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Baseline assessment of milk composition in indigenous Kanni Aadu goats under field conditions in Tamil Nadu

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Abstract
The present study was undertaken to evaluate the compositional and physicochemical properties of milk obtained from Kanni aadu goat reared under village conditions in the Tirunelveli region of Tamil Nadu. Totally, ten milk samples were collected from healthy lactating animals maintained under semi-intensive management. Samples were analyzed for crude protein, fat, lactose, ash, total solids, solids-not-fat, water content, density and titrable acidity using standard analytical procedures. The mean values recorded for crude protein, fat, lactose, ash, total solids, solids-not-fat, water content, density and acidity were 3.73±0.12%, 4.10±0.11%, 4.45±0.09%, 0.68±0.02%, 12.96±0.25%, 8.86±0.17%, 87.04±0.25%, 27.81±0.15 and 0.16±0.004% lactic acid, respectively. The results indicate that milk from Kanni aadu goats contains appreciable levels of essential nutrients and exhibits acceptable physicochemical characteristics. The findings highlight the nutritional significance of Kanni aadu goat milk and its potential contribution to rural food security.

Keywords: Kanni Aadu goat, goat milk, milk composition, physicochemical properties, indigenous breed

Introduction
Goat rearing plays a vital role in supporting rural livelihoods, especially in developing countries where small ruminants contribute substantially to household income and nutritional security. Generally, goats are often referred to as a “walking bank” or the “poor man’s cow” because they serve as an easily accessible financial resource for smallholder farmers. Goat milk is highly valued for its easy digestibility, balanced nutrient composition, and suitability for individuals with digestive sensitivity. The presence of smaller fat globules and a distinct protein profile enhances its digestibility when compared to milk from other dairy species.

India possesses a large population of indigenous goat breeds adapted to diverse environmental conditions. Tamil Nadu is home to several native breeds including Kanni, Salem Black and Kodi goats. The Kanni aadu goat is primarily distributed in the southern districts such as Tirunelveli, Thoothukudi and Ramanathapuram. Although the breed is mainly reared for meat production, milk obtained from these animals is commonly utilized for household consumption in rural areas.

The composition of goat milk varies depending on breed, feeding practices, stage of lactation and environmental factors. Understanding the compositional characteristics of milk from indigenous breeds is important for evaluating its nutritional value and suitability for processing. Information regarding milk composition of Kanni aadu goats under field conditions is limited. Therefore, the present study was conducted to assess the compositional and physicochemical characteristics of milk obtained from Kanni aadu goat reared in the Tirunelveli region of Tamil Nadu.

Materials and Methods
The study was carried out in villages of Tirunelveli district, Tamil Nadu, which constitutes the native breeding tract of Kanni aadu goats. A total of 10 milk samples were collected from healthy lactating Kanni aadu goats maintained under semi-intensive management conditions. Milk samples were collected hygienically during morning milking after discarding the initial foremilk. The samples were immediately transferred into sterile containers and transported to the laboratory under refrigerated conditions for further analysis.

The collected milk samples were analyzed for crude protein, fat, lactose, ash, total solids and solids-not-fat using standard analytical procedures recommended by AOAC (2005) [1]. Crude protein content was determined by the Kjeldahl method. Fat content was estimated using a Soxhlet apparatus following standard analytical techniques. Lactose, ash, total solids and solids-not-fat were determined using established laboratory procedures (AOAC, 2005) [1]. Milk density was measured using a lactometer, and titratable acidity was determined by standard titration method and expressed as percent lactic acid.

The data obtained were subjected to descriptive statistical analysis. Minimum, maximum, mean, standard deviation and standard error were calculated using standard statistical methods.

Results and Discussion

The compositional and physicochemical characteristics of milk from Kanni aadu goats are presented in Table 1. The results indicate that the milk contains appreciable levels of essential nutrients and falls within the normal compositional range reported for goat milk.

The crude protein content observed in the present study ranged from 3.18 to 4.20 percent, with a mean value of 3.73 ± 0.12 percent. Protein is a major nutritional component of milk and contributes to growth, tissue repair and immune function. The protein values recorded in this study are consistent with the range reported for goat milk by Jenness (1980) [6] and later confirmed by Park *et al.* (2007) [9]. More recent studies have also indicated that goat milk protein typically varies between 3.0 and 4.2 percent depending on breed, feeding system and lactation stage (Getaneh *et al.*, 2016; Kumar *et al.*, 2018) [4]. The observed protein levels therefore suggest good nutritive quality of Kanni aadu goat milk.

