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Yield and Quality of Buffalo Milk in Semi-intensive and Intensive Farming in Mymensingh District of Bangladesh

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ABSTRACT

This study aimed to compare the buffalo milk yield and quality under semi-intensive and intensive management in village conditions. During the experiment, day-to-day milk production was recorded. pH, Acidity, Total solids, Specific gravity, Milk fat, Solids not fat, Lactose, Mineral, and standard plate count were evaluated. The average daily milk yield (L/d) of buffaloes under semi-intensive practice and intensive groups were 2.84 and 4.48 L/d, respectively, which were significantly different ($p<0.01$) from each other. There was a significant difference ($p<0.05$) in specific gravity of milk, milk fat percentage, acidity, and pH of milk between the two management systems. The efficiency of milk production was significantly ($p<0.05$) higher in intensive systems than semi-intensive systems. In case of microbial quality, buffalo milk from semi-intensive system (5.97±0.84) log CFU/ml resulted significantly ($p<0.05$) higher standard plate count than intensive system (5.85±0.06) log CFU/ml. The result of the experiment showed better performance of buffalo in intensive conditions rather than semi-intensive in terms of milk quality and yield.

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Introduction

Dairy buffalo production has long been a tradition in Asia, especially in South Asian countries like Bangladesh, India, Pakistan, and Afghanistan. The world buffalo population is estimated to be approximately 203.9 million heads as of 2023 (Trapanese et al*.,* 2024). About 92.5% of the total buffaloes are found in Asia. Within Asia, about 71.32% of buffaloes are in South Asia, 12.8% in East Asia, and only 8.4% are found in South-East Asia. Compared to other Asian countries, Bangladesh has only 1.93 million buffaloes (Bangladesh Economic Review, 2020). The contribution of buffalo to total milk production in Bangladesh remained more or less stagnant due to the absence of any milk improvement program. Whereas, in India, the buffalo forms the backbone of India's dairy industry which shares 67.99% of the world's buffalo milk production (Chakravarty, 2013). Dairy buffalo production improvement in Bangladesh is important due to the potential for higher milk yield and better feed utilization, with buffalo milk offering a high fat-to-protein ratio (2:1) that enhances its market value (Addeo et al., 1993). Buffalo milk is nutritionally superior to cow milk, containing more fat, protein, and vitamins, making it ideal for dairy products like cheese, butter, and ice cream (Ng-KwaiHang et al., 1984). Increasing public awareness of buffalo milk's benefits will aid in the advancement of the dairy buffalo sector (Amarjit and Toshihiko, 2003). Buffaloes, despite their important role in South Asia's livestock sector, have been neglected in Bangladesh, though recent efforts from both government and private organizations aim to boost dairy buffalo production. There is very few information about the milk production and quality of buffalo raised in semi-intensive system in Bangladesh. Therefore, this study focused on finding buffalo milk yield and quality under intensive and semi-intensive management practices in village conditions to improve milk production in the country.

Materials and Method

This experiment was performed to determine the milk quality by providing improved management (intensive) under village conditions compared to farmer practice (semi-intensive). The 10-week experiment, followed by a 2-week adaptation period, was conducted in the Senbari region of Trishal Upazila, Mymensingh district (24° 34′ 57″ N, 90° 23′ 41″ E), from August to October 2019. In the study, ten buffaloes were divided into two groups of five based on body weight, parity, and milk yield where the semi-intensive T1 group was managed by traditional farmer practices and the intensive T2 group under improved management. The T2 group was given a 15-day adaptation period before the study began. During the study, milk was mixed thoroughly after milking and then 200ml of milk samples were collected on a daily basis in a labeled plastic bottle with the identifying marks from individual buffaloes and kept in an icebox. Samples were immediately transferred from the field to the laboratory. The chemical analyses of samples were done in the Dairy Chemistry and Technology Laboratory of Bangladesh Agricultural University and Standard plate count was done in the Dairy Microbiology and Biotechnology Laboratory of Bangladesh Agricultural University. Samples were analyzed through different tests such as physical tests, chemical tests, and microbial tests.

