NEPALESE JOURNAL OF AGRICULTURAL SCIENCES,
January, 2026, volume 30
e-ISSN: 2091-0428; p-ISSN 2091-041X; esjindex ID =6279

Study on the Effect of Breeds on Physiochemical Parameters of Goat Milk at National Goat Research Program, Bandipur Tanahun Nepal

Maheshwar DAHAL[1], Raju KADEL[2], Shivahari GHIMIRE[3] and Buddhi Ram ACHARYA[2]

[1]Nepal Agricultural Research Council, Livestock and Fisheries Research, Kathmandu
[2]National Goat Research Program, Bandipur, Tanahun
[3]National Cattle Research Program, Rampur, Chitwan
Corresponding Author's Email: dr.maheshwardahal@gmail.com

ABSTRACT

This study analyzed breed-specific variations in milk composition among pure Saanen, pure Boer, and pure Khari goats at National Goat Research Program in Bandipur, Tanahun between March and May, 2018. Using a milk analyzer, we evaluated 96 Saanen, 12 Boer, and 12 Khari milk samples for protein, fat, SNF, lactose, and freezing point. Statistical analysis was performed using SPSS software with mean comparisons at a 0.01 significance level. The results revealed no significant differences ($p>0.01$) among the breeds for protein, lactose, SNF, and freezing point values. However, pure Boer goats showed significantly higher fat content (7.96±0.48%) compared to both Saanen and Khari breeds ($p<0.01$), while no significant difference was observed in fat level between Saanen and Khari goat milk. Despite Boer goats having the highest fat percentage, their low milk yield makes them less suitable for dairy product manufacturing, particularly for cheese production. The comparative analysis demonstrated that Saanen goats possess superior milk production characteristics compared to both Khari and Boer breeds. Saanen is recommended as the most appropriate breed for commercial dairy processing in Nepal due to its balanced milk composition and better production performance.

Key words: Genetic group, goats, milk, production parameter

INTRODUCTION

Asia is often regarded as the global hub of goat farming, holding 60% of the world's one billion goats. Most of these goats including dairy breeds are raised by small-scale farmers, many of whom have poor resource and landless. Goat milk plays a vital role in underdeveloped nations, serving as a key source of nutrition and livelihood for rural

populations (Park, 2007). In terms of total production, Asia and Africa outpace the Mediterranean region in goat milk output. Globally, non-bovine milk accounts for over 17% of total milk production, yielding approximately 133 million tons annually. Within this, goat milk contributes around 12.2 million metric tons about 2% of the world's milk supply (Yadav, 2016). Although Asia lacks the structured marketing and distribution systems found in Europe, it leads in both production (52%) and consumption of goat milk. The top Asian producers are India, Bangladesh, and Pakistan, while Sudan, South Sudan, and Somalia dominate in Africa. In Europe, the leading producers are France, Spain, and Greece (FAO,1997). Dairy goat farming is becoming increasingly popular in Nepal due to the country's favorable geographical and economic conditions. Goat milk plays a crucial role in combating malnutrition, particularly in rural communities. Recently, it has also been recognized for its potential in dengue disease prevention and management. In many Nepalese villages, goat milk is primarily fed to children rather than sold commercially. Beyond its nutritional benefits, goat milk is valued for its medicinal properties, aiding in the management of diabetes, dengue fever, ulcers, and skin allergies. Nutritionally, goat milk is comparable to cow milk, offering similar levels of protein, fat, and other key nutrients. However, it has distinct advantage, smaller fat globules make it easier to digest, and it is less likely to cause allergic reactions compared to milk from other livestock. Despite these benefits, goat milk accounts for only about 2% of the world's total milk production (FAO, 1997). In terms of mineral content, goat milk contains slightly higher levels of calcium, phosphorus, and chlorine than cow milk. However, it has a lower iron content (Banerjee, G.C., 2008, Eighth Edition). These nutritional characteristics make goat milk a valuable dietary component, particularly for individuals with digestive sensitivities or specific health needs.

