



RESEARCH ARTICLE

Assessment of Milk Production and Milk Quality Traits of Indigenous Goats under Traditional Grazing Based Systems

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ABSTRACT

This experiment compared the milk production and the milk composition of domestic goats raised through the use of the traditional management systems in three tehsils of the District Swat (Kabal, Charbagh, and Matta). Sixty milk samples (20 per tehsil) were taken and collected on the basis of lactating does and the samples were analyzed through the automated milk analyzer to determine fat, protein, lactose, solids-not-fat (SNF), density and pH. Direct measurements were made on the daily milk yield. Most of the milk composition characteristics and milk yield showed significant differences ($p < 0.05$) between locations. Matta goats had the greatest milk production per day (2.05 L/day) followed by Charbagh (1.29 L/day) and Kabal (1.01 L/day). The content of fat and SNF was greater in Kabal (3.94% and 8.45%), and the content of proteins was the highest in Matta (4.21%). There were no significant variation in milk density and pH, regarding the locations. The effects of feed type and parity were also significant ($p < 0.0001$) on the milk yield, with the supplementary diets and greater parities being linked with better production. The analysis of correlation indicated that milk yield was positively related to protein, lactose and SNF and fat had a negative relationship with milk yield at all locations. In general, Swat indigenous goats showed to be inconsistent in their potential to produce milk based on location, feeding and physiological parameters. Traditional goat production systems have the potential to be improved in terms of productivity and quality of milk by improving nutritional management and implementing location specific strategies.

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1. Introduction

Livestock production is a critical part of the livelihood of smallholder farmers in the developing nations whereby it is mostly controlled by traditional systems that are low-intensive [1]. Goats are a valuable source of milk, meat and income to poor rural households that do not have sufficient resources due to their small body size, adaptability, resistance to adverse factors as well as the low amount of feed and management required [2]. Goat keeping in Pakistan especially in the mountainous areas of Khyber Pakhtunkhwa is a major component of rural subsistence, where native breeds help to assure local food security and rural economy [3].

Swat District is a large livestock producing area, where there are over 380,000 goats in the area. A majority of goats are farmed in large systems whose features encompass traditional pasture grazing, small-scale additional feeding, and little record keeping [4]. These conditions have a direct impact on important productive characteristics such as milk yield and milk quality which are significant indicators of nutritional value, marketability and economic returns to the farmers [5]. Especially goat milk, is gaining significance because of its high digestibility, small fat globules, therapeutic virtue and adaptation to those who cannot digest cow milk [3,6].

Although goats are important in the area, little scientific information on the performance of milk under the management of local conditions is available [7]. The

differences between the milk yield and composition in various tehsils, feeding systems, and parities are important to understand so that specific interventions can be developed to increase productivity [3,8]. Thus, the current study compared the milk production potential and milk composition of the indigenous goats raised according to the traditional management system in three tehsils of the District Swat namely Kabal, Charbagh, and Matta.

2. Materials and Methods

2.1. Study Area

The research was carried out in three tehsils of District Swat that include Kabal, Charbagh and Matta where goats are mostly kept in extensive and traditional management. The milk samples were taken in lactating does that were kept by smallholder farmers that were subjected to similar grazing-based management practices.

2.2 Gaot age and lection time

2.3 Timing of Milk Collection

2.2 Milk Sampling and Handling

There were 60 milk samples taken, 20 samples in each of the tehsils. The samples were obtained during regular farm visits of the identified does which were considered to represent the local flock. Udders were sponged before being sampled. The milk was gathered in sterile bottles of plastic material and put on ice boxes and carried to the Veterinary Research and Disease Investigation Center (VR&DIC) Swat to be analyzed in the laboratory.

2.3 Milk Composition Analysis

An automatic milk analyzer was used to determine the composition of milk which measured: Fat (%); Protein (%); Lactose (%); Solids-not-fat (SNF %); Milk density; pH. The daily milk yield (L/day) was measured by means of standard measuring containers.