Physical parameters

The physical parameters like color, flavor, texture, and taste were determined according to Nelson and Traught (1964). The specific gravity test was performed by using Quevenne Lactometer, Lactometer cylinder, and floating dairy thermometer according to the method described by Aggarwala and Sharma (1961).

Specific gravity = (Corrected Lactometer reading /1000) +1 CLR = LR + (Supplied sample temperature - adjusted lactometer temperature) * 0.1

The Chemical test

The milk compositions e.g. Milk fat, milk protein, lactose, mineral, Total solids, and Solids-not-fat (SNF) were analyzed by using a Lactoscan milk analyzer (Milktronic Ltd., 600 Stara Zagora, Bulgaria). In case of any doubt on Lactoscan reading values that were cross-checked by using in the conventional method bycalculating pH, Acidity (%), Total solids content (g/Kg), Fat content (g/Kg), Solids-not-fat content (g/Kg), Protein content (g/Kg), Lactose content (g/Kg), and Ash content (g/Kg).

The Microbial test

Microbial property was assessed by conducting SPC (Standard Plate Count). The result was expressed in log cfu/ml.

Statistical analysis

The data on milk composition and quality was subjected to statistical analysis using SPSS, Version 16.0. An Independent t-test was employed in the analysis of data

Result and Discussion

The study illustrated the comparative analysis of milk production and efficiency between the semi-intensive group and the intensive management group. Intensively managed buffaloes produced significantly more milk (4.48±1.07 L/d) than those in the semi-intensive group (2.84±0.10 L/d), with a 1.64 L/d difference ($p<0.01$) on a daily basis (Table 1). These more milk production, likely due to a higher concentrate feed intake in intensive management system (El-Bordeny et al., 2017; Sherasia et al., 2014). This also might be due to good management practice in intensive management system (Marumo et al., 2022). The efficiency of milk production (EMP) was also higher in the intensive group (0.653±0.166) compared to the semi-intensive group (0.472±0.054), with a significant difference ($p<0.05$). According to the study, the intensively managed group produced 181g more milk per unit of dry matter. This indicates, by consuming the same amount of dry matter milk yield increased. In a study it was found that milk production per unit of dry matter intake increases with the improved diet and management (Sehgal et al.,2018 and El-Bordeny et al., 2017). The average mean and standard deviation of Specific gravity of milk samples collected from semi-intensive management and improved management buffalo milk were 1.030±0.001 and 1.032±0.001, respectively (Table 1). Statistical analysis showed that the differences in the specific gravity of buffalo milk from two different sources were highly significant ($p<0.001$). Han et al. (2012) found milk produced in intensive management system had higher values of specific gravity within the normal range (1.0317–1.0380). All the organoleptic tests were normal in both groups (Table 2). This might be due to using almost similar source of feed in both management system.

Table 1. Milk yield and specific density of buffalo milk collected from intensive and semi-intensive farming

Parameters	Semi-intensive	Intensive	P value	Level of significance
Average Milk Yield (L/d)	2.84±0.10	4.48±1.07	0.0012	**
Efficiency of Milk Production (EMP)	0.472±0.054	0.653±0.166	0.0012	**
Sp.gr	1.029±0.001	1.032±0.001	0.012	**
LR	29.85±0.96	32.00±0.82	0.012	**

Sp. gr= Specific gravity; LR= Lactometer reading; ** = Level of significance at 1%

Table 2. The color, flavor, taste, and texture quality of buffalo milk in semi-intensive and intensive management system

Physical parameters	Source of Milk	
	Semi-intensive	Intensive
Color	Whitish	Whitish
Flavor	Normal flavor (milky)	Normal flavor (milky)
Taste	Slightly sweet	Slightly sweet

