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Research Paper

A comparative study of raw buffalo milk components from two sources: local markets and buffalo breeders' fields in Shatrah city

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ABSTRACT

A study was conducted in Shatrah City, Iraq, from April 1 to August 1, 2022, to compare and evaluate the physicochemical Composition of raw buffalo milk from two sources: local markets (including street vendors and dairy shops) and buffalo breeders' fields. 100 raw buffalo milk samples were collected, with 50 samples from each source. The results showed that raw buffalo milk samples from breeders' fields had significantly higher ($p < 0.05$) fat, solid non-fat, protein, lactose, total solids, ash, and milk density than those from local markets. In contrast, raw buffalo milk samples from local markets had significantly ($p < 0.05$) higher water content (moisture) than those from breeders' fields. The mean values of fat, solid non-fat, protein, lactose, total solids, water, ash, and density in samples from breeders' fields and local markets were as follows: (31.33±0.590, 0.62±0.0142, 85.98±0.312, 14.01±0.312, 4.97±0.122, 3.28±0.073, 8.89±0.204, 5.25±0.150) ((24.42±0.745, 0.49±0.016, 90.22±0.256, 9.76±0.251, 3.92±0.125, 2.59±0.083, 6.99±0.225, 2.77±0.130), respectively. The study results indicated that some vendors in the local markets of Shatrah City (street vendors and dairy shops) adulterated raw buffalo milk to increase their profit margins by adding water, partially removing fat, or using other readily available adulteration methods.

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1. INTRODUCTION

Milk is a highly nutritious food source, containing high-quality nutrients such as proteins, fats, carbohydrates, and minerals in significant quantities compared to other foods [1]. Despite its high % biological value of 82%, milk is one of the cheapest animal protein sources, compared to 67% in red meat [2].

Buffalo milk is distinguished by its high total solids content, high-fat content ranging from 7% to 13%, high total mineral content, especially calcium and phosphorus, and bright white colour compared to cow's milk [3]. Buffalo milk is rich in unsaturated fatty acids and has a higher shelf life than cow's milk [4], [5].

These characteristics make buffalo milk an essential raw material in producing dairy products such as liquid milk, cream, cheese, butter, yogurt, and ghee (animal fat). [6] Pointed out that buffalo milk has desirable processing properties in the dairy industry, making it suitable for producing mozzarella cheese.

The importance of studying milk components lies in the fact that some of these components, such as the fat content, determine the product's price products price, which is an important economic factor for the farmer. It also helps protect consumer health, ensure the safety of dairy products, and reduce milk adulteration. [7] Indicated that the classification of raw milk from dairy animals has become essential for food safety economically and for the consumer's health.

Some farmers and dairy sellers resort to milk adulteration to obtain an additional profit margin at the expense of product quality and consumer health. Adulteration can be either natural or artificial. Natural adulteration involves adding water to milk, removing some of the fat, adding water and skimmed milk, or combining these methods [8].

This study aims to compare and evaluate raw buffalo milk's chemical composition and physical properties obtained from local markets (including street vendors and dairy shops) and buffalo breeders' fields in Shatrah City, DhiQar Governorate.

2. RELATED WORK

Milk adulteration is defined as adding any foreign substance to milk or removing any of the natural components milk in a way that harms the health and economy of the consumer or deceives him for the purpose of obtaining illegitimate profit [9].

[10] Indicate that there are several methods of adulterating milk, such as adding water, urea, starch, gelatin, and others, these methods cause a decrease in the nutritional value of milk, and some additives may cause health problems for the consumer. While [11], [12] reported that most of the milk samples taken from the brokers were adulterated with water, this addition greatly affected the chemical properties of the milk, except for the lactose content. [13] reported that water was the most contaminated substance in market milk samples, followed by detergents, rice flour, caustic soda, salt and sugar, the percentage of adulteration by adding water was higher in market milk samples compared to milk samples taken from dairy producers, this addition caused a decrease in the specific gravity of milk, as well as an increase in the freezing point and change in the PH value towards neutrality.

3. METHODOLOGY

A study was conducted in Shatrah City, DhiQar Governorate, Iraq, from April 1 to August 1, 2022, to compare and evaluate the physicochemical Composition and some physical properties of raw buffalo milk from two sources: local markets (including street vendors and dairy shops) and buffalo breeders' fields.

100 raw buffalo milk samples were collected, with 50 samples from each source. Each sample was 100 ml in volume. After collection, the samples were immediately stored in a box filled with crushed ice and transported to the laboratory for analysis using a German-made EKO Milk device. The device was used

to estimate the percentages of fat (F%), protein (P%), lactose (L%), solid non-fat (SNF%), and milk density. The total solids (TS%) were estimated according to [14].

The ash content (Ash%) was estimated using the following equation:

- Ash% = SNF% - (L% + P%)

The water content (moisture%) in milk was estimated using the following equation:

- W% = 100 - TS%

3.1. Statistical Analysis

The data were statistically analyzed using the [15] statistical software, and the significance of the means was tested using the LSD test.

