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Original Article

Evaluation of Different Chemical and Physical Components of Milk in Cows, Buffalos, Sheep, and Goats

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Abstract

In recent years, the consumption of milk and dairy products has dramatically increased in several parts of the world. Different livestock plays an essential role in global milk production. This study was designed to evaluate different chemical and physical components of milk in four groups of livestock, including cows, buffalos, sheep, and goats. To this end, 200 raw milk samples were collected from cows, buffalos, sheep, and goats (n=50) across Dhi-Qar Governorate, Iraq, for a period of one year (from 01.10.2018 to 01.06.2019). The findings showed sheep and buffalos' milk samples had a significantly higher percentage of total solids (TS%), compared to cows and goats' milk samples (P<0.05). However, there were no significant differences in the TS% between sheep and buffalos' milk samples. Furthermore, the mean TS% values in cows, buffalos, sheep, and goats' milk samples were determined at 11.14%, 12.87%, 13.26%, and 11.33%, respectively. As for fat percentage (F%), buffalos' milk samples had significantly higher F% (4.80%), compared to milk samples of cows, sheep, and goats (P<0.05). Additionally, sheep's milk samples had significantly higher F% (P<0.05) than cows and goats' milk samples determined at 2.78%, 4.20%, and 2.98%, respectively. The findings showed the percentage of solids not fat (SNF%) was significantly higher in sheep's milk (8.97%), compared to milk samples of cows, buffalos, and goats (P<0.05). Additionally, it was found that the SNF% was significantly higher (P<0.05) in Buffalos' milk samples, compared to cows and goats' milk samples determined at 8.36%, 8.60%, and 8.35%, respectively. Moreover, the results revealed that the percentage of milk protein content in sheep's milk was significantly higher than the cows, buffalos, and goats' milk (P<0.05). Recorded data also showed no significant differences in the percentage of milk lactose among cows, buffalos, sheep, and goats' milk samples (P<0.05). Furthermore, the findings illustrated that the percentage of milk ash (Ash%) in sheep's milk samples was significantly higher than the cows, buffalos, as well as goats' milk samples (P<0.05), and no significant differences were observed among cows, buffalos, and goats' milk samples in the Ash% (P<0.05). In addition, there were no significant differences in the specific gravity among different milk samples (P<0.05). Finally, the results displayed no significant differences between cows and goats' milk samples in all the studied traits (P<0.05).

Keywords: Animal type, Buffalos, Cows, Sheep, Total solids

1. Introduction

In recent years, there has seen a dramatic increase in the consumption of milk and dairy products in several parts of the world. Different livestock contributes to global milk production. Cows, buffalos, goats, sheep, and camels produce 85%, 11%, 2.4%, 1.4%, and 0.2% of global milk, respectively (1). Milk is characterized as a highly nourishing nutrient as its contents are enriched with different invaluable macro/micronutrients, such as proteins, fats, vitamins, and other active biological substances (2).

Knowledge of the chemical and physical components of milk determines its nutritional value and the extent of its acceptance by consumers. All types of mammals

milk contain the same ingredients but in different proportions and quantities. Gantner, Mijić (3) have indicated that milk is a primary source of feeding young mammals in the early stages of the first part of their life since it is a rich source of energy, fat, proteins, and growth factors. Its composition and characteristics differ significantly across species and are affected by several factors, including the type of animal (4).

The composition of the livestock milk is highly complex. It is well documented that milk naturally possesses many chemical and physical components. Milk obtained from different farm animals contains the same composition; however, this composition differs across livestock. Different milk compositions can be heavily influenced by several factors, such as genetic factors, environmental conditions, and the stage of lactation. Miller and Lu (4) have revealed that goats' milk contains a higher percentage of fat and ash, compared to cows' milk. However, Kanwal, Ahmed (5) have indicated that sheep's milk contains a higher percentage of protein, fat, as well as minerals, and a lower percentage of lactose, in comparison with the cows, buffalos, and goats' milk. Hamad and Baiomy (6) have found that buffalos' milk is characterized by its higher content of total solids, fat, protein, and ash, compared to local cows' milk.

This study, therefore, aimed to evaluate different chemical and physical components of milk in cows, buffalos, sheep, and goats.