The pH and Fat % show significant differences among milk samples between the two groups. The average mean and standard deviation of pH obtained from the semi-intensive group and intensive group were 6.49±0.10 and 6.78±0.10 respectively (Table 3). Statistical analysis showed that the differences in pH of buffalo milk from two different sources were significant ($p<0.001$). However, the pH value aligned with the normal range of 6.55–6.79 (Pamuk et al., 2013). The acidity percentage of milk samples collected from the semi-intensive group and the intensive group were 0.199 ± 0.037 and 0.16±0.016, respectively, both within the normal range that are 0.11–0.18% (Kanwal et al., 2004). However, higher acidity value of milk from semi-intensive system indicates lower hygienic precaution in pre and post milking. Moreover, there might be less sanitary quality maintained that resulted in fast acidity development (López-Carlos et al., 2023). The TS value of the T_2 group was increased by 18% to that of the T_1 group which is also a significant difference($p<0.001$).

Table 3. Chemical composition and microbial quality of buffalo milk in semi-intensive and intensive system

Variables	Semi-intensive	Intensive	P value	Level of Significant
pH	6.49±0.10	6.78±0.10	0.0040	*
Acidity	0.199±0.037	0.164±0.016	0.0040	*
Total Solids(g/kg)	14.97±2.63	17.72±1.01	0.0001	**
Fat(g/kg)	7.86±1.30	9.32±0.58	0.0001	**
SNF(g/kg)	8.08±0.83	8.54±0.39	0.068	NS
Protein(g/kg)	3.58±0.37	3.64±0.16	0.082	NS
Lactose(g/kg)	4.06±0.53	4.19±0.27	0.060	NS
Mineral(g/kg)	0.73±0.13	0.70±0.05	0.065	NS
SPC (log cfu/ml)	5.97±0.84	5.85±0.06	0.043	*

SNF= Solids not fat; SPC= Standard plate count; ** = Level of significance at 1%; * = Level of significance at 5%; S=Non-significance at 5%

A total of 19 percent fat was increased in the T2 groups than that of the T1 group, and a significant difference was found between the treatments ($p<0.001$). The SNF%, Milk Protein%, Lactose% and the Mineral% shows no significant difference ($p>0.05$). The SNF% was 8.05±0.83 and 8. 45±0.39 for T1 and T2 groups, respectively. SNF values were similar across systems ($p > 0.05$) with averages of 8.36% to 9.39% (Sanyal et al., 2016). Protein percentages was within the average range non-descript

buffalo protein percentage (Misra et al., 2009). The lactose percent of buffalo milk was 4.06±0.53 and 4.19±0.27 for the T1 and T2 groups, respectively where the lactose content in buffalo milk of the T1 group was 0.13% less than that of the T2 group. Lactose also content remained with normal range of 3.28–4.63% (Kanwal et al., 2004). The mineral content (%) of milk of T1 and T2 were 0.73±0.13 and 0.70±0.05 percent, respectively (Table 3). Mineral content was found like the reporting levels of 0.74–0.77% (Ojha et al., 2017). The average mean and standard deviation of the number of viable bacteria present in the milk samples collected from semi-intensive and improved management were 5.97±0.84 Log cfu/ml and 5.85±0.06 Log cfu/ml respectively (Table 3). Statistical analysis showed that the differences among the number of bacteria of milk from the above sample were significant ($p<0.05$). In both system the bacterial count was high that might be due to less hygienic conditions (Saleem et al., 2015).

Conclusion

The study highlights significant insights into how management practices influence both yield and quality of buffalo milk. Buffalos reared under the intensive system demonstrated higher milk production compared to those in the semi-intensive system, likely due to better feed management, controlled environments, and optimized resource utilization. However, quality parameters such as SNF, protein, lactose, minerals and sensory characteristics showed minimal variation, suggesting that both systems can maintain acceptable quality standards when managed effectively. The findings underscore the importance of choosing the management system based on production goals, resource availability, and economic considerations. While the intensive system may offer higher yields, it requires greater investment in infrastructure and operational costs. Conversely, the semi-intensive system provides a more sustainable option for small-scale farmers with limited resources. Further studies are recommended to explore the long-term economic viability and environmental impact of each system, along with their effects on buffalo health and welfare.

Conflicts

The authors declare no conflict of interest.

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