

# EFFECT OF LACTATION LENGTH AND LITTER SIZE ON MILK COMPOSITION OF BOER GOAT WITHIN ONE MONTH OF PARTURITION

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✉ Supporting Information

**ABSTRACT:** The aim of this study was to determine the effect of lactation length and litter size on the milk composition of Boer goats. Milk samples from 23 lactating Boer goats reared in NLBO (National Livestock Breeding Office), Pokhara, Nepal, were collected and analyzed in a laboratory present within a farm. Goats were reared under the same environment and provided with similar care and management. Lactation length showed a non-significant effect on fat content in the milk whereas all other constituents were influenced significantly. Similarly, litter size showed a significant effect on the freezing point of milk only. Litter size and all milk constituents were negatively correlated. However, Litter size and freezing point showed moderately strong correlation. Twinning did not significant influence fat, protein, lactose and solids nonfat content of goat milk. All constituents were weakly correlated to litter size however freezing point showed moderately strong correlation. Thus, more focus must be given to the nutritional management of triplets and twins to improve their growth rate compared to a single kid.

**Keywords:** Boer goat, Lactation length, Milk composition, Litter size, Twinning.

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## INTRODUCTION

Boer goats (*Capra aegagrus hircus*) are one of the most desirable goat breeds with good meat conformation, short hair and a variety of color patterns and are believed to be the result of a genetic pooling of African indigenous goats, Indians goats, Angora goats, and European dairy goats (Lu, 2001). Boer goats were believed to be brought in Nepal around 1999 A.D. Boer goats started being reared for detailed research in Goat Research Center, Bandipur in 2008 A.D (Nepali, 2016). Its demand has been increasing worldwide for its excellent body conformation, fast-growing rate, and good carcass quality (Lu, 2001). Boer breed has higher immunity to diseases and quicker maturity than our local breeds. The growth rate of Boer kids was found to be 150- 300 grams per day (Nepali, 2016). The average growth rates were also recorded as 291, 272, 245, and 250 g/day in male goats and 272, 240, 204, and 186 g/day in female goats from birth to 100, 150, 210, and 270 days of age respectively (Lu, 2001). Multiple kids can easily be reared as it produces an adequate amount of milk during lactation.

Two percent of the world's total annual milk supply is maintained by goats. Goat milk possesses higher digestibility of protein and fat, alkalinity, buffering capacity, and certain therapeutic values over a cow or human milk (Park, 2009). Goat milk has significantly higher protein and ash, but lower lactose, than human milk (Park, 2009). It can therefore be considered as the main replacement of cow's milk for lactose intolerant individual (Kalyankar et al., 2016). Goat milk is richer in caproic, caprylic, and capric acids than cow milk with 6, 8, and 10 carbon atoms, respectively (Chilliard, 1997). It is composed of medium-chain fatty acids (8-12 carbon atoms) that are efficient antimicrobials (Desbois and Smith, 2010). Goat milk is rich in calcium and phosphorus and is consumed in many regions, such as the Middle East, southern Asia, and some tropical countries.

Milk composition is affected by multiple factors like age, breed (Sung et al., 1999), nutrition, parity, stage of lactation (Ciappesoni et al., 2004), environment, fodder, the season of kidding (Crepaldi et al., 1999), etc. The main aim of this paper was to determine the effect of lactation length and litter size on milk constituent's i.e. fat, lactose, Solids Non Fat (S.NF), protein, and freezing point. Various researches have been carried out to determine the composition and factors affecting the composition of goat milk. However, there is limited information specific to Boer goats in the Nepalese environment during the early stage of lactation.

## MATERIALS AND METHODS

### Study area

Milk samples were collected from Boer goats reared under the intensive system in NLBO, Pokhara primarily for research purpose and up-grading of local breed. The research site is located within longitude 83° 58' 20.604" E and latitude 28° 15' 48.996" N at an altitude of about 793m above sea level (Figure 1). Twenty three Boer goats were lactating at the time of data collection. These therefore constituted the sample population. All goats were kept under the same environmental conditions and were provided with similar care and nutrition. Goats were fed with 600 gm of concentrate per day. Ipi-Ipil (*Leucaena leucocephala*), *Melia azadirachta*, *Ficus semicordata*, etc. and Oat (*Avena sativa*), Sudan, Berseem, etc. were the major sources of fodder and forage respectively provided to the goats.