2. Materials and Methods

2.1. Milk Sample Collection

A total of 200 raw milk samples were collected from cows, buffaloes, sheep, and goats (n=50) across Dhi-Qar Governorate, Iraq, for a period of one year (from 01.10. 2018 to 01.06. 2019). After the milking process, once the udder was emptied, samples were taken immediately, and then, the milk was homogenized well. Afterward, 100 ml of each sample was taken and placed in an insulated box containing crushed ice to prevent potential damage to the samples until they were transported to the laboratory for further analysis.

2.2. Estimation of Milk Components

The percentage of fat (F%), protein (P%), lactose (L%), solids not fat (SNF%), and milk specific gravity was estimated using LactoFlash device (Funke Gerber, Germany).

The percentage of total solids (TS%) was estimated based on the methodology proposed in a study conducted by Javaid, Gadahi (7). Furthermore, ash percentage (Ash%) was estimated according to the following equation: Ash%= SNF% - (L% + P%).

Ash percentage= percentage of solids not fat - (protein percentage + lactose percentage).

2.3. Statistical Analysis

The data were statistically analyzed using SPSS software (2006, 21), and the average significance was tested using the Least Significant Difference test.

3. Results and Discussion

As can be observed in table 1, the TS% was significantly higher in sheep and buffalos' milk than the cows and goats' milk (P<0.05). Recorded data showed no significant differences in TS% between sheep and buffalos' milk samples, as well as cows and goats' milk samples. The TS% values in the milk samples of cows, buffalos, sheep, and goats were 11.40±0.18, 12.87±0.24, 13.26±0.27, and 11.33±0.19, respectively. These results are in agreement with the findings of previous studies by Kanwal, Ahmed (5), Soliman (8), Ahmad, Gaucher (9), Mahmood and Usman (10), Hamad and Baiomy (6), Kapadiya, Prajapati (11), as well as Ghadge, Prasad (12).

Table 1. Mean±standard error of the effect of the type of agricultural animal on the percentage of total solids and solids not fat

Animal Type	Total Solid Percentage	Solids Not Fat percentage
Cows	11.14±0.18[a]	8.36±0.13[a]
Buffalos	12.87±0.24[b]	8.60±0.15[a]
Sheep	13.26±0.27[b]	8.97±0.17[b]
Goats	11.33±0.19[a]	8.35±0.12[b]

Vertically different letters mean that there are significant differences (P<0.05).

Results also revealed that the SNF% (Table 1) in sheep's milk samples was significantly higher than that in the cows, buffalos, and goats' milk samples (P<0.05). This finding is in line with the results of previous studies conducted by MALAU-ADULI and Anlade (13), Kanwal, Ahmed (5), Hamad and Baiomy (6), Abdel (14), Taher, Hassan (15), as well as Kapadiya, Prajapati (11).

The results shown in table 2 indicated that F% was significantly higher in the milk samples of buffalos (4.80±0.20), compared to those obtained from cows (2.78±0.11), sheep (4.20±0.14), and goats (2.98±0.13), respectively (P<0.05). On the other hand, the F% of milk was significantly higher in sheep' milk, in comparison with the cows and goats' milk (P<0.05). However, no significant differences were observed between cows and goats' milk F%. These findings are in agreement with the results obtained in previous studies conducted by MALAU-ADULI and Anlade (13), Soliman (8), Kanwal, Ahmed (5), Imran, Khan (16), Ahmad, Gaucher (9), Hamad and Baiomy (6), Mahmood and Usman (10), Taher, Hassan (15), Abdel (14), Kapadiya, Prajapati (11), as well as Ghadge, Prasad (12).

Table 2. Mean±standard error of the effect of the type of agricultural animal on the percentage of fat, protein, and lactose

Animal Type	Fat Percentage	Protein Percentage	Lactose Percentage
Cows	2.78±0.11[a]	3.09±0.050[a]	4.68±0.074[a]
Buffalos	4.80±0.20[b]	3.28±0.052[b]	4.66±0.062[b]
Sheep	4.20±0.14[c]	3.54±0.061[c]	4.67±0.052[c]
Goats	2.98±0.13[a]	3.05±0.30[a]	4.63±0.042[a]

Vertically different letters mean that there are significant differences (P<0.05).

