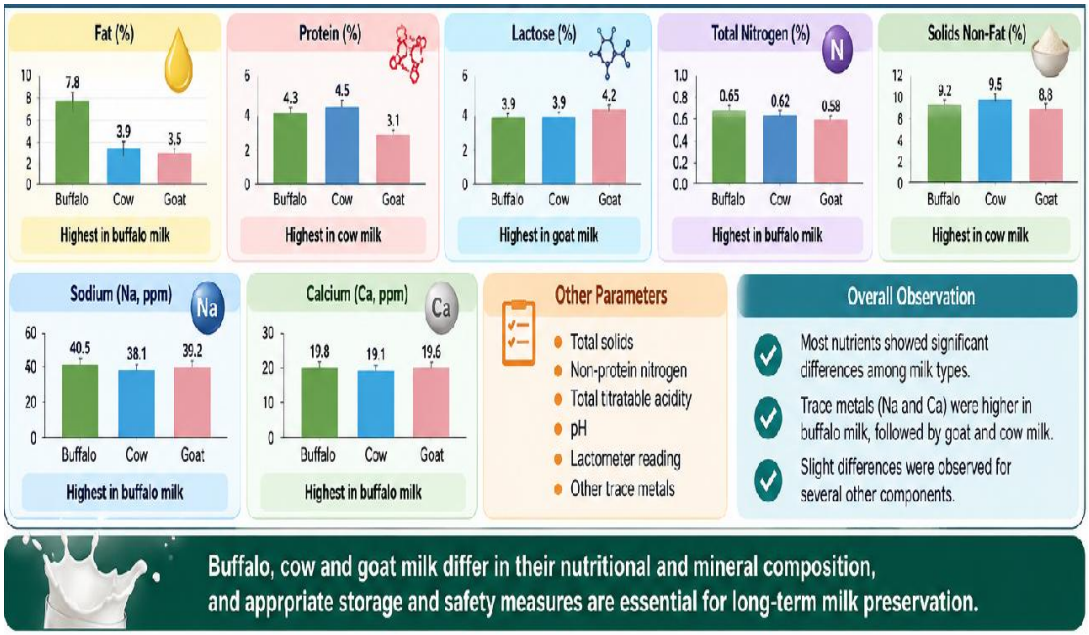
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**Graphical Abstract**




## 1: Introduction

Milk is a white liquid produced by mammary glands of mammals in females. It's a paste or jelly of butterfat particles in water. Each fat globule is wrapped in a shell of phospholipids and proteins: the emulsifiers prevent the individual globules from colliding into visible grains of butterfat and shield the globules from the fat-digesting enzymes in the milk's liquid part. Non homogenized cow milk's fat globules are about four micrometers across on average. These are cows, buffalo, sheep, goats, and camels. The milk from the raw milk varies depending on the breed of cow. Other sites state that fatter milk-producing breeds produce less milk than leaner breeds. Milk also reflects the stage of lactation, with the early lactation being colostrum, which is full of antibodies and has a different color and taste than regular milk (Rashida et al., 2004).

Milk is high in saturated fat, protein, calcium, and vitamin C. Cow's milk is slightly acidic with a pH level of 6.4–6.8. In most societies around the world, including the Western world, people consume milk even after infancy, as animal milk is also used as a food (Barham et al., 2015). Pasteurized or UHT milk (processed liquid milk) is the main dairy product in Pakistan, and other dairy products include powdered milk, cream, butter, ghee, yogurt, cheese, and ice cream (Ali et al., 1980; Moore et al., 2012). Casein protein micelles are the largest structures in the liquid portion of milk (Holt, 1985). They are compounds consisting of thousands of protein molecules bound to nanometer-sized calcium phosphate particles. Each micelle is slightly rounded and has a diameter of 10 micrometers (Henle et al., 1996). There are four types of casein proteins, and these two proteins account for about 0% of the milk proteins, and most of the casein proteins are contained in micelles. Pakistan was the third largest milk producer (GOP, 2007). It is also estimated that out of the total milk production of 38.37 million tons, 71% comes from buffalo, 24% from cows, and 5% from sheep and goats (Rashida et al., 2004). However, today, there are many private enterprises engaged in the production of milk and other dairy products. Almost all the dairy farms are located in Lahore, Faisalabad, and other major