### Sample collection procedure

- Goats were handled by two individuals in which one restrains the goat while the other one performs milking operation by hand.
- The teats were washed with clean water and rubbed with a clean towel to remove excess water.
- A total of 10 ml of milk sample was collected from both teats in a sterile container to analyze the milk composition.
- The teats were cleaned again after milking was completed.

The collected milk sample was then taken to the laboratory located within the farm. The samples were homogenized before analysis using Akashganga Milk Analyzer, AMA-Mini-40. The data obtained were recorded and analyzed to determine the effect of lactation length on milk constituents.

### Data analysis

Data regarding the age and lactation length was obtained from the recoding system present within the farm. The obtained data were recorded in an Excel sheet and were analyzed using IBM SPSS version 20 (Amos, 2011). The lactation length was divided into three categories as 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> week of lactation. The relation between lactation length and milk constituents was analyzed using ANOVA test whereas an Independent sample T-test was used to determine the relationship between litter size and milk composition.

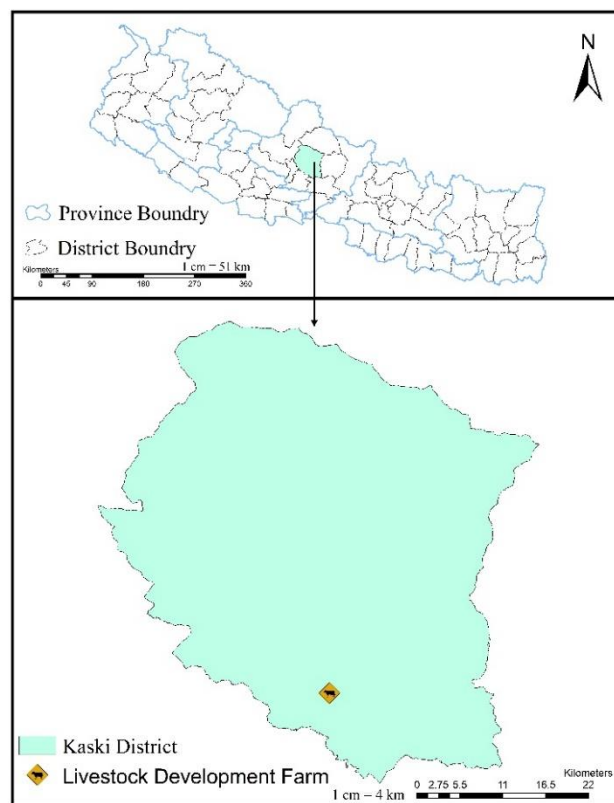
## RESULTS

### Effect of lactation length on milk composition

The effects of lactation length on milk composition are shown in Table 1. The study revealed that there was no significant effect ( $p=0.232$ ) of lactation length on the fat content of milk during the first month of lactation. The lowest fat percent was recorded on the 4<sup>th</sup> week of lactation. Lactation length showed a significant effect ( $p=0.041$ ) on the Solids nonfat (S.N.F) content. Solids nonfat slightly decrease in 3<sup>rd</sup> week but was elevated again on 4<sup>th</sup> week. The freezing point showed a significant difference ( $p=0.041$ ) due to variation in lactation length. The trend in freezing point indicates a constant decrease with increase in lactation length. A significant effect ( $p=0.042$ ) of lactation length on the protein content of milk was also recorded during our study. Protein content was reduced during the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> week of lactation respectively. The lactose content of the milk was significantly affected ( $p=0.049$ ) by lactation length. Lowest lactose content was recorded at 3<sup>rd</sup> week of lactation based on our study

### Effect of litter size on milk composition

Results of our study revealed that fat, S.N.F, protein, and lactose content of milk showed no significant difference within 1 month of parturition due to variation in litter size (Table 2). All components are weakly correlated (negatively) to litter size except freezing point. Goat milk from does with two kids showed slightly lower fat, protein, lactose, and S.N.F content but insignificant compared to a goat with single kids (Table 2). The freezing point of milk showed significant variation ( $p=0.043$ ) with the number of kids. The freezing point was negatively correlated ( $r= -0.424$ ) to litter size similar to other milk constituents.



