CHEMICAL ANALYSIS OF FRESH MILK OBTAINED FROM DIFFERENT SOURCES

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ABSTRACT

Dairy animals such as cows, buffalo, sheep, goats, and others are milked to collect their entire, fresh, and pure lacteal secretion. The current research examined fresh milk from buffaloes, cows, and goats and compared the results for fat, protein, lactose, total solids, solids that were not fat, total nitrogen, non-protein nitrogen, pH, lactometer reading, and trace metals. The degree of significance for critical nutrients and the non-significant difference for these components in the examined samples were discovered. While the amount of protein in cow's milk was greater than that of buffalo and goat, the amount of fat in buffalo's milk was higher than that of goat and cow. Goat milk has a higher proportion of lactose (3.9%) than that of cow and buffalo milk. The levels of solid, not fat, in these milk samples were highest in cow, buffalo, and goat milk, whereas the amounts of total nitrogen in buffalo milk, cow milk, and goat milk were 0.65%, 0.62, and 0.58 percent, respectively. Goat milk (39.2 ppm), cow milk (38.1 ppm), and buffalo milk (40.5 ppm) had the highest levels of sodium. On the other hand, lower concentrations of other metals in the milk samples were found in buffalo (19.8 ppm), goats (19.6 ppm), and cows (19.1 ppm) with higher Ca concentrations. Additionally, there were only minor variations in the nutritional values of each milk sample that was examined. However, for storage of milk for long duration, is very important and safety measures are very necessary.

Keywords: Milk, Quality assessment Nutrients, human health

INTRODUCTION

Mammals' female mammary glands generate milk, a whitish liquid. Particles of

butterfat with water form a paste or jelly. The emulsifiers keep the individual fat globules from colliding into visible butterfat grains and protect them from the fat-digesting enzymes in the liquid portion of the milk. Each fat globule is encased in a shell made of proteins and phospholipids. The fat globules in unhomogenized cow milk typically measure four micrometers in diameter. These include sheep, goats, camels, buffalo, and cows. Different cow breeds produce different types of raw milk. Leaner breeds produce more milk than bigger ones, according to some websites. Additionally, milk reflects the stage of lactation; colostrum, which is rich of antibodies and has a distinct color and flavor from ordinary milk, is a product of early lactation (Rashida et al., 2004). Saturated fat, protein, calcium, and vitamin C are all abundant in milk. Cow's milk has a pH between 6.4 and 6.8, making it somewhat acidic. Animal milk is also used as food, thus individuals in most countries, including the Western world, continue to drink it once they are older (Barham et al., 2015). According to Ali et al. (1980) and Moore et al. (2012), the most popular dairy product in Pakistan is pasteurized or UHT milk (processed liquid milk). Other dairy products include powdered milk, cream, butter, ghee, yogurt, cheese, and ice cream. According to Holt (1985), the biggest structures in the liquid part of milk are micelles of the casein protein. Thousands of protein molecules are bonded to calcium phosphate particles that are nanometers in size to form these compounds. The diameter of each micelle is 10 micrometers, and they are gently rounded (Henle et al., 1996). These two proteins make up over 80% of the milk proteins, and the majority of casein proteins are found in micelles. There are four different forms of casein proteins. According to GOP (2007), Pakistan was the third-largest producer of milk. An estimated 38.37 million tons of milk are produced annually, with buffalo accounting for 71%, cows for 24%, and

sheep and goats for 5% (Rashida et al., 2004). However, a large number of private businesses are now involved in the manufacture of dairy products, including milk. Major towns like Lahore and Faisalabad are home to almost all of the dairy farms. But in Pakistan, issues with sedimentation and aging-gelation are reducing the marketability and shelf life of UHT milk in the dairy sector. Since customers drink both fresh and processed milk, which may result in major issues such adulteration and a rise in the number of somatic cells in milk, this can be related to the quality of the milk, which is crucial for their health. The following aims and objectives guided the conduct of this research since fresh milk from various breeds should be of high quality: (1) Assessing fresh milk quality from diverse goat, cow, and buffalo species; (2) Finding essential components in different milks. (3) Comparison of Selected Milk's Nutrient Content.

MATERIALS AND METHODS

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.

Lactometer Reading and Specific gravity

The method suggested by Lampert (1965) and Eckles et al. (1957) was used to obtain the lactometer reading and specific gravity of milk samples.

Acidity

The AOAC (2000) technique was used to assess the acidity of milk samples, and the following formula was used to compute the results.

$$\text{Acidity (\%)} = 0.009 \times \frac{\text{volume of N/10 NaOH used (ml)}}{\text{Weight of sample (g)}} \times 100$$

pH values

A pH meter was used to directly measure the pH of milk samples (Consort C 833, Multi parameter analyzer).

Contents of fat

The AOAC technique (1990) was used to calculate the percentage of total fat in different milk samples.

