



Effect of Different Lactation Stages on Milk Yield and Milk Composition in Azi-Kheli Buffaloes in District Swat

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ABSTRACT

This study aimed to evaluate the effect of lactation stages on milk yield and milk composition and to find a correlation among different lactation stages with milk composition in Azi-Kheli buffaloes in district Swat. The study was conducted at, Azi-Kheli Buffalo Improvement and Conservation Farm Charbagh, District Swat. For the current research study total of eighteen Azi-Kheli buffaloes were selected having the same parity and different lactation stages. The animals were divided into three groups based on lactation stages, each group contained six animals. Overall daily milk yield in the early lactation stage was significantly higher followed by mid and late lactation stages. Fat content was significantly higher during the late lactation stage followed by the mid and early lactation stages. Milk protein, lactose, solid not fat, and total solid were not affected ($p>0.05$) during the early, mid, and late lactation stages. All lactation stages (early, mid, and late) revealed no significant correlation among different milk contents, although some values indicated strong negative and positive correlations but non-significant ($p>0.05$). It is concluded that the Azi-Kheli breed has the potential to produce high milk fat during the late lactation stage and needs consideration for future breeding.

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Key words

Livestock, Azi-Kheli buffaloes, Lactation, Milk yield, Total solid, Milk fat

INTRODUCTION

The domestic water buffalo (*Bubalus bubalis*) account for over 70% of all water buffaloes in the globe and are considered important in Pakistan since they contribute the most to milk production. The milk output of swamp buffaloes (*Bubalus carabanesis*) is lower than that of water buffaloes (FAO STAT, 2021). Pakistan is the

world's fourth-largest milk producer country and produces 63,684 tonnes of milk per year, out of which 51,340 tonnes are consumed by humans (Economic Survey, 2020-21). Buffaloes contribute more to the national economy than cattle, sheep, and goats combined, with a share of around 62 percent of total milk output in Pakistan (Sohail et al., 2009). In Pakistan, there are five kinds of buffalo: Nili, Ravi, Nili Ravi, Kundi, and the recently introduced Azi-Kheli (Khan et al., 2007). Azi-kheli is a known Pakistani buffalo breed and is mostly found in the Swat, Shangla, Malakand, Dir, and Bajaur districts of Khyber Pakhtunkhwa (Jabbar et al., 1988). Khwazakhela Swat is the origin of this breed. The word Azi-kheli is derived from the tribe's ancestral (homeland) name the Azi-khel. This valley is located on the river's edge (Swat River) and the length is almost 124 km². The usual temperature in this valley is between 2 and 33°C, with an annual rainfall of 1400-1500 mm (Khan et al., 2009).

Milk is chemically characterized as a colloidal

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solution of minerals, salt, sugar, fat, and protein (Bekere and Harun, 2020). Milk is a complex fluid, consisting mostly of water, protein, fats, vitamins, and minerals and its content composition consists of 3.2% lipids, 4% protein, 5% lactose, and 0.7% minerals salt (Urgu *et al.*, 2019). Lactoferrin and lacto peroxidase, two milk proteins, are well recognized for their antibacterial and immunological modulatory properties (Niaz *et al.*, 2019). The nutritional value and technical features of milk and milk products are determined by the composition of raw milk, which is more important for the dairy sector (Yasmin *et al.*, 2020). Furthermore, milk prices and consumer interest vary with milk components, particularly fat and solid not fat (SNF), which can have a direct impact on farm revenue (Maheshwari and Jaishankar, 2021). The milk composition and milk yield in different lactation cycles are different as well as affected by the environment surrounding the animal (Yadv *et al.*, 2013). Numerous studies were conducted on Nilli Ravi and Kundi buffalo's milk yield and composition in Pakistan and other countries; however limited research studies have been conducted on Azi-Kheli buffalo, especially in their home tract Swat, Khyber Pakhtunkhwa. The current research aimed to explore the effect of different stages of lactation on milk composition and milk yield of Azi-Kheli buffalo reared in their home tract District Swat.

MATERIALS AND METHODS

Study area and animal selection

This study was conducted at Azi-kheli Buffalo Improvement and Conservation Farm Charbagh, District Swat. For the current research study total of eighteen Azi-Kheli buffaloes were selected having the same parities and different lactation stages. The animals were divided into three groups based on lactation stages e.g. Early lactation (01-90 days), mid-lactation (91-180 days), and late lactation (181-270 days). Each group consisted of six animals.