4. RESULTS AND DISCUSSION

The results of the study showed a significant superiority ($p < 0.05$) of raw buffalo milk samples collected from breeders' fields in all major components (fat, solid non-fat, protein, lactose) compared to raw buffalo milk samples collected from local markets.

4.1. Fat

The fat content in the breeders' samples was lower than that reported in studies by [16], [17] and higher than that reported in studies by [18], [19], [20]. The fat content in the market samples was lower than that reported in studies by [8], [21] and slightly higher than that reported in studies by [18].

The lower fat content in the market samples may be attributed to milk adulteration, which involves removing some fat and adding water [22].

4.2. Solid Non-Fat

The solid non-fat content in the breeders' samples was lower than that reported in studies by [23], [16] and higher than that reported in studies by [24], [25], [17], [19], [20]. The solid non-fat content in the market samples was lower than that reported in studies by [8], [18] and higher than that reported in studies by [17]. The lower solid non-fat content in the market samples may be attributed to milk adulteration by adding water [26].

4.3. Protein

The protein content in the breeders' samples was lower than that reported in studies by A [16] and slightly higher than that reported in studies by [18]. The protein content in the market samples was lower than that reported in studies by [18], [17].

4.4. Lactose

The lactose content in the breeders' samples was lower than that reported in studies by [27] and higher than that reported in studies by [16], [19], [20]. The lactose content in the market samples was lower than that reported in studies by [18] and similar to that reported in studies by [24], [25].

The study showed a clear superiority in the components of raw buffalo milk taken from breeders' fields compared to samples taken from local markets. This may indicate adulteration of buffalo milk in local markets by removing some of the fat or adding water.

Table 1. Mean (± Standard Error) of Major Milk Components in Raw Buffalo Milk Samples from Local Markets and Breeders' Fields

Milk Sources	Views No.	Fat %	Solid Non-Fat%	Protein (%)	Lactose (%)
Market samples	50	2.77^{b}±0.130	6.99^{b}±0.225	2.59^{b}±0.083	3.92^{b}±0.125
Breeders' samples	50	5.25^{a}±o.150	8.89^{a}±0.204	3.28^{a}±0.073	4.97^{a}±0.122

Different letters within one column indicate a significant difference ($p<0.05$). The results showed a significant superiority ($p < 0.05$) of raw buffalo milk samples collected from breeders' fields in total solids, ash content, and milk density. The raw buffalo milk samples collected from local markets had a significantly higher ($p < 0.05$) moisture content. The mean values of total solids%, moisture%, ash%, and density in raw buffalo milk samples collected from breeders' fields and local markets were as follows:
(31.33±0.590, 0.62±0.014, 85.98±0.312, 14.01±0.312)
(24.42±0.745, 0.49±0.016, 90.22±0.256, 9.76±0.251)

4.5. Total Solids

The results for the breeders' samples were lower than those reported by [27], [23] higher than those reported by [17], [19], [20], and similar to those reported by [24], [25]. The results for the market samples were lower than those reported by [17], [19], [20] and consistent with those reported by [28].

4.6. Moisture

The results for the breeders' samples were higher than those reported by [27] and lower than those reported by [18], [17]. The results for the market samples were higher than those reported by Al-[18], [17]. The higher moisture content in the market samples may be attributed to the lower total solids content due to the partial skimming of fat and the addition of water. The results of this study are consistent with those of [28], [22], [13].

4.7. Ash

The results for the breeders' samples were lower than those reported by [27], [23] and higher than those reported by [24], [25]. The results for the market samples were lower than those reported by [18] and higher than those reported by [24]. This study's results are inconsistent with those of [28].

4.8. Density

The results for the breeders' samples were lower than those reported by [17] and higher than those reported by [24], [29], [8]. The results for the market samples were lower than those reported by [8], [29], and higher than those reported by [24], and slightly higher than those reported by [18]. The lower density of raw buffalo milk in the market samples may be attributed to milk adulteration by adding water [22]. The results of this study are consistent with those of [28], [22].

Table 2. Mean (± Standard Error) of Total Solids, Moisture, Ash, and Density in Raw Buffalo Milk Samples from Local Markets and Breeders' Fields

Milk Sources	Views No.	Total solids%	Water%	Ash %	Density
Market samples	50	9.76^{b}±0.251	90.22^{a}±0.256	0.49^{b}±0.016	24.42^{b}±0.745
Breeders' samples	50	14.01^{a}±0.312	85.98^{b}±0.312	0.62^{a}±0.014	31.33^{a}±0.590

5. CONCLUSION

It is concluded from the study that raw buffalo milk samples taken directly from the breeders' fields were significantly superior in milk component ratios and density, while market milk samples were significantly superior in water percentage. Milk samples taken from the markets were adulterated by one or more means of adulteration.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Muayad Abdulwahid Jaber Al-Fayad	✓	✓	✓	✓		✓		✓	✓	✓	✓			

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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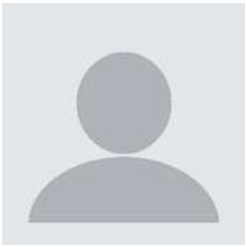

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