cities. However in Pakistan, the shelf life and marketability of UHT milk in the dairy industry are declining due to sedimentation and aging-gelation problems. This can be attributed to the quality of milk, which is essential for the health of consumers, as consumers consume fresh and processed milk, which can lead to serious problems such as adulteration and increased somatic cell count in milk. Fresh milk from different breeds should have quality, so this study was conducted with the following objectives and goals: (1) To determine the quality of fresh milk from different buffalo, cow and goat species; (2) To identify important nutrients in various milks. (3) Comparison of Nutrients of Selected Milk.

## 2. Materials And Methods

### 2.1: Samples Collection

Total 30 fresh milk samples (10 each) of buffaloes, cows and goat were collected in sterile bottle from commercial supplier and rural areas of Rawalpindi Region. These samples were analyzed in BCH laboratory, PMAS Arid Agriculture University Rawalpindi.

### 2.2: Lactometer Reading and Specific gravity

Lactometer Reading and Specific gravity of milk samples were determined by following procedure recommended by Eckles *et al*. (1957) and Lampert (1965).

### 2.3: Acidity

Acidity test of milk samples was performed according to method of AOAC (2000) and values were calculated by using following formula.

$$Acidity\ (\%) = \frac{0.0009\ \times Vol\ of\ \frac{N}{10}\ NaOH\ used}{Weight\ of\ sample\ (g)} \times 100$$

### 2.4: pH values:

The pH of milk samples was determined directly by using a pH meter (Consort C 833, Multi parameter analyzer).

### 2.5: Fat contents

The percentage of total fat in various milk samples was determined by using method of AOAC (1990).

### 2.6: Lactose contents

Lactose sugar in milk was estimated by using the method proposed by Patel and Mistry (1997). Briefly a well-mixed and homogeneous sample of milk (10 ml) was taken in china dish and heated at 65°C and few drops of concentrated acetic acid in milk samples were added. The reaction mixture was filtered through Whatman (No.41) filter paper in 250 ml volumetric flask and filled up to mark by adding distilled water. A freshly prepared 10 ml of Fehling's solution and 2 drops of methylene blue were added and titrated against lactose solution till bricks red color was obtained.

### 2.7: Solid-Not-Fat

Amount of Solids not fat was calculated according to method reported by Davide (1977) using lactometer. Percent solids not fat in milk samples was calculated according to formula reported by Kanwal *et al*. (2002)

### 2.8: Total solids

Total solid in milk samples were determined by using method of AOAC (1990). A sample (5g) was taken in a clean dried china dish (already weighed) and heated in a water bath for 15 minutes. It was further kept in oven for 3 hours at 100 ° C and cooled in a dessicator for half an hour and weighed.

### 2.9: Protein

Percentage of total protein in milk samples were determined by Kjeldhal method as described in AOAC (2000).

**2.10: Mineral Analysis**

Milk sample (2 g) was added 10 ml of nitric acid and heated at 60-70°C for 15 minutes, until solution become cleared. Then 5ml of perchloric acid was added and heated at 80 °C for 15 minutes and boiled vigorously, until volume remain 1-2 ml. Reaction mixture was cooled and volume was raised up to 10 ml by diluting double distilled water and saved in low temperature till analysis . Analysis of metal ions was carried out by using flame atomic absorption spectroscopy and following a method described by Richards (1968).

## 3. Results and Discussion

Results pertaining to analysis of various parameters from fresh milk of buffaloes, cows and goats are shown in Tables 1-3 and Figures 1-2. The lactometer reading of milk was recorded for the assessment of quality of milk, whether water have been added or not (Table 1). Normal milk have specific gravity about 1.030 (LR=30) and lower values of LR indicates that the milk had been adulterated.

