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Physicochemical and biofunctional characterization of Malabari goat milk

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Abstract

Goat milk, renowned for its high nutritional value, digestibility, and distinct medicinal and dietary benefits, holds great promise as a functional food. However, the potential of milk from indigenous goat breeds remains underexplored. This study focuses on the physicochemical properties and biofunctional activities of Malabari goat milk, derived from a native breed of Kerala. Analysis of fresh Malabari goat milk revealed a composition of 14.24% total solids, 5.73% fat, 4.20% protein, 4.39% lactose, 0.76% ash, a pH of 6.43, and 0.17% lactic acid. Biofunctional assays demonstrated that the milk exhibited a radical scavenging activity of 45.55% and ACE inhibition of 27.18%. However, it showed no antibacterial activity. These findings underscore the significant biofunctional properties of Malabari goat milk, suggesting its potential health benefits and reinforcing the need for further research into its applications.

Keywords: Goat milk, Malabari goat, indigenous goat breeds, DPPH, ACE

Introduction

Malabari goat, one of the indigenous goat breeds of Kerala, inhabit mainly Malappuram, Calicut, Kannur, and Wayanad districts of Kerala. The term Malabari (Telicherry) comes from Telicherry, which is now Thalassery, on the Malabar coast in the Kannur district, where they originally came from and where they are still found today. They are medium-sized to small animals with a range of coat colours, including black, white, and admixtures. Even though they produce milk they are mainly reared for meat production. This minor goat breeds milk needs further exploitation.

In India, the goat is referred to as the "poor man's cow" due to its considerable economic impact on the poor. According to 20th livestock statistics, there were 148.88 million goats, an increase of 10.1% since the last census (Livestock census, 2019) ^[10]. Goat milk has unique biological properties that set it apart from cow or human milk, including high buffering capacity, distinct alkalinity (Park *et al.*, 2007) ^[13], high digestibility due to the smaller size of its fat globules (about 3.49 μ m), and higher amounts of medium and short chain fatty acids (caproic, caprylic, and capric acid), which have been linked to a reduction in cholesterol in human tissues by preventing cholesterol synthesis and enhancing its molecular transport (Fahmi *et al.*, 1956) ^[8]. Additionally, compared to cow milk, goat milk proteins are easier to digest and absorb amino acids more effectively (Park, 2009) ^[12]. Medically, when human milk is insufficient, goat milk is advised for new-borns (Carver, 2003) ^[4].

There is little information available in literature regarding Malabari goat milk. Therefore, the present study is aimed to find out the milk Composition and biofunctional activities of Malabari goat milk.

2. Materials and Methods

2.1 Milk sample

Fresh pooled goat milk sample was collected from Government Goat Farm, Parassala, Trivandrum, Kerala. The farm maintains the pure Malabari goat breed (fig 1). Pooled milk was immediately transported to the laboratory.

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Fig 1: Malabari goats maintained at government goat farm, Trivandrum

2.2 Milk composition analysis

Acidity, Total solids, Lactose, and ash content were determined according to Association of Analytical Communities (AOAC, 2007) [2]. Milk fat content was determined by Gerber method. The pH of milk was recorded using a digital pH meter at 25 °C. The total protein content of the milk was determined by Kjeldahl method. The percent of true protein was estimated by multiplying the nitrogen content by 6.38.

2.3 Analysis of bio-functional properties

2.3.1 Antioxidant Activity (DPPH)

The free radical scavenging activity of milk samples was measured by the DPPH method with a slight modification (Zou *et al.*, 2014; Guravaiah, 2018) [18, 9].

2.3.2 Antibacterial activity

An agar well diffusion assay was performed to assess the inhibitory activity of skim milk against target strains (*Bacillus cereus*, *Escherichia coli*, *Salmonella typhimurium*, and *Staphylococcus aureus*) as described by Vieira *et al.* (2014) [17] with some modifications.

2.3.3 Anti-hypertensive activity

The samples were evaluated for the presence of Angiotensin-Converting Enzyme (ACE) inhibitory activity. The assay of ACE-inhibitory activity is based on the liberation of hippuric acid from hippuryl-L-histidyl-L-leucine (HHL) catalyzed by ACE and measured by the method of Cushman and Cheung (1971) [5].

2.4 Statistical analysis

All experiments were carried out in triplicates and the mean values were tabulated (SPSS 29 static analysis, IBM).

3. Results and Discussion

The physicochemical analysis of fresh Malabari goat milk revealed significant nutritional characteristics, as summarized in Table 1. The total solids content was found to be 14.24%, consistent with the findings of Singh and Sengar (1970) [19] for indigenous goat breeds. The fat and protein contents averaged 5.73% and 4.20%, respectively, which are typically higher than those reported for standard goat milk. This higher content can be explained by the findings of Park *et al.* (2007) [13] on indigenous goat breeds. The lactose content was approximately 4.39%, aligning with the studies of Drackova *et al.* (2008) [6], Soliman (2005) [16], and Mahmood and Usman (2010) [11]. The ash content was 0.76%, closely matching the 0.75% reported by Mahmood and Usman (2010) [11]. Titratable acidity and pH were measured at 0.174% lactic acid and 6.43, respectively,

which are in agreement with the findings of Elbagermi *et al.* (2014) [7] and Sawaya *et al.* (1984) [15]. The lower pH and higher acidity of goat milk are primarily attributed to the presence of casein, lactate, phosphate, and citrate.