Milk fat content ranged from 3.56 to 4.56 percent, with an average value of 4.10 ± 0.11 percent. Milk fat is an important source of energy and contributes to flavor, texture and processing suitability of dairy products. The values obtained in this study fall within the normal range reported for indigenous goat breeds. Park *et al.* (2007) [9] reported fat content between 3.0 and 6.0 percent in goat milk, while Haenlein (2004) [5] highlighted that breed and feeding conditions strongly influence fat levels. Recent findings by Lad *et al.* (2017) [7] and El-Hatchimi *et al.* (2020) [3] also reported similar fat values in local goat breeds, indicating that the present findings are comparable with contemporary observations.

The lactose content ranged from 4.10 to 4.91 percent, with a mean of 4.45 ± 0.09 percent. Lactose serves as the principal carbohydrate in milk and plays a crucial role in energy supply and mineral absorption. The lactose values observed in this study are consistent with earlier reports by Parkash and Jenness (1968) [10] and Park *et al.* (2007) [9]. Recent reports by Ranadheera *et al.* (2019) [11] further indicated that lactose concentration in goat milk generally remains stable and varies within a narrow range of 4.1 to 4.8 percent, which aligns well with the present observations.

Ash content, representing the mineral fraction of milk, ranged from 0.58 to 0.76 percent, with an average value of 0.68 ± 0.02 percent. Milk minerals are essential for skeletal development, enzymatic reactions and metabolic functions. The ash values recorded in the present study are comparable to those reported by Haenlein (2004) [5] and Getaneh *et al.* (2016) [4]. Similar mineral content in indigenous goat milk has also been reported in recent studies by Kumar *et al.* (2018), indicating that Kanni aadu goat milk provides adequate mineral nutrition.

Table 1: Mean (± SE) Composition and Nutritive Value of Kanni Aadu Goat Milk

Constituents	Minimum	Maximum	Mean	Standard Deviation	Standard Error
Crude Protein (%)	3.18	4.20	3.73	0.36	0.12
Fat (%)	3.56	4.56	4.10	0.33	0.11
Lactose (%)	4.10	4.91	4.45	0.26	0.09
Ash (%)	0.58	0.76	0.68	0.06	0.02
Total Solids (%)	12.10	13.98	12.96	0.76	0.25
Solids Not Fat (%)	8.00	9.45	8.86	0.52	0.17
Water (%)	86.02	87.90	87.04	0.76	0.25
Density	27.01	28.45	27.81	0.44	0.15
Acidity (LA)	0.14	0.18	0.16	0.01	0.004

The total solids content ranged from 12.10 to 13.98 percent, with a mean value of 12.96 ± 0.25 percent, whereas solids-not-fat averaged 8.86 ± 0.17 percent. Total solids and solids-not-fat are important indicators of milk quality and processing suitability. The values observed in the present study are in agreement with those reported by Park *et al.* (2007) [9] and El-Hatchimi *et al.* (2020) [3]. Variations in these parameters may be influenced by feeding regime, stage of lactation and environmental factors (Getaneh *et al.*, 2016) [4].

The water content averaged 87.04 ± 0.25 percent, which is within the expected range for goat milk. Density and titratable acidity values were recorded as 27.81 ± 0.15 and 0.16 ± 0.004 percent lactic acid, respectively. These values indicate that the milk samples were fresh and of acceptable quality. Titratable acidity is widely used as an indicator of milk freshness and microbial stability, and the values recorded in the present study are consistent with those reported for normal goat milk (Haenlein, 2004; Ranadheera *et al.*, 2019) [5, 11].

The variations observed among milk samples may be attributed to differences in feeding practices, stage of lactation, environmental conditions and genetic factors (Loewenstein, 1982; Kumar *et al.*, 2018) [8]. Overall, the results suggest that milk from Kanni aadu goats possesses desirable nutritional and physicochemical properties and can serve as a valuable dietary source.

Conclusion

The present study evaluated the composition and physicochemical properties of milk obtained from Kanni aadu goat reared in the Tirunelveli region of Tamil Nadu. The results revealed that Kanni aadu goat milk contains appreciable levels of protein, fat, lactose and minerals. The observed values for total solids and solids-not-fat indicate good nutritive quality. The findings suggest that milk from Kanni aadu goats can serve as a valuable nutritional source for rural populations. The information generated in this study provides baseline data on milk composition of Kanni aadu goat breed and highlights its potential for utilization in dairy processing and value-added product development.

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