Daily milk yield and milk sample collection

The daily milk yield (MY) of the selected buffalos was recorded on milking time. The milk samples were collected twice a day and the standard protocol was followed by wearing gloves, lab coats, etc. Before sampling, teats (udder) were disinfected with 70% ethanol to prevent the transfer of microbes. Sterile sampling bottles of 10ml volume were used for the collection of milk samples. These samples were transported to the laboratory for further analysis.

Laboratory work

The laboratory work was conducted at the Dairy

Technology Lab, Department of Livestock Management, Breeding and Genetics, Faculty of Animal Husbandry and Veterinary Sciences, the University of Agriculture Peshawar. The percentage of different milk components was obtained from milk samples by using an auto milk analyzer (Lacto-scan).

Statistical analysis

The collected data was subjected to a statistical package (Statistix-8.1) for analysis. Analysis of variance was performed by using complete randomized design (CRD) and means between the groups were compared using the LSD test and the Pearson correlation method was used for correlation.

RESULTS AND DISCUSSION

Results regarding the average daily milk yield and milk composition of Azi-Kheli buffalos in different lactation stages i.e., early, mid, and late lactation are presented in Table I. It was found that the animals in the early stage of lactation have a high daily milk yield ($p < 0.05$) followed by mid and late lactation stages. Similar results were reported by Khan *et al.* (2022) that Azi-Kheli buffaloes give 2494.02 L of milk per lactation (305 days) in which daily milk yield was 8.17 L and Tamboli *et al.* (2023) reported 9.92 L in Nili Ravi buffaloes in 96 days. Similarly, Tipu *et al.* (2021) recorded a high daily milk yield in Nili Ravi buffaloes in 20 days. However, Afzal *et al.* (2007) noted 1831.6 L of daily milk yield in Nili Ravi buffaloes per lactation (300 days) which is 6.10 L per day. The difference between the two studies might be due to differences in genotype. The fat contents in the late lactation stage were significantly higher as compared to early and mid-lactation stages and the remaining components of milk e.g. proteins, lactose, SNF, total solids, and ash showed no significant variation in

Table I. Comparison of milk yield and milk composition in response to different lactation stages in Azi-Kheli Buffalo breed.

Lactation stages	Daily milk yield (L)	Fats (%)	Protein (%)	Lactose (%)	SNF (%)	Total solids (%)	Ash (%)
Early lactation	9.20 ^a	6.84 ^c	3.54	4.68	8.90	17.3	0.79
Mid lactation	8.43 ^b	7.51 ^b	3.46	4.80	9.06	17.2	0.80
Late lactation	7.00 ^c	8.21 ^a	3.57	4.72	8.94	17.1	0.87
SEM	1.08	0.47	0.39	0.30	0.51	0.48	0.22
P-value	0.003	0.001	0.063	0.071	0.061	0.079	0.066

SNF, solid not fat

different lactation stages. Similarly, [Tipu et al. \(2021\)](#) reported the same average percentage of fats, proteins, and lactose in Nili Ravi buffalo which coincides with our results of the lactation stage. [Arote et al. \(2021\)](#) in the late lactation stage reported milk fat contents of Murrah buffaloes, which are close to our results according to lactation stages and the same protein percent in the lactation stage. [Abbas et al. \(2014\)](#) found that milk SNF of Nili Ravi buffaloes in the winter season was (9.07%) followed by spring (9.23%) and summer season (9.57%) and nearly coincides with the findings of our study. Similarly, the results of [El-Salam et al. \(2011\)](#) of total solid content in the Bhadawara buffaloes breed are in line with the current study results. [Yasmin et al. \(2020\)](#) reported 0.81 % ash in Nili Ravi buffaloes, which is close to our results. Similarly, [Hans et al. \(2006\)](#) recorded ash content in water buffalo × swamp buffalo as 0.85%, which also lies close to our findings, but the variation may be due to differences in breeds.

Table II. Overall correlation of milk components of Azi-Kheli Buffalo breed.

Milk component	Fat	Protein	Lactose	Ash	SNF
Fat	1				
Protein	0.0844 0.7392	1			
Lactose	-0.0311 0.9025	0.0194 0.9392	1		
Ash	0.4813 0.0431	0.3933 0.1063	-0.0973 0.7009	1	
SNF	-0.1321 0.6014	0.1582 0.5307	0.2086 0.4062	0.1280 0.6128	1
Total solid	0.0000 1.0000	0.1787 0.4780	0.0588 0.8167	0.1390 0.5823	0.0785 0.7569

The results of the overall correlation of milk components are given in [Table II](#). The results indicated a weak correlation among different milk components. Milk fats have a weak positive correlation with ash content and have very weak negative correlation with lactose and SNF content. Similarly, the proteins have a weak positive correlation with ash as well as the remaining contents. The correlation of milk yield and contents with the early lactation stage is presented in [Table III](#). In the early lactation stage, the correlation analysis of daily MY showed a moderate positive correlation with fats and total solids while having a weak negative correlation with the lactose content of milk. The fat content had a strong positive correlation with protein content while having a

moderate positive correlation with the total solid content of milk, a weak correlation was also observed with other milk contents. The correlation of proteins with lactose, SNF, and total solid content was weak and negative.