Table 1: Physicochemical properties of Malabari goat milk

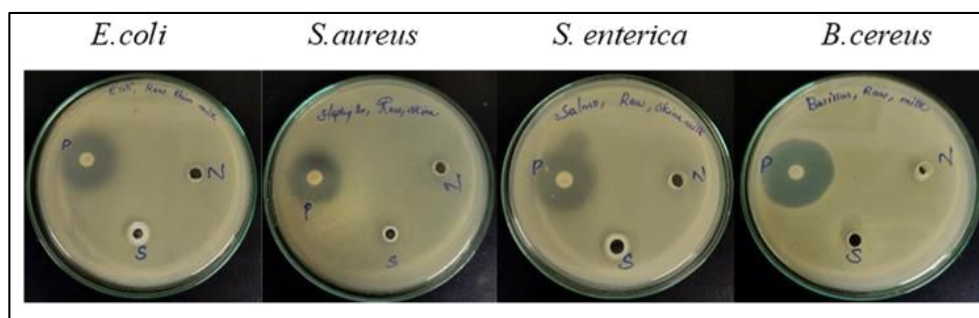
Property	Mean (%)	Standard deviation
Total solids	14.25	0.316
Fat	5.73	0.503
Protein	4.20	0.240
Lactose	4.39	0.416
Ash	0.76	0.015
pH	6.43	0.288
Titrateable acidity (% lactic acid)	0.17	0.047

Figures are mean ± standard deviation of triplicate analysis.

The antioxidant activity of the milk samples was determined by the DPPH assay and the percent radical scavenging activity of fresh Malabari goat milk was found to be 45.55%. Goat milk has proven antioxidant potential. The antioxidant potential of whole boiled Gaddi goat milk was reported by Preeti (2018) [14] as 35.15% RSA. Alyaqoubi *et al.* (2014) [1] studied the antioxidant activity of fresh Jamnapari goat milk samples from different locations and reported 56%, 62%, and 67% RSA. Obtained results were higher than the report by Preeti (2018) [14] and lower than the findings of Alyaqoubi *et al.* (2014) [1]. This is clearly due to breed variation. The natural antioxidants present in milk, such as α -tocopherol, carotenoids, conjugated linoleic acid, casein, and lactoferrin found in whey, contribute to its antioxidant activity (Calligaris *et al.*, 2004) [3].

The existence of ACE (Angiotensin converting enzyme) inhibitory activity in the samples was examined. The Cushman (1971) [5] method is used to test the ACE inhibitory activity based on the liberation of hippuric acid from hippuryl-L-histidyl L-leucine (HHL), which is catalyzed by ACE. Antihypertensive activity in terms of ACE inhibitory activity was found to be 27.18%. The available literature data regarding goat milk antihypertensive activity couldn't be compared with the obtained results as most of them are actually inhibitory activity after either enzymatic hydrolysis or fermentation.

Antimicrobial activity was tested using the skimmed portion of the milk. Skim milk was prepared by centrifugation at 5000g for 30 min at 5 °C which defatted the milk. It was then tested for antibacterial activity against four identified pathogens (*B. cereus* ATCC 10876, *E. coli* NCIM 2685, *S. enterica* ATCC 6017, and *S. aureus* ATCC 25923). However skim milk portion of fresh Malabari goat milk didn't exhibit antimicrobial activity against any of the tested pathogens.



(P-positive control, N-negative control, S-sample)

Fig 2: Antibacterial activity of the skimmed Malabari Goat milk

Conclusion

Goat milk has unique biological properties that set it apart from cow or human milk, including high buffering capacity, distinct alkalinity, high digestibility due to the smaller size of its fat globules, and higher amounts of medium and short chain fatty acids. In the present study milk of one of the indigenous goat breeds of Kerala was explored. The physicochemical analysis of fresh Malabari goat milk demonstrated its significant nutritional value with a total solids content of 14.24%, and higher fat and protein levels compared to standard goat milk. The antioxidant activity of the milk, as measured by the DPPH assay, showed a radical scavenging activity of 45.55%, indicating substantial antioxidant potential, though slightly lower compared to some other goat breeds. The ACE inhibitory activity of 27.18% suggests potential antihypertensive benefits. Despite its notable biofunctional properties, the fresh Malabari goat milk did not exhibit antimicrobial activity against the tested pathogens. This lack of antibacterial activity contrasts with some findings from other studies and suggests that further investigation is needed to explore the broader potential health benefits of Malabari goat milk. Overall, the study highlights the promising functional attributes of Malabari goat milk and underscores the need for continued research into its diverse applications in nutrition and health.

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