**Table 1,- Determination of physical parameters of different types of milk**

| Milk | LR | Sp. gravity | TTA (%) | pH |
|---|---|---|---|---|
| Buffalo | 26.6 ±0.5 | 1.01 | 0.11 | 6.4 |
| Cow | 27.1± 1.2 | 1.02 | 0.13 | 6.5 |
| Goat | 28.2 ±1.4 | 1.03 | 0.16 | 6.3 |

L R= Lactometer Reading, TTA= Total Titratable Acidity, Triplicate analysis ($p < 0.05$) n= 5

**3.1: pH and total acidity**

pH and total titratable acidity of milk samples were noted at early stage. The titratable acidity test is a simple acid- base reaction and shows %age of acidity in milk samples. No significance difference was found in fresh milk of buffaloes, cows and goats (Table 1). Campbell and Marshall (1975) found maximum value of acidity in milk (0.23%). In the present study value of acidity found in goat milk was 0.16 % followed by cow 0.13 % and buffalo milk 0.11 %. When the pH of milk is changed, the acidic or basic groups of the proteins will be neutralized. If an acid is added to milk, or if acid producing bacteria are allowed to grow in milk, the pH falls, causing casein precipitation.

3.2: **Fat, Solids non- fat and total solids**

The determination of fat contents of milk is considered to be a satisfactory measure for the assessment of overall quality of fresh milk. However, skimming of milk as well as additional of water and dried powder milk is suspected and estimation of total solids, are considered to be important in milk samples for quality assurance. In the present study the concentration of fat in buffalo milk was 6.2 % followed by goat milk (5.8 %) and cow milk (5.2 %) (Table 2). These findings of fat in buffalo, cow and goat milks are similar to those reported by Rashida *et al*. (2004) from similar type's milk of from Rawalpindi and Islamabad areas. Some studies revealed that about 98 % of milk fat is a mixture of triacyl glycerides, which further include neutral lipids, fat soluble vitamins and pigments (e.g carotene, which gives butter its yellow colour), sterols and waxes. Milk fat acts as a solvent for the fat soluble vitamins A, D, E and K and also supplies essential fatty acids like linoleic, linoenic and arachidonic acids. Total solid contents of milk found in fresh Buffalo milk were (12.1 %) cow (13.5%) and goat milk (12.5 %) as reported by Gervilla et al. (1997). Total solids of milk other than fat are called solid not fat (SNF), Higher values of SNF was found cow milk (8.6 %) followed by goat (8.5 %) and buffalo milk (8.4 %) (Table 2). The variation in SNF contents of various types of milk are related to seasons, lactation stage and environmental conditions and breed of animals ( Athar and Shah, 1991), A higher value of total protein was found in cow milk 4.2 % followed by buffalo milk 3.6 and goat milk 3.1 %. Whereas TN found in buffalo milk was 0.64 % followed by cow milk (61 %) and goat milk (0.55 %) respectively. While slight difference in values of NPN was observed in different types of milk (Table 2 and Fig.1).

**Table 2: Chemical composition (%) of different types of milk**

| Milk | Fat | Lactose | Protein | TN | SNF | NPN | TS |
|---|---|---|---|---|---|---|---|
| Buffalo | 6.2 ± 0.5 | 3.9 ±0.5 | 3.6 ±0.3 | 0.64 | 8.4±0.8 | 0.003 | 12.1±0.5 |
| Cow | 5.2± 0.2 | 4.3 ±0.7 | 4.2 ± 0.4 | 0.61 | 8.6±0.2 | 0.004 | 13.2±0.8 |
| Goat | 5.8. ±0.4 | 4.8 ±0.6 | 3.1 ±0.6 | 0.55 | 8.5±0.1 | 0.004 | 12.5±0.6 |

TN= Total Nitrogen, SNF= Solid Non Fat, NPN= Non Protein Nitrogen, TS= Total solids. Mean values ± SD on the basis of triplicate analysis ($p < 0.05$, n= 5