Table III. Correlation between milk yield and milk components in early, mid and late lactation stages.

Milk component	DMY	Fats	Protein	Lactose	ASH	SNF
Early lactation stage						
Fats	0.5542 0.3324	1				
Protein	0.1440 0.8162	0.7185 0.1715	1			
Lactose	-0.196 0.7519	0.2432 0.6934	-0.2000 0.7470	1		
Ash	0.0591 0.9248	0.3631 0.5480	0.3155 0.6051	-0.2073 0.7380	1	
SNF	0.3581 0.5540	0.1269 0.8389	-0.1124 0.8572	-0.3423 0.5728	0.8257 0.0850	1
Total solid	0.6940 0.1936	0.5396 0.3480	-0.0181 0.9769	0.0553 0.9296	0.6224 0.2622	0.8076 0.0984
Mid lactation stage						
Fats	0.2919 0.5745					
Protein	-0.2521 0.6299	-0.2014 0.7019				
Lactose	-0.6521 0.1605	-0.7472 0.0878	0.5836 0.2240			
Ash	0.1187 0.8228	0.3811 0.4560	0.6708 0.1447	0.1374 0.7953		
SNF	0.8625 0.0271	0.4261 0.3995	-0.2000 0.7040	-0.7064 0.1166	0.2236 0.6702	
Total solid	0.2510 0.6314	0.6115 0.1971	0.4077 0.4223	-0.4007 0.4311	0.4376 0.3855	0.2120 0.6868
Late lactation stage						
Fats	-0.2204 0.6348					
Protein	0.3220 0.4812	-0.4237 0.3435				
Lactose	-0.3498 0.4419	-0.2989 0.5149	0.1676 0.7194			
Ash	0.5292 0.2220	-0.0595 0.8992	-0.1217 0.7949	-0.2203 0.6350		
SNF	0.0769 0.8699	-0.9248 0.0029	0.6453 0.1175	0.4288 0.3370	-0.2179 0.6388	
Total solid	-0.4250 0.3418	0.3394 0.4565	0.2322 0.6164	0.2655 0.5651	0.0602 0.8979	-0.1458 0.7551

The ash content possessed strong and moderate positive correlations with SNF and total solids respectively. SNF was also strongly correlated with the total solid contents of milk. The correlation of milk yield and contents with mid lactation stage is presented in Table III. In mid lactation stage, the correlation analysis of DMY showed a strong positive correlation with SNF while a moderate negative with the lactose content of milk. The fat content displayed a moderate positive correlation with total solid content while having a moderate negative correlation with lactose of milk, a weak correlation was also observed with other milk contents. The correlation of proteins with lactose and ash was moderately positive, while with total solid content was weakly positive. The lactose content possessed strong negative and weak negative correlations with SNF and total solids, respectively. SNF was found weakly positively correlated with total solid contents and SNF of milk. The correlation of milk yield and contents during the late lactation stage is presented in Table III. During the late lactation stage the correlation analysis of daily MY revealed a moderate positive correlation with ash while a moderate negative with fats, lactose, and total solid content of milk. The fat content exhibited a weak negative correlation with proteins, lactose, and ash content while having a strong negative correlation with SNF of milk, a weak positive correlation was also observed in total solid milk contents. The correlation of proteins with SNF was moderately positive. The lactose content possessed a weak negative correlation with ash and a weak positive with SNF and total solids.

CONCLUSIONS

It is concluded from the present study that milk fat contents are inversely related to milk production. Milk yield was significantly higher during the early lactation stage followed by the mid and late lactation stages while the milk fat was significantly lower during the early lactation stage followed by the mid and late lactation stages. So further research is needed to explore for future breeding strategies in the Azi-Kheli buffalo breed.

DECLARATIONS

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IRB approval

The experimental work was approved by the Board of Studies (BOS) (January 2023).

Ethical statement

The experiment was approved by the Ethical Committee of the Faculty of Animal Husbandry and Veterinary Sciences (FAHVS), The University of Agriculture Peshawar before the practical execution of this experiment.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Statement of conflict of interest

The authors have declared no conflict of interest.

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