**Figure 1 - Map showing livestock development farm in Pokhara, Nepal.**

**Table 1 - Table showing the effect of lactation length on milk composition of Boer goats**

Composition	Lactation period (In days)			p-value
	7-14	15-21	22-30	
Fat (%)	5.963±1.983	6.150±1.801	4.440±1.582	0.232
S.N.F (%)	10.438±0.466	9.930±0.414	10.040±0.182	0.041
Freezing point (Fp) (°C)	0.692±0.048	0.654±0.024	0.648±0.014	0.041
Protein (%)	3.788±0.181	3.610±0.152	3.600±0.071	0.042
Lactose (%)	5.700±0.278	5.420±0.229	5.460±0.114	0.049

Mean ± SD ; Significant at p < 0.05

**Table 2 - Table showing the effect of litter size on milk composition of Boer goats**

Composition	No of kids		Correlation coefficient (r)	p-value
	Single	Twins		
Fat (%)	6.44±2.357	5.39±1.587	-0.263	0.225
S.N.F (%)	10.357±0.556	10.031±0.366	-0.343	0.109
Freezing point (Fp) (°C)	0.689±0.056	0.656±0.020	-0.424*	0.043
Protein (%)	3.757±0.336	3.631±0.130	-0.350	0.101
Lactose (%)	5.657±0.336	5.469±0.199	-0.346	0.106

Mean ± SD, Significant at p < 0.05, \*denotes correlation is significant at 0.05 level.

## DISCUSSION

The study performed by Idamokoro et al. (2017) was in line with our findings showing that the milk composition including fat showed no significant difference ( $p > 0.05$ ) during the early, mid, and late stages of lactation. The mean fat percent of Boer milk was calculated to be 4.7% (Mestawet et al., 2012) which was lower than the result obtained within our study. The lower level of fat in goat milk is due to an increase in the molar percentage of propionic acid and the decline in the molar percentage of acetic acids found in the rumen (Morand-Fehr and Sauvant, 1980). But some researches in goats showed that the fat content in the milk gets slowly decreased in 30 days experimental period. The reason behind the decrease of milk fat can be explained by the increase in the percentage of monounsaturated fatty acids with the progress of lactation from 28.2% in colostrum to 33.0% at 30 days post-partum at the expense of polyunsaturated fatty acid which is the main component of milk fat (Marounek et al., 2012). The average fat globule size of goat milk (3.5  $\mu\text{m}$ ) is significantly smaller than that of cow milk (4.5  $\mu\text{m}$ ) and goat milk possesses a higher percentage of small fat globules than that of cow milk (Knights and Garcia, 1997).

The average SNF content in the milk of Boer goats was observed to be 9.20±0.40% which is lower compared to our findings (Idamokoro et al., 2017). Mean S.N.F content of Boer goat's milk raised under the intensive and extensive system was obtained to be 10.4 ± 6.5% and 10.7 ± 5.1% respectively (Greyling et al., 2004). The research performed by Simos et al. (1996) explained that S.N.F content in the milk was determined by genetic factors rather than the energy intake of an animal.

The correlation coefficient between the freezing point and lactose content in the Boer milk was obtained to be 0.930 (strongly correlated) which is in line with the finding of Janštová et al. (2019) stating that freezing point of goat milk is influenced mainly by lactose and chlorides content in the milk. The proportion of milk constituents in a true solution determines the freezing point of milk and whose proportion of those constituents are affected by multiple factors like breed, the occurrence of subclinical mastitis, nutritional deficiencies, stage of lactation, water intake, thermal stress, and seasonal variation, presence of CO<sub>2</sub> in milk, etc. (Slaghuys, 2001). The freezing point of the milk helps to determine the adulteration of water in the milk as it is the least variable component of milk in normal conditions (Zee, 1982).

Milk protein content tends to increase along with the advancement of the lactation period but this outcome didn't hold the truth in case of milk within a month after parturition based on the result obtained during our study (Singh, 1990). Proteins are composed of different amino-acids with 0.7–1.0