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EFFECT OF WATER AND FEEDING FREQUENCIES ON MILK PRODUCTION AND COMPOSITION OF AZIKHELI BUFFALO IN NORTHERN PAKISTAN

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ABSTRACT

The study aimed to determine the effect of water and feeding frequency on feed intake, weight gain, milk production, and composition of Azikheli buffalo in climate conditions of Northern Pakistan. Forty multiparous Azikheli buffaloes with similar live body weight, third lactation stage were selected and randomly divided into four groups with ten replicates in each group: GP-1 (water and feed once daily), GP-2 (water and feed twice daily), GP-3 (water-adlib + feed thrice daily), and GP-4 (water-adlib + adlib feed). The basic feed consisted of maize fodder, wild grass, wheat straw. The concentrate feed (2 kg) was supplemented to all groups. Individual access to watering and feed were provided for each animal. The feed samples were analyzed for their chemical composition, and digestibility. The data mean was calculated using repeated-measures ANOVA. Different water frequencies have a statistically significant effect on water intake, dry matter intake, milk production, and milk composition. The average daily water intake in GP1, GP2, GP3, and GP4 was 28.00, 44.00, 56.00 and 67.30 liters, respectively. The average intake of dry matter was 10.20, 11.15, 12.40 and 12.97 kg, respectively. Daily milk yield was 6.90, 7.44, 8.10 and 8.38 liters, respectively. Dry matter intake and milk production were significantly influenced by the frequency of water consumption and nutritional balance. A balanced diet and unrestricted access to water increased milk production by 1.90 liters per animal per day. It was determined that a balanced diet and ad libitum water consumption increased the feed intake and milk production in Azikheli buffaloes and could yield higher profitability of dairy farms.

Key words: water consumption, feed intake, milk composition, Azikheli buffalo

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INTRODUCTION

Buffalo is commonly used dairy animal in Pakistan, accounting for over 62% of the country's total milk production (1). Commonly bred breeds are Nili Ravi, Kundi, and Azikheli buffalo. The latter breed is the least numerous but has high potential for milk and meat production (2). With improved management and nutrition, the current milk yield of the Azikheli buffalo can be further enhanced (3).

Nutrition plays a crucial role in the performance of producing animals. Proteins and carbohydrates are essential for growth and milk production in dairy animals (4). Additionally, the ad libitum availability of clean water throughout the day is also crucial for high milk production.

Different dairy farming systems may have various direct or indirect effects on animal production and health (5, 6). Clean water availability is essential for digestion, energy metabolism, transport of nutrients and metabolites, cell function, and waste elimination (7). Buffaloes with a high milk production must consume large quantities of water. The water intake is highly correlated with environmental temperature, feed type, milk production, and physiological condition. Dairy animals consume between 3 and 4 liters of water per kilogram of dry matter intake. The water intake and demands are directly proportional to the dry matter (DM) intake and the DM content of the feed/ration, i.e., increased consumption of rations with high dry matter contents will increase water consumption (8). When the water intake of small ruminants was gradually reduced from 100 percent to 50 and 40 percent of ad libitum intake, the DM intake decreased significantly (9).

The findings of earlier studies conducted by Kaliber and Silanikove (10) and Vosooghi et al. (11) indicate that there was a decrease in feed intake when water was restricted. Heat stress alone, costs the U.S. livestock industry $2.4 billion annually (12). Heat stress affects the feed intake, body temperature, metabolic processes, feed efficiency ratio, milk production and composition, reproduction, diseases, and behavioral changes. Animals lose water through their urine, milk, perspiration, faces, and respiration (13).

Thus, water restriction could have a direct impact on the performance of dairy animals, including feed digestibility, digesta flow rate, saliva excretion and blood parameters (14). The dairy animals may consume up to 50% of its daily requirements within the first hour after milking (15, 16), whereas the highest water consumption is correlated with high feed and dry matter intake (15).