In Nepal, only a small number of farmers commercially produce goat milk, while most raise goats primarily to feed their kids. Indigenous breeds yield very little milk and their lactation periods are short, barely meeting the nutritional needs of their offspring. Saanen and crossbred goats produce significantly higher milk volumes. While a few Nepalese farmers keep pure Saanen goats, the majority raise local or crossbreds. Only government institutions maintain pure Saanen breeds for breeding or research purposes. National Goat Research Program Bandipur and Goat Development Farm Chitlang, Makwanpur Nepal raising goats for research and making cheese. Indigenous goats showed very high levels of milk fat and protein, whereas Saanen goats showed much lower levels. In National Goat research program, Bandipur now a days started to produce goat cheese. It is organic, which is attractive to consumers. Many consumers around Gandaki province they buy goat cheese regularly and others too. They also make soap from the Saanen goat milk including other ingredients. A human infant fed solely on goat milk is oversupplied with protein, Ca, P, vitamin A, B1, B2, niacin, pantothenic acid, while

deficient in iron, vitamin B6, B12, C, D, and folic acid (Jenness, 1980). Goats are important for both commercial and subsistence types of farming systems in Nepal. Commercial farmer's rears goats primarily for meat production and subsistence farmers use them as a source of meat and milk, as well as cash for other expenses (Casey and Van Niekerk, 1988).

Breed description

A. Boer Goat

The Boer goat (*Capra hircus*), found in South Africa, consists of a mixture of blood from various goats. The fact that the Boer goat is generally farmed with under extension conditions in South Africa, this breed is capable of producing offspring with exceptional growth rates. The average 100-day weights of performance Boer goat kids were 25.3 kg for male, and 22.3 kg for female kids. During 1996, these goats were 26.9 and 23.4 kg, respectively (Campbell, 1998). Having established the fact that high fecundity is one of the Boer goat's strongest attributes, the conclusion may be drawn that milk production of the doe during the preweaning stage is of most importance to enable high growth rates of kids, especially in having multiple births. It has been reported that the extent of mammary development in milch goats depends on, amongst others, the number of fetal placental units and placental weight (Hayden et al., 1979).

In Nepal, a more recent initiative, the Agriculture and Food Security Project (ASFP) imported purebred Boer bucks and does from Australia in the fiscal year 2014/015. Prior to this, some private farmers had already introduced Boer bucks independently. Subsequently, the *Kisanko Lagi Unnat Biubijan Karyakram (KUBK)* program facilitated the large-scale importation of purebred Boer bucks and does. After their arrival, these goats were distributed to establish community managed Boer breeding nucleus herds in Gwadi (Gulmi) and Dibarna (Arghakhanchi). Some bucks were provided to the National Goat Research Program (NGRP) in Bandipur to form a government managed Boer nucleus herd. These nucleus herds produce purebred Boer goats, which are then supplied to multiplier herds across various project districts. The NGRP also distributes breeding bucks to commercial farmers to enhance meat goat production. Today, Boer goat meat is increasingly available in markets, and Boer bucks have gained popularity among farmers for breeding purposes at the farmers field level.

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B. Saanen Goat

The Saanen breed originates from Switzerland, from the Saanen Valley, where the annual average temperatures are 9.5° C (Silva et al. 2017). Saanen does are heavy milk producers and usually yield between 3% and 4% fat. The Saanen is a typical dairy type goat; it has a dished or straight facial line and a wedge-shaped body. Saanens are of medium height when compared with the other Alpine breeds in Australia. Does weigh at least 64 kg. Saanen goats are large in size with straight nose and erect ears pointed forward and upward. The body has good dairy conformation and the udder is well developed. It is known as the milk queen of the goat world. Goat have straight and curved sharp horn. Average height of male is 75 cm and female 90 cm. The breed is sensitive to excessive sunlight and performs best in cooler conditions. Saanen goat which is the most commonly used breed in goat breeding studies possesses 800-1000 kg milk yield with 3-4% fat content, 250-300 days of lactation period 1.80- 1.90 kidding rate and 55-60 kg live weight. Saanen is probably the most developed dairy breed. The milk production performance of the Saanen goat breed was superior to that of crossbred and local goat.