The recorded data tabulated in table 2 showed that P% in sheep's milk was significantly higher than that in the cows, buffalos, and goats' milk (P<0.05). Additionally, it was revealed that the P% in buffalos' milk was significantly higher than (P<0.05) that in the cows and goats' milk (Table 2). On the other hand, there were no significant differences in the P% observed in the cows and goats' milk samples. The mean P% values in the milk samples of cows, buffalos, sheep, and goats were 3.09±0.050, 3.28±0.052, 3.54±0.061, and 3.05±0.030, respectively. These findings are in line with the results of previous studies, including MALAU-ADULI and Anlade (13), Kanwal, Ahmed (5), Soliman (8), Park, Juárez (17), Imran, Khan (16), Braun and Preuss (18), Mahmood and Usman (10), Hamad and Baiomy (6), Abdel (14), Gantner, Mijić (3), Kapadiya, Prajapati (11), as well as Ghadge, Prasad (12).

Additionally, the findings revealed no significant differences in the L% of milk samples among cows, buffalos, sheep, and goats (P<0.05). An arithmetic increase was noted in favor of cows' milk samples in the proportion of lactose sugar, and the average ratios in the milk samples of cows, buffalos, sheep, and goats were 4.68±0.074, 4.66±0.062, 4.67±0.052, and 4.63±0.042, respectively. This finding is in agreement with the results of previously conducted studies, such as Abdel (14) on cows and buffalos' milk, Kanwal, Ahmed (5), Ahmad, Gaucher (9), Hamad and Baiomy (6), as well as Kapadiya, Prajapati (11) on cows, goats, and sheep's milk. The obtained results are also consistent with the findings obtained by Khan, Islam (19), Imran, Khan (16), as well as Mahmood and Usman (10). The results regarding sheep and goats' milk are also consistent with the findings of previous studies carried out by MALAU-ADULI and Anlade (13), as well as Taher, Hassan (15).

As illustrated in table 3, the Ash% in sheep's milk was significantly higher than that in the cows, buffalos, and goats' milk samples (P<0.05). However, no significant differences were observed among cows, buffalos, and goats' milk samples in terms of the Ash% (Table 3). This finding is in agreement with the results of previous studies by MALAU-ADULI and Anlade (13), Kanwal, Ahmed (5), Ahmad, Gaucher (9), Hamad and Baiomy (6), Mahmood and Usman (10), Taher, Hassan (15), Salman, Khaskheli (20), as well as Kapadiya, Prajapati (11).

Table 3. Mean±standard error of the effect of the type of agricultural animal on Ash% and specific gravity

Animal Type	Ash%	Specific Gravity
Cows	0.60±0.016[a]	1.03017±0.24[a]
Buffalos	0.62±0.018[a]	1.03233±0.32[a]
Sheep	0.74±0.019[b]	1.03282±0.27[a]
Goats	0.59±0.015[a]	1.03016±0.21[a]

Vertically different letters mean that there are significant differences (P<0.05).

As depicted in table 3, there were no significant differences in the milk-specific gravity among cows, buffalos, sheep, and goats' milk samples (P<0.05). The averages of milk-specific gravity are shown in table 3. With regards to buffalos, sheep, and goats' milk, the findings are in line with the results of a study by Kanwal, Ahmed (5); for buffalos, cows, and goats' milk, they are in agreement with the findings of a study performed by Prajapati, Kapadiya (21). Moreover, considering buffalos and sheep's milk, the findings were consistent with the results obtained by Mahmood and Usman (10), and regarding cows and buffalos' milk, they agreed with the findings of the studies by Lee, Page (22), as well as Ahmed and El Zubeir (23). Finally, the findings related to cows, sheep, and goats' milk are consistent with the results of a previous study conducted by Taher, Hassan (15).

Authors' Contribution

Study concept and design: M. A. J. A.
Acquisition of data: M. A. J. A.
Analysis and interpretation of data: M. A. J. A.
Drafting of the manuscript: M. A. J. A.
Critical revision of the manuscript for important intellectual content: M. A. J. A.
Statistical analysis: M. A. J. A.
Administrative, technical, and material support: M. A. J. A.

Ethics

The study protocol was approved by the ethics committe board of the University of Thi-Qar, Nasiriyah, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

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