Compared to sheep and goats, high-milk-yielding dairy animals are extremely sensitive to a limited water supply (12). In the past, research had been conducted on water restriction in small ruminants (17). However, to the best of our knowledge, no systematic research has been conducted on the effect of water and feed consumption frequency in dairy buffaloes, particularly the Azikheli buffalo breed, under hot summer conditions and intensive farming system yet. In 2015, benchmark and snapshot assessments were conducted in various regions of Pakistan. Due to a lack of awareness, it was observed that dairy farmers were not providing adlib water, feed, or balanced rations to dairy animals (18, 19). During the survey in northern Khyber Pakhtunkhwa, it was found that most farmers provide water once per day and keep their animals in sheds with inadequate ventilation. Once or twice a day, insufficient amounts of poor-quality roughages were provided as part of a substandard feeding system. The effect of water intake on animal feed intake, body weight gain, milk production, and composition, particularly in Pakistani buffaloes, is poorly understood. Therefore, this study was designed to investigate the relationship between water/balanced feed intake frequency and feed intake, milk production, and milk composition in Azikheli buffaloes during July and August in Khwazakhela Swat Khyber Pakhtunkhwa region, northern Pakistan.

MATERIAL AND METHODS

Forty multiparous Azikheli buffaloes with similar body weight (470±10), third lactation, and milking stage (80±10 days in milk) were selected and divided into four groups with 10 replicates in each group: GP-1 (water and feed once daily), GP-2 (water and feed twice daily), GP-3 (water-adlib + feed thrice daily), and GP-4 (water-adlib + adlib feed). The basic feed consisted of 22 kg maize fodder, 13 kg wild grass, 5 kg wheat straw. Concentrate feed (2 kg) was supplemented to all group uniformly (Table 1). The animals were assigned in groups with randomized block design. Each animal was housed separately and had an individual access to water (graduated water tubs) and feed. They were confined in an intensively closed shed and were tied with rope near the feeder. All animals were weighed at the beginning of the study and then on two-week-interval. The duration of the research was 42 days. The temperature of the environment and the shed was recorded daily. The average temperature inside the shed ranged 34-39 °C in July and August, while the outdoor temperature ranged 29-33 °C.

This study was conducted in compliance with the ethical procedure for animal care and experimental use of animals with the approval of the International Livestock Research Institute, and in the framework of Agriculture Innovation Program and Pakistan Research Council project grant (AID-BFS-G-11-00002).

Weather data

Weather data record was received from the Climate change center (Swat). Data regarding temperature and rain fall during the research experiment is given in Fig. 1 with graphical presentation.

The animals were fed daily with weighed quantities of green forage, wheat straw, and ~2.0 kg of concentrate (Table 1). They were kept under the same microclimate and zootechnical conditions. Maize, and natural grasses were available as green forage during July and August. The concentrate feed components were ground in Wiley mill (Thomas Scientific) using 1 mm mesh screen. They were analyzed gravimetrically by submerging the samples in solution containing a known weight of the sample. The separation, weighing, and calculating of the constituents were done in accordance with the AOAC standards (20) for DM (method 934.01), ash (method 942.05), ether extract (EE, method 920.39), and CP (method 981.10). The acid detergent fiber-ADF, method 973.18 (20) and neutral detergent fiber-NDF, method 2002.04 (20) were analyzed without correction for residual CP, using semi-automated procedure of sequential solvent extractions and filter bag technology on Ankom 200 Fiber Analyzer (ANKOM Technology, Macedon, New York). The two-stage in vitro procedure was adopted for determination of the in vitro DM digestibility (DMD) as reported earlier by Khan et al. (2).

Azikheli buffalo were milked twice daily, at 5:00 a.m. and 5:00 p.m. The milk was measured in a graduated jug and recorded daily for each individual buffalo during milking. In the laboratory of the Veterinary Research Diagnostic and Investigation Center (VRDIC) Balogram Swat, milk samples were analyzed on milk analyzer (Lactoscan SA-Milkotronic limited, Nova Zagora, Bulgaria) for milk composition and somatic cell count (cell/ml). The analysis of the data was performed using repeated-measures ANOVA.