Lactose contents

The technique suggested by Patel and Mistry (1997) was used to determine the amount of lactose sugar in milk. In a nutshell, 10 milliliters of well mixed, homogenous milk were placed in a china dish, heated to 65 degrees Celsius, and then a few drops of strong acetic acid were added. After passing the reaction mixture through Whatman (No.41) filter paper in a 250 ml volumetric flask, distilled water was added to fill it to the mark. After adding two drops of methylene blue and 10 milliliters of newly made Fehling's solution, the mixture was titrated against lactose solution until a brick-red hue was achieved.

Solid-Not-Fat

Using a lactometer, the amount of solids rather than fat was determined using the methodology described by Davide (1977). The method published by Kanwal et al. (2002) was used to determine the percentage of solids rather than fat in milk samples.

Total amount of solids

The AOAC (1990) technique was used to determine the total solid in milk samples. A 5g sample was placed in a sanitized, dried china dish that had already been weighed, and it was cooked for 15 minutes in a water bath. After three hours at 100 oC in the oven, it was

chilled for 30 minutes in a desiccator before being weighed.

The protein

The Kjeldhal technique, as outlined in AOAC (2000), was used to calculate the percentage of total protein in milk samples.

Mineral Analysis

Two grams of milk, ten milliliters of nitric acid, and fifteen minutes of heating at 60 to 70 degrees Celsius were used to clarify the solution. Next, 5 milliliters of perchloric acid were added, heated to 80 degrees Celsius for 15 minutes, and then quickly boiled until the volume was just 1-2 milliliters. After cooling, the reaction mixture was diluted with double-distilled water to increase its volume to 10 milliliters, and it was then stored at a low temperature until analysis. A Richards (1968) approach was followed in order to analyze metal ions utilizing flame atomic absorption spectroscopy.

RESULTS AND DISCUSSION

Tables 1-3 and Figures 1-2 provide the findings from the examination of many parameters from fresh milk from goats, cows, and buffaloes.

Regardless of whether water had been added or not, the lactometer reading of the milk was recorded in order to evaluate its quality (Table 1). The specific gravity of normal milk is around 1.030 (LR=30), while lower LR readings suggest that the milk was tampered with.