In Nepal, according to Mr. Dala Ram Pradhan, former manager of Goat Development Farm in Chitlang, Makwanpur, first purebred Saanen goats were introduced in 1971 through Israeli government. About 20 Saanens were initially brought to the Livestock Development Unit in Khumaltar, Lalitpur, and then transferred in 1972 to Goat Development Farm in Chitlang for research and breeding purposes. In a more recent initiative, the Agriculture and Food Security Project (ASFP) imported purebred males and does from the United States of America in the fiscal year 2014. These goats formed a nucleus herd at the National Goat Research Program in Bandipur, NARC. Under this project, 15 males and 20 does were allocated for research activities. Also, seven breeding goats were distributed to various locations in Dadeldhura district, while three were maintained at the National Animal Breeding office (NLBO) in Pokhara for semen collection and breeding programs. The purebred Saanen goats developed at the NGRP, Bandipur have been distributed to multiple districts, including Makwanpur, Tanahun, Kaski, Lamjung, and Syangja. These goats are being crossbred with local breeds to produce different blood level crossbreds, enhancing goat productivity in Nepal (Saanen Booklet, GRS, 2018).

C. Khari Goat

Khari is the principal goat breed of Nepal found across the country. They represent 56% of the total goat population in the country (Kharel & Neopane 1998). Having twinning kids are common on Khari as compared to other Nepali breed. The litter size of Khari

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goat at birth is 1.6 and the kidding interval is substantially shorter than one year. They attain sexually maturity at an age of 7 to 10 month and produce the first progeny at an age of 12 to 17 years (Gorkhali et al, 2022). The weight is 16-20 kg in a year. Breeds are variations in weight and coat color. They are Seti (Pure white), kali (Pure black), Khairi (brown), Ghorli (brown to white and other color patches), Shingari (black with white stripes on face) and Dhobini (ash colour) (Kharel & Neopane 1998). Body length 63.1±0.39 cm, heart girth 65.5 ±0.37cm and weither height is 55.9±0.28 cm respectively. There population is normal in size. They have been characterized at phenotypic and chromosomal level (Annual Report, ABD 2003). Age at first service is in 311±5.6, weight at first service 15.4 ± 0.22 kg, Age at first kidding 453±6.2, kidding intervals 302±3.7, litter size at birth 3.38±0.06 kg and gestation length 144.8±0.15 days (Gorkhali et al, 2021).

MATERIALS AND METHODS

A total of 120 milk samples were collected over a three-month study period, including 96 samples from Saanen goats, 12 from pure Boer goats, and 12 from pure Khari goats. All goat milk samples were collected once daily during the morning milking time. Goats' udders were washed with clean water and allowed to dry before collection. Milk samples were obtained from two different farms of National Goat Research Program (NGRP) at the Chhap site. Each sample, consisting of 15 ml of milk, was collected daily in clean, sterile plastic bottles. After collection, samples were stored in the NGRP laboratory at a temperature of 2-8°C and analyzed within 1-2 hours. Before analysis, each sample was stirred gently for more than 5 minutes using vertical and circular slow movements to ensure uniformity. Physiochemical analysis was conducted using a milk analyzer. Statistical analysis of the data was performed using the Kruskal-Wallis test in SPSS software.

RESULTS AND SIACUSSION

A. Fat content

The analysis revealed significant variations in fat content among different goat breeds. Pure Saanen milk showed an average fat content of 3.13±0.22%, while Pure Khari milk contained 4.53±0.49% fat. Pure Boer milk showed substantially higher fat levels at 7.96±0.48%, significantly exceeding the values observed in the other two breeds.

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Table 1. Fat value of milk samples collected from different pure goat breeds.

S.N.	Breed	Mean ±SEM	p-value
1	Pure Saanen	3.13±0.22	**0**
2	Pure Khari	4.53±0.49	
3	Pure Boer	7.96±0.48	

B. Protein

Protein content was found in the range 2.71±0.024 % in Pure Saanen milk, 2.79±0.06% in pure Khari and 2.72±0.06 % in Pure Boer (Table 2). There was non-significant difference between the amount of protein content and milk of different goat breed. The amount of protein content in Pure Saanen, Pure Khari and Pure Boer milk was nearly similar.

Table 2. Protein value of milk samples collected from different pure goat breeds.

SN	Breed	Mean ±SEM	p-value
1	Pure Saanen	2.71±0.024	0.544
2	Pure Khari	2.79±0.06	
3	Pure Boer	2.72±0.06	

C. Lactose

Lactose content was found in the range of 3.84±0.035 % in Pure Saanen, 3.86±0.12 % in Pure Khari and Pure Boer milk 3.85±0.09 %. There was non -significant ($p>0.05$) difference between the amount of lactose content of different goat breeds. The amount of lactose content in Pure Saanen, Pure Khari and Pure Boer milk was nearly similar.