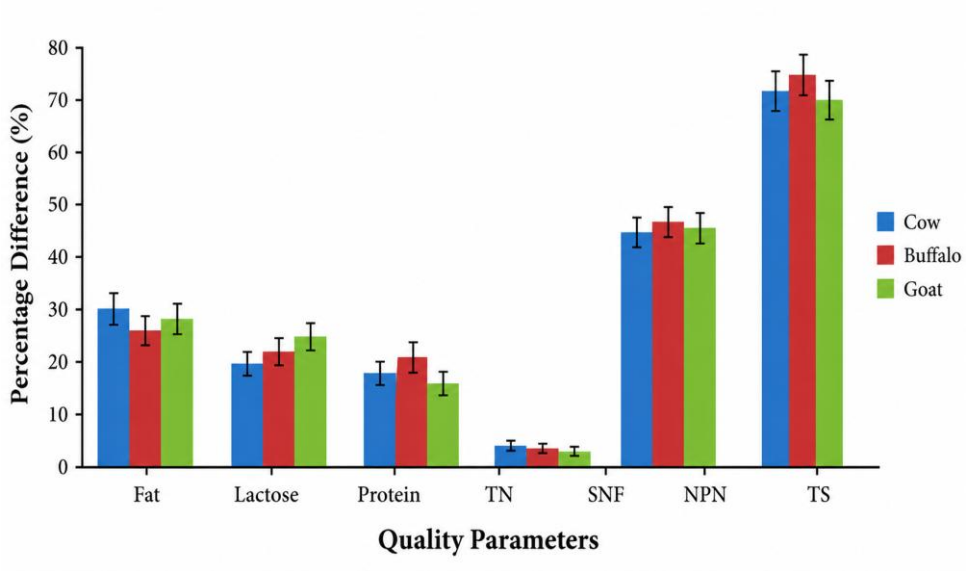



**Figure 1. Comparison of quality of different types of milk**

**Table 3: Analysis of metal ions (ppm) of different types of milk**

| Milk | Na | K | Ca | Mg | Fe | Cu | Zn |
|---|---|---|---|---|---|---|---|
| Buffalo | 40.5 ±2.5 | 11.7 ±0.5 | 19.8 ±2.1 | 6.4 ±1.1 | 3.4 ±0.8 | 1.2 ±0.5 | 6.4 ±1.1 |
| Cow | 38.1± 1.5 | 12.4 ±0.4 | 19.1 ±3.3 | 6.5 ±0.8 | 3.1 ±0.6 | 1.1 ±0.2 | 6.2 ±1.2 |
| Cow | 39.2 ±1.3 | 12.3±0.1 | 19.6 ±1.5 | 6.3 ±0.5 | 3.9 ±0.4 | 0.8 ±0.0 | 5.8 ±1.3 |

Mean values ± SD on the basis of triplicate analysis $p < 0.05$ n= 5

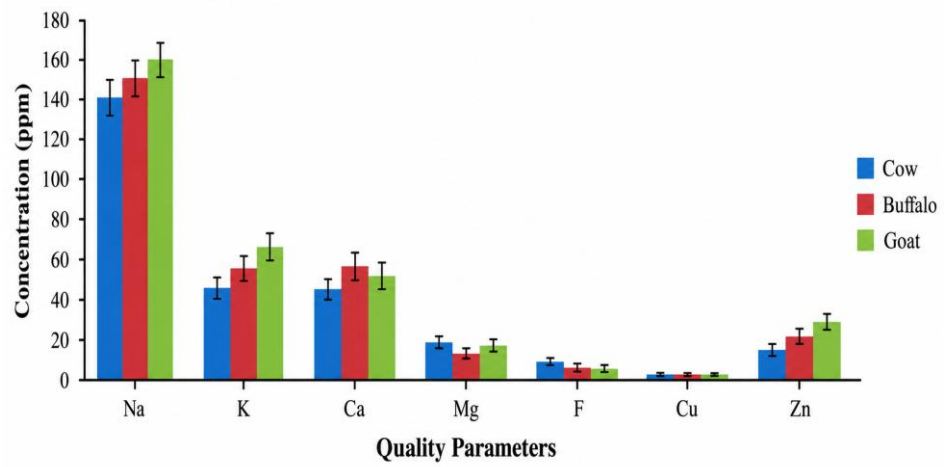



**Figure 2. Comparison of metal ions analyzed from different types of milk3.3: Protein, Total Nitrogen and Non Protein Nitrogen contents of Milk**

