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The Significance of Sheep Milk: Understanding Its Importance

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1.0 Introduction:

That's an interesting point about the potential benefits of milk and dairy products from small ruminants like sheep, especially in light of the increasing trend of people avoiding red meat for health reasons. It's notable that India has a significant population of sheep, yet their milk yield potential remains largely untapped. Exploiting the milk yield potential of sheep could offer several advantages, including providing a source of dairy for those who may be avoiding other types of meat, and potentially offering unique bioactive components due to the diet of these animals, which primarily consists of greens. Efforts to further research and develop the dairy industry related to small ruminants in India could have positive implications for both public health and the agricultural sector. It could also contribute to food security and economic development, particularly in rural areas where sheep farming is common (Mohapatra *et al*., 2019).

Sheep rearing in developing countries primarily focuses on livelihood security, with sheep valued for meat and wool rather than milk. Despite significant sheep populations, demand for sheep milk is minimal in these regions. India ranks third globally in sheep population, but most sheep are raised for meat and wool purposes, leading to negligible contribution to global milk production. Milking sheep in developing countries is a relatively new concept, but sheep milk formulations are expected to provide significant health benefits in the era of functional foods. Small ruminant milk and products, particularly for infants, are considered medicinal necessities, supported by anecdotal experiences highlighting the medical importance of sheep milk (Haenlein, 2001).

For many small and marginal farmers, sheep rearing is not just a livelihood but a way of life that has been passed down through generations. The positive effects of sheep milk on various aspects of human health, such as bone growth, skin health, cardiovascular health and more, highlight its potential as a valuable resource that deserves further exploration and promotion (Mohapatra *et al*., 2019).

2.0 Physico-Chemical Properties of Sheep Milk:

Comparing the milk of horses, donkeys and sheep with human milk, researchers concluded that sheep milk could serve as a viable alternative to both breast milk and infant formula. Today, there is a global surge in interest to uncover the lesser-known aspects of sheep milk. Access to information on its composition, physicochemical characteristics and nutritional aspects is crucial for generating consumer demand, product development and effective marketing strategies (Claeys *et al*., 2014). Ewes' milk is rich in proteins (28%), minerals and lipids and its composition is close to that of Buffalo milk; the caseins include slight differences in amino-acid sequence. The milk contains more calcium, phosphate and magnesium and the lipid fraction contains higher proportions of middle-chain fatty acids. Due to its richness, ewes' milk gives a high cheese-making yield (Faye and Konuspayeva, 2012).

Calcium might aid in lipid metabolism. Notably, while cow milk is a prominent calcium source, sheep milk possesses an even higher calcium concentration. Recent analysis reveals calcium levels of 182, 130, 120, 93, and 28 mg/dL in sheep, goat, cow, mare and human milk, respectively. Lactose content in sheep milk is 0.3 mg/100 mL. Additionally, sheep milk contains a significant amount of whey protein (approximately 10.6 g/L) and unmatched levels of

arginine, leucine and phenylalanine. Sheep milk exhibits the highest total carnitine content (943 µmol/L), followed by cow (169 µmol/L), goat (136 µmol/L), mare (75 µmol/L), and human (65 µmol/L) milk. Taurine concentration in sheep milk (140 µmol/L) is closest to that of human milk (300 µmol/L), surpassing mare (30 µmol/L) and cow (10 µmol/L) milk. Consequently, these in vitro analyses suggest a favorable composition of sheep milk for the postprandial absorption and disposal of lipids toward oxidative pathways. However, longer-term randomized controlled trials (RCTs) are necessary to validate any benefits from consuming these milk-derived compounds (Penhaligan *et al*., 2022)

There are distinct differences in physico-chemical characteristics of goat, sheep and cow milk. Sheep milk has higher specific gravity, viscosity, titratable acidity, refractive index and lower freezing point than cow milk (Haenlein and Wendorff, 2006). The higher viscosity of sheep milk is due to the differences in total solid content of the milk, which caused a significant effect on the firmness of yogurt curd (Jumah *et al*., 2001).

2.1 Energy Content

Sheep milk boasts a high energy value of 5932 kJ/kg (Park, 2007a), surpassing that of cow, buffalo, camel, goat, and human milk, which range from 3169 to 3730 kJ/kg (Barłowska, 2007), 3450 kJ/kg (Kanwal *et al*., 2004), 3283 kJ/kg (Shamsia, 2009), 3018 kJ/kg (Park, 2007) and 2407 kJ/kg (Shamsia, 2009), respectively. Donkey milk, on the other hand, exhibits the lowest energy value, ranging from -1842 to 2051 kJ/kg (Guo *et al*., 2007).

3.0 Significance of Sheep Milk:

Sheep milk's elevated levels of protein, fat and calcium per casein unit lead to a greater cheese yield per liter of milk (Mohapatra *et al*., 2019). Compared to cow milk, the casein micelles in sheep milk boast a higher calcium content, eliminating the need for supplemental calcium chloride (CaCl2) in sheep cheese production. Additionally, sheep milk requires less rennet or chymosin to achieve satisfactory curd formation, without experiencing impaired rennet coagulation rates or diminished gel firmness (Balthazar *et al*., 2017).

Several studies have illustrated that ovine cheese provides an optimal matrix for delivering probiotics, ensuring their enhanced survival both during cold storage and gastrointestinal digestion. For instance, in an Argentinean semi-hard ovine cheese, a probiotic blend comprising *Lactobacillus acidophilus* LA-5 and *Bifidobacterium animalis* ssp. *lactis* BB-12 consistently maintained survival rates well above 7 log cfu/g throughout storage (Perotti *et al*., 2014).

Probiotics in ovine cheese enhance starter bacteria growth, improve rheological features and boost proteolysis and lipolytic activities, yielding health-promoting substances. Pecorino cheeses, made from heat-treated ewe's milk using traditional lamb rennet paste (LRP) or LRP containing specific probiotics. Cheese containing *Lactobacillus acidophilus* LA-5 or a mix of *Bifidobacterium lactis* BB-12 and *Bifidobacterium longum* BB-46 showed significantly higher levels of free amino acids compared to traditional cheese. Addition of probiotics increased lipolytic activity, with the highest content of health-promoting molecules observed in cheese containing *Lactobacillus acidophilus*. Probiotic cheeses-maintained preference and acceptability, receiving higher preference scores than traditional cheese (Albenzio *et al*., 2010).

4.0 Sheep Milk Holds Significant Value for Various Reasons:

1. **Nutritional Density**: It contains higher concentrations of protein, fat, and calcium per casein unit compared to other types of milk, leading to its use in cheese production and its potential health benefits.
2. **Cheese Production**: Its unique composition results in a higher cheese yield per liter of milk, making it economically valuable for cheese makers.
3. **Probiotic Delivery**: Studies suggest that sheep milk may serve as an excellent matrix for delivering probiotics, with enhanced survivability during storage and digestion.
4. **Health Benefits:** Sheep milk's composition and bioactive compounds may offer health benefits, such as promoting gut health, supporting bone health due to its calcium content, and potentially aiding in weight management.
5. **Cultural Significance:** In regions where sheep farming is prominent, such as Mediterranean countries, sheep milk holds cultural significance, being used in traditional dishes and cuisines.

6. **Economic Importance:** Sheep milk production contributes to rural economies, providing livelihoods for farmers and supporting local industries, particularly in regions where sheep farming is a major agricultural activity.

Overall, sheep milk's nutritional, culinary and economic significance underscores its importance in various aspects of agriculture, food production and human nutrition.

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