2.4 Data Analysis

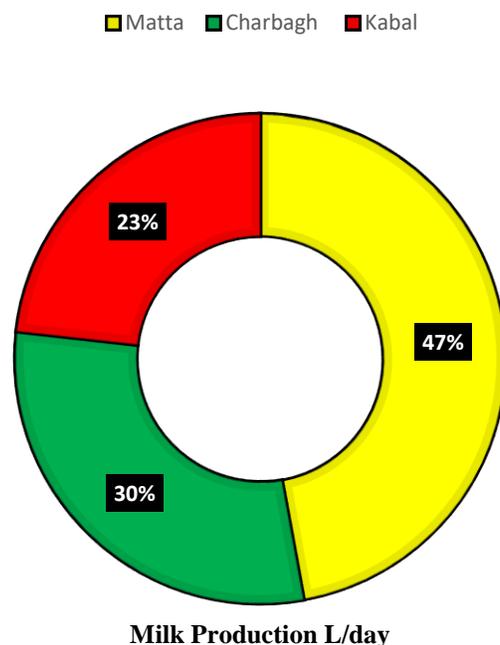
Data analysis was done using SAS (version 6.12) software. The effects of the location, feed type and parity on milk yield and composition were determined by analysis of variance (ANOVA). Correlation tests were conducted in order to assess the association between milk components and milk yield. At p less than 0.05, the differences were regarded as significant.

3. Results

3.1 Milk Yield

The average daily milk production of native goats with conventional management was 1.45 0.28 L/day. There was a lot of variability in Milk yield ($p < 0.0001$) among tehsils: Feed type also significantly affected the milk yield ($p < 0.0001$). The most lucrative result (2.01 L/day) was registered in goats that were given a combination of grazing

and concentrate supplement and the lowest yield was obtained in pure-grazing goats (1.05 L/day). The effect of parity was significant ($p < 0.0001$) and milk yield improved between the first parity (1.17 L/day) to third parity (1.69 L/day).



3.2 Milk Composition

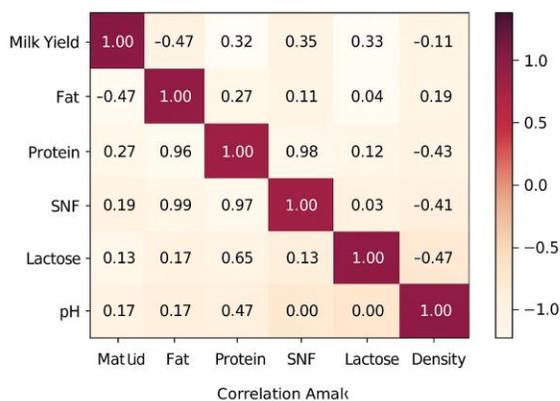
There were considerable differences ($p < 0.05$) in the composition of milk across the three locations. The average values in all the samples were: Fat: $3.87 \pm 0.16\%$; SNF: $8.34 \pm 0.31\%$; Lactose: $3.70 \pm 0.19\%$; Protein: $4.02 \pm 0.17\%$; pH: 6.55 ± 0.18 ; Density: 26.65 ± 2.11 .

Location-specific variations involved: Both highest fat and SNF: Kabal (3.94% fat; 8.45% SNF); Highest protein: Matta (4.21%).

3.3 Correlation Analysis

Heatmaps of correlations revealed the relationship between variables: milk yield and composition. The milk yield was negatively correlated with fat at all sites. Protein and SNF were positively correlated to milk yield although this was not always statistically significant. There was always and significant correlation between lactose and SNF and protein. pH was maintained quite constant and had low correlation with milk yield.

Figure 2. Goat milk yield correlation heatmap



4. Discussion

The yield of milk recorded in this experiment is in tandem with other native goat breeds that are reared in extensive systems [9,10]. The high-performance of goats in Matta tehsil is probably due to the increase in the availability of forage resources and supplementary feed [11]. The great impact of feeding system supports the fact that nutritional management plays an important role in enhancing milk productivity even in the traditional husbandry practices [12,13].