It indicates that values of these parameters obtained from fresh and processed milk have non significance difference and not mostly effecting on the quality of milk. Whereas difference in proteins contents of cow, buffalo and goats milks was reported by Rashida *et al*. (2004). These results of proteins contents are also partly supported by Louis (1970).Milk proteins represent one of the greatest contributions of milk to human nutrition. Some workers have viewed that losses of soluble proteins in the milk whey during ripening are compensated by the increase of concentrations of nutrients in the drying processes. Normally nitrogen content of milk is distributed among caseins (76%), whey protein (18%) and non-protein nitrogen (NPN (6%), but other minor proteins was not included (Puerto et al.,2004).

### 3.4: Lactose contents of Milk

The results regarding lactose analyzed from milk ( Table 2, Fig 1) indicates that lactose contents of goat milk (4.8 % ) followed by cow ( 4.3 %) and buffalo ( 3.9 % ) . Lactose is the principal carbohydrate of milk and made up by two sugars, glucose and galactose, and these monosaccharides are easily fermented to lactic acid, whereas under controlled conditions they can also be fermented to other acids to give a desire flavour such as propionic acid. Lactose is less soluble in water and also less sweet then sucrose. The variations in lactose content of various milk samples were also reported by different authors ( Rashida *et al*., 2004; Hanjir *et al*.,1989 ).

### 3.5: Metal ions in Milk

Fresh milk samples of buffaloes, cows and goats were analyzed for different metal ions (Table 3 and Fig.2). The metal ions like Na, K, Ca, Mg, Fe, Cu and Zn represent significance level within milk samples but non-significant difference when results of these metals were compared with each other. It was observed that buffalo milk contain Na (40.5 ppm), goat (38.1 ppm) and cow milk (39.2 ppm), whereas K content of cow milk (12.71 ppm), goat (12.3 ppm) and buffalo (11.7) was found. Whereas results of Ca, Mg, Fe, Cu and Zn are given in Table 3 and Fig.2. Franco *et al*. (2003) reported non-significant difference in Ca, Fe and Cu and other metals from milk and cheeses samples. They further revealed that losses of these metals in the whey balance the tendency to increase their concentration for the normal drying during ripening. However, some milk products had higher Na, K and Mg concentration than some fresh cheese. Furthermore higher amounts of Zn lost probably consequences of association with albumins and other proteins of milk.

It is concluded that fresh milk of all of three breed (buffaloes, cows and goats) contains all essential nutrients like protein, lactose, fat and essential metal ions and non-significance difference were recorded among these milk samples. However, treatment of milk at various temperatures is required to reduce microbial growth and also to increase shelf life of milk for long duration without altering its quality

## 4. Conclusion

The present study compared the physical, chemical, and mineral composition of fresh buffalo, cow, and goat milk to assess their nutritional quality. The results demonstrated that all three types of milk contained essential nutrients, including fat, lactose, protein, total solids, and important mineral elements. Buffalo milk exhibited the highest fat content (6.2%) and total nitrogen (0.64%), whereas cow milk showed the highest protein content (4.2%) and solids-not-fat (8.6%). Goat milk contained the highest lactose concentration (4.8%) and total titratable acidity (0.16%). The lactometer readings ranged from 26.6 to 28.2, indicating variations in the physical properties of the milk samples. Mineral analysis revealed the presence of sodium, potassium, calcium, magnesium, iron, copper, and zinc in all three milk types, with some variations in their concentrations. Overall, the observed differences highlight the nutritional contributions of milk obtained from different animal species. However, these findings should be interpreted in light of the sampling design and statistical evidence. Appropriate statistical analysis is necessary to establish whether the observed differences are significant. Furthermore, hygienic handling, suitable heat treatment, and proper storage are essential to minimize microbial contamination and extend milk shelf life while preserving its nutritional quality.

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