Table 3. Lactose value of milk samples collected from different pure breeds.

SN	Breed	Mean± SEM	P-Value
1.	Pure Saanen	3.84 ± 0.035	0.978
2.	Pure Khari	3.86 ±0.12	
3.	Pure Boer	3.85 ± 0.09	

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D. SNF (Solid not Fat)

SNF content was found in the range of 7.28±0.065 % in Pure Saanen milk, Pure Khari 7.48±0.17 and Pure Boer 7.27±0.20. There was non-significant ($p>0.05$) difference between the amount SNF is higher in Pure Khari and similar of Pure Saanen and Pure Boer.

Table 4. SNF value of milk samples collected from different pure goat breeds.

S.N.	Breed	Mean ±SEM	p
1	Pure Saanen	7.28±0.065	0.58
2	Pure Khari	7.48±0.17	
3	Pure Boer	7.27±0.20	

E. Freezing Point

Freezing Point values was found in the range 0.56±0.09 where as Pure Khari was 0.48±0.013 and Pure Boer was 0.49±0.010, shown in Table 5.

Table 5. The freezing point values of milk samples collected from different breeds of goats.

SN	Breed	Mean ±SEM	p-value
1	Pure Saanen	0.56±0.09	0.93
2	Pure Khari	0.48±0.013	
3	Pure Boer	0.49±0.010	

The significant variations in milk fat content among the studied goat breeds (Saanen: 3.13±0.22%; Khari: 4.53±0.49%; Boer: 7.96±0.48%) align with existing research on breed-specific milk composition. Our findings support the work of Park et al, 2007, who reported that fat content in goat milk varies substantially by breed, ranging from 2.5% to 7.0% across different genetic lines. The exceptionally high fat content in Pure Boer milk (7.96%) corresponds with findings by Mestawet et al, 2012, who noted that Boer goats, being a meat-purpose breed, typically produce milk with higher fat percentages compared to dairy breeds like Saanen. Protein content in goat milk was higher than that reported by Kholif et al,1994.

The fat content was highest in the third parity followed by the second parity and least in the first parity, wet season had higher fat content than dry season. Park et al, 2007 reported that lactose typically ranges between 3.8- 4.1% in goat milk, serving as the

primary osmotic regulator in mammary secretions, which explains its consistent levels across breeds. Pandya & Ghodke 2007, who reported that SNF content in goat milk typically ranges between 7.0 - 9.5%, varying slightly depending on breed and management factors. Similarly, Park et al, 2007 noted that genetic differences among goat breeds could lead to minor variations in SNF, though environmental and nutritional factors often play a more dominant role. In contrast, Kholif et al, 2016 observed lower SNF values (6.8- 7.2%) in some goat breeds, possibly due to differences in feeding regimes or regional conditions. The relatively higher SNF content in pure Khari milk in the present study could be attributed to its adaptation to local climatic conditions, which may influence milk composition. Further research is needed to assess the impact of diet, lactation stage, and agroecological factors on SNF variability in these breeds.

CONCLUSION

This study showed there were variations in the physio-chemical composition of milk depending on the goat breed, which ultimately affects the quality of different milk products. The composition among Saanen, Khari, and Boer goat milks, with Boer milk showing significantly higher fat content compared to Khari and Saanen. Protein content remained relatively consistent across breeds suggesting minimal genetic influence on this component. Lactose levels showed remarkable constancy confirming its role as a physiologically regulated constituent in caprine milk. The SNF content followed a pattern similar to fat, with Khari milk containing slightly higher amounts than Saanen and Boer. These findings highlight how breed-specific genetic selection has differentially affected milk composition, with dairy breeds (Saanen). Further research with larger sample sizes for each group and expanded breed comparisons is recommended to validate these findings, better assess breed-specific performance traits and also aware the Nepalese farmers to consume goat milk and milk products.

ACKNOWLEDGEMENTS

We sincerely thank the staffs of National Goat Research Program in Bandipur, Tanahun, for their technical support. We extend our special gratitude to Mr. Daniel Laney, Past President of the American Dairy Goat Association, for his expert guidance and valuable assistance during the milk sample collection to analysis.

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