The values in Milk composition found in the present study are within the normal biological range of indigenous goats but they vary due to environmental factors, availability of feed, and genetic potentials [14,15].

Table 1. Descriptive statistic of milk composition in three tehsil of district Swat.

Parameters	Location 1(Kabal)	Location 2(Charbagh)	Location 3(Matta)	P.value
Fat %	3.94 ± 0.17	3.89 ± 0.17	3.74 ± 0.21	0.0001
SNF %	8.34 ± 0.23	8.41 ± 0.31	8.15 ± 0.33	0.0001
Density	26.94 ± 2.08	26.43 ± 2.60	26.56 ± 1.80	0.0631
Lactose %	3.69 ± 0.19	3.77 ± 0.13	3.63 ± 0.16	0.0001
Protein %	3.87 ± 0.18	3.96 ± 0.07	4.21 ± 0.22	0.0001
pH	6.6 ± 0.09	6.61 ± 0.06	6.41 ± 0.09	0.0723

The negative correlation between the fat percentage and the milk yield can be explained by the existing physiological trends, in which the larger the milk volume, the more likely it is that the fat concentration will be diluted [16,17]. It is indicated that the protein, lactose, and SNF are strongly positively correlated, and thus, they are interdependent to define the overall milk quality [3,18]. These results indicate that native goats in Swat have the stable milk composition properties with potential nutritional value even when they are managed using low inputs [19].

The fact that there are no significant differences between the milk pH and density between the locations implies that they are relative stable parameters of milk quality, which is supported by the literature that shows that these characteristics are not highly affected by the environment [3,20].

The correlation analysis also gave significant information on the relationship between milk yield and milk composition characteristics of indigenous goats reared within the traditional management systems in District Swat [3]. In all three sites, there was a negative relationship between milk yield and fat percentage, which suggests that the higher the volume of milk the do produced, the lower was the fat percentage [3, 5]. This negative correlation has been well reported in dairy animals and is explained by the dilution effect, with large-scale production of milk diluting

down the relative concentration of fat globules in the milk [3].

Protein, lactose, and solids-not-fat (SNF) on the other hand were found to be positively correlated with milk yield but the ratings and statistical significance varied across the three tehsils [3]. Such results suggest that goats with greater production also produce more milk and, may also preserve or even raise the levels of important nutritional elements. The positive correlation between lactose and SNF is not surprising since lactose is the major carbohydrate in the milk and a key factor that determines the osmotic pressure that affects the volume of milk [11]. On the same note, the high correlation between protein and SNF among locations shows the interdependence of the various components of milk that make up the total milk quality [3, 2].

Protein and SNF demonstrated high positive inter-correlations especially at Matta and Charbagh which imply that goats that have high levels of protein also have more milk that has a higher content of non-fat solids [3, 6]. These patterns are characteristic of native goats and they are a reflection on their natural stability in terms of milk composition even under low-input management regimes [3,12]. Fat on the other hand showed negative correlations with protein, SNF and density in most sites once again confirming the biological trade-off between milk volume and fat content [3].

There was a low level of correlation between milk pH and yield or other components, which is expected considering the stability pH has as a quality parameter in milk, and its insensitivity to short-term environmental or physiological variations [19, 20].

5. Conclusion

This experiment proves that there is a significant difference in the production and milk composition of native goats that are kept under conventional systems in District Swat. Matta Goats showed better milk production and more protein in the milk, probably because the animals were better fed and the environment was favorable. The location, type of feed and parity showed significant impact on milk yield and there was a significant difference in fat, protein, SNF and lactose among the tehsils. In general, the results indicate that the following is necessary: Better feeding policies. Selective breeding of native goats with good performance. Management intervention based on location. These measures will improve the quality and productivity of milk, which will eventually benefit the smallholder farmers and boost the economy of livestock.

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