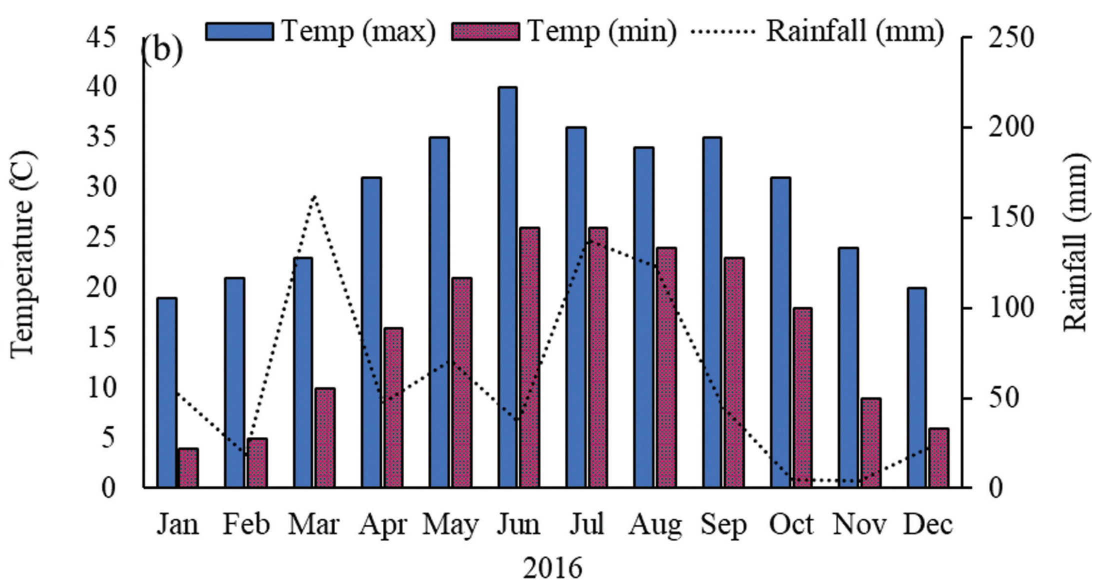

Figure 1. Total monthly rainfall (mm), minimum, and maximum temperature (°C) of the experimental area from January to December

Table 1. Chemical profile of forage fraction of ration and concentrates

Chemical Composition %	Maize	Wild grass	Wheat Straw	Concentrates
Dry matter (g/100g)	28.60	37.10	91.30	90.10
Crude Protein	8.90	10.10	2.58	16.10
Ether extract	3.46	2.95	1.48	5.50
ADL	3.49	6.11	12.10	3.90
Starch	24.80	18.70	0.83	83.20
ADF	26.20	31.10	49.50	18.90
NDF	45.10	49.30	75.10	35.10
DMD	64.00	61.20	40.30	86.50

ADL-acid detergent lignin, ADF-acid detergent fiber, NDF-neutral detergent fiber, DMD-dry matter digestibility

RESULTS

The frequency of water consumption had a significant ($p<0.001$) impact on the water intake, feed intake, body weight, milk yield, and composition of Azikheli buffalo (Table 2). GP1, GP2, GP3, and GP4 consumed 28.5, 47.0, 70.0, and 66.5 liters of water per day, respectively. Daily water intake increased by 31.5 liters in GP-3 and by 28 liters in GP-4.

Table 2 summarizes the lack of a significant ($p<0.05$) effect of different water consumption frequencies on the live body weight of Azikheli dairy buffaloes. The mean dry matter intake (DMI) in GP1, GP2, GP3, and GP4 was 11.1, 11.7, 12.2, and 13.0 kg/day, respectively. There was a positive effect of water intake on DMI. Higher water and balanced diet consumption had positive effect on DMI intake which increased by 1.9 kg in GP-4.

Table 2. Effect of different water frequencies on the live body weight of Azikheli dairy buffaloes

Parameters	GP1	GP2	GP3	GP4	SEM	p
LBW (initial)	480	470	480	470	0.08	---
LBW (final)	475	470	490	480	0.07	0.10
DWI (liters)	28.5^{d}	47.0^{c}	70.0^{a}	66.5^{b}	0.04	<0.001
DMI	11.1^{d}	11.7^{c}	12.2^{b}	13.0^{a}	0.06	<0.01

GP-1 (water + feed once daily), GP-2 (water + feed twice daily), GP-3 (water-adlib + feed thrice daily), and GP-4 (water-adlib + Adlib feed)
LBW-live body weight, DWI-daily water intake, DMI-dry mater intake

There was a significant effect ($p<0.001$) of water consumption on milk production (Table 3). According to Table 3, the average daily milk yield in GP1, GP2, GP3, and GP4 was 6.90, 7.44, 8.30, and 8.80 liters, respectively. GP-4 had higher daily milk yield by 1.90 liters compared to GP1.