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

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

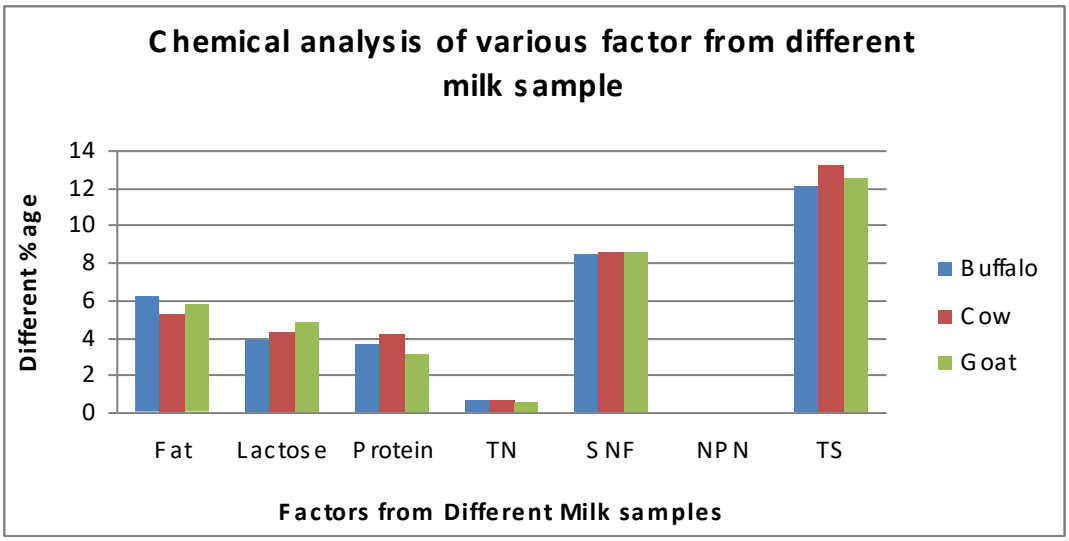

Figure 1. Comparison of quality of different types of milk

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

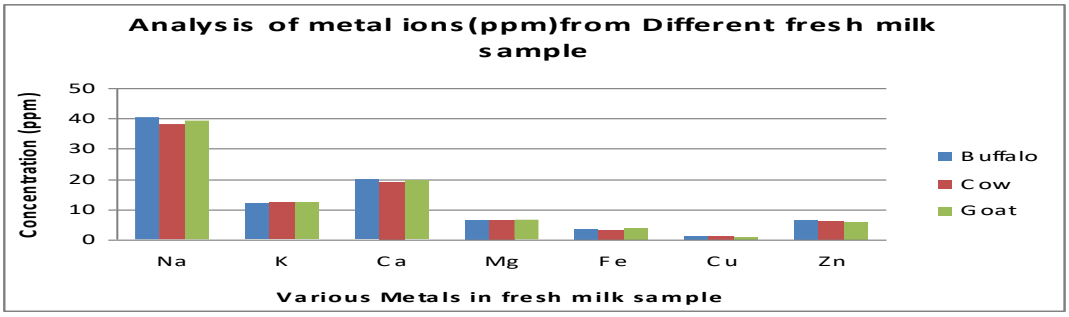

Figure 2. Comparison of metal ions analyzed from different types of milk

pH and total acidity

Early on, the milk samples' pH and total titratable acidity were recorded. A basic acid-base reaction, the titratable acidity test indicates the percentage of acidity in milk samples. The fresh milk of goats, cows, and buffaloes did not vary significantly (Table 1). The highest amount of acidity in milk was reported to be 0.23% by Campbell and Marshall (1975). The acidity value of goat milk in the current research was 0.16 percent, followed by cow milk at 0.13 percent and buffalo milk at 0.11 percent. The proteins' acidic or basic groups will be neutralized when the pH of milk is altered. The precipitation of casein occurs when the pH of milk drops due to the addition of an acid or the growth of bacteria that produce acid.

Fat, Solids non- fat and total solids

For evaluating the overall quality of fresh milk, the measurement of milk fat content is regarded as a good metric. However, it is thought that milk is skimmed, that water and dry powdered milk are added, and that the measurement of total solids is crucial for ensuring the quality of milk samples. According to Table 2, the fat content of buffalo milk was 6.2% in the current research, followed by goat milk (5.8%) and cow milk (5.2%). The fat content of buffalo, cow, and goat milks is comparable to what Rashida et al. (2004) found in comparable milk types from the Rawalpindi and Islamabad regions. According to some research, triacyl glycerides make up around 98% of milk fat. Other components include neutral lipids, fat-soluble vitamins and pigments (including carotene, which gives butter its yellow color), sterols, and waxes. Essential fatty acids such as arachidonic, linoleic, and linoenic acids are found in milk fat, which also serves as a solvent for the fat-soluble vitamins A, D, E, and K. Gervilla et al. (1997) observed that the total solid contents of milk in fresh buffalo milk were 12.1%, whereas those in cow and goat milk were 13.5% and 12.5%, respectively. Solid not fat (SNF), which is the total solids of milk other than fat, was higher in cow milk (8.6%), goat milk (8.5%), and buffalo milk (8.4%). (Table 2). Seasons, lactation stage, environmental factors, and animal breed all affect the difference in SNF concentrations of different kinds of milk (Athar and Shah, 1991).

Protein, Total Nitrogen and Non Protein Nitrogen contents of Milk

Cow milk has the highest total protein content (4.2%), followed by buffalo milk (3.6%) and goat milk (3.1%). On the other hand, TN was 0.64 percent in buffalo milk, 61% in cow milk, and 0.55% in goat milk. However, Table 2 and Figure 1 show a little variation in NPN levels between milk kinds. It shows that there is no significant variation in the

values of these parameters between fresh and processed milk, and that they do not primarily affect the quality of milk. Rashida et al. (2004), however, noted differences in the protein composition of goat, buffalo, and cow milk. Louis (1970) also provides some support for these protein content findings.One of milk's most significant contributions to human nutrition is its proteins. Some researchers believe that the loss of soluble proteins in milk whey during ripening is compensated for by increased nutritional concentrations throughout the drying process. The nitrogen content of milk is typically divided among caseins (76%), whey protein (18%), and nonprotein nitrogen (NPN) (6%), although other small proteins were not included (Puerto et al., 2004).

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 sweeter 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).

Metal ions in Milk

Metal ion levels in fresh milk samples from goats, cows, and buffaloes were measured (Table 3 and Fig.2). When comparing the findings of these metals to one another, the metal ions such as Na, K, Ca, Mg, Fe, Cu, and Zn indicate a non-significant difference

yet a substantial amount within milk samples. The K content of cow milk (12.71 ppm), goat milk (12.3 ppm), and buffalo milk (11.7 ppm) was found to be higher than that of goat milk (38.1 ppm), buffalo milk (40.5 ppm), and goat milk (39.2 ppm). Table 3 and Figure 2 provide the findings for Ca, Mg, Fe, Cu, and Zn, respectively. According to Franco et al. (2003), there was no discernible variation in the levels of Ca, Fe, Cu, and other metals in samples of milk and cheese. They also showed that the propensity to raise the concentration of these metals for proper drying during ripening is balanced by the losses of these metals in the whey. However, compared to certain fresh cheese, other milk products showed greater concentrations of Na, K, and Mg. Additionally, elevated zinc levels likely resulted from their connection with milk proteins, including albumins. All three breeds' fresh milk—goats, cows, and buffaloes—is shown to have all necessary elements, including protein, lactose, fat, and vital metal ions. No significant differences were found between the milk samples. However, milk must be treated at different temperatures to inhibit microbial development and extend its shelf life without compromising its quality.

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