In all treatment groups, water consumption frequency had no significant effect on milk composition (fat, protein, lactose, solids not fat, total solids, and ash) or somatic cell count. Although numerical variation in milk composition and somatic cell count was observed due to water consumption frequency differences (Table 3). The milk fats varied between 7.40% and 7.85%. High milk fat contents were recorded in GP1 compared to GP4 (Table 3).

Table 3. Effect of water consumption frequency and feeding frequency on milk production and composition in Azikheli buffalo

Composition	GP1	GP2	GP3	GP4	SEM	p
Milk yield (liters/day/head)	6.90[d]	7.44[c]	8.30[b]	8.80[a]	0.07	<0.001
Fats	7.85	7.60	7.50	7.40	0.06	NS
Lactose	4.90	4.85	4.91	4.99	0.08	NS
Protein	3.95	3.90	3.82	3.89	0.56	NS
Ash	0.90	0.88	0.97	0.98	0.08	NS
Solid not fat	9.75	9.63	9.70	9.86	0.02	NS
Total solid	17.50	17.20	17.20	17.30	0.10	NS
SCCx1000 cell/ml	110	135	095	150	0.07	NS

NS: non-significant, SEM: standard error mean; GP-1 (water-once daily + feed), GP-2 (water-twice daily + feed-twice daily), GP-3 (water-adlib + feed thrice daily), and GP-4 (water-adlib + Adlib feed), SSC: Somatic cell count

DISCUSSION

Water is essential for vital and various physiological processes such as digestion, transport of nutrients, milk production, urine excretion, and regulation of body temperature (16). The findings of earlier published data by Thokal et al. (21) supported the conclusions of the current study. They found that the average water intake of dairy cattle increased significantly ($p<0.001$) as the frequency of water supply increased from one to three times per day. Ali et al. (22), Abdullatif and Ahmed (23), and Mengistu et al. (24) reported that a group with unrestricted access to water provision consumed significantly more water than groups with restricted access. In addition to the frequency of water supply, several significant factors can influence buffalo water intake: feed intake, feed DM content, physiological stage of the animals, live body weight, environmental and ambient temperature (25).

Similarly, Williams et al. (26) reported that animals had a lower DMI when supplied with water once per day as opposed to twice or thrice. Alamer and Al-hozab (27) also reported that the feed intake of small ruminants in Saudi Arabia decreased in response to water restriction. The DMI was reduced due to a restriction in dairy animal water intake (28). According to a similar study by Silanikove et al. (29), adlib water intake increased DM intake and had a positive effect on animals. In another similar study, water restriction decreased DM consumption relative to normal water intake (26). Availability of potable water has a strong correlation with DMI (25). The average daily water intake in dairy cows is between 3.8 and 4.7 liters per kilogram of DMI when fed silage mixed with another diet (30), and 4.2 liters per kilogram of DMI when fed a hay diet. With an increase in water intake and unrestricted access to water, feed intake and DMI improved significantly, as confirmed by the above published data.

Reducing the amount of drinking water available to dairy animals decreased water intake and decreased milk production compared to adlib water intake (26, 31). Thokal et al. (21) also reported a 16% decrease in milk production in dairy cows when watering frequency was restricted from free access to twice daily. Consistent with earlier findings, the current study confirmed that increased water intake increased milk yield (25). Aganga (32) conducted a similar study and reported that lactating small ruminants produced 50% less milk after 72 hours of water deprivation. In a previous study, it was demonstrated that restricting water intake significantly decreased milk production compared to unrestricted water intake (33).

Aganga (32) reported that prolonged water deprivation may increase the viscosity of milk as well as its protein, fat, and lactose content. No significant effect of water frequency was observed on milk composition (34). Restricting cattle's watering frequency from free access to twice a day had no effect on milk composition (21).

CONCLUSION

Free access to drinking water and a balanced diet had a positive effect on the overall performance of the animals. Azikheli buffalo had higher water and feed consumption and produced more milk when they had free access to drinking water. Milk production increased by an average of 1.9 liters per day.

CONFLICT OF INTEREST

The authors declare that they have no known conflict of interest in the conduction of the current study.

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AUTHORS' CONTRIBUTION

MNMI conceived the research idea, research methodology and proposal development, financial acquisition, and gave final approval of the manuscript. HS, B and KA conducted the research, gathered the data, and participated in interpretation of the results. NK was involved in hypothesis formulation and manuscript writing. NA took part in data analysis, manuscript writing, and proofreading. All authors have reviewed and approved the final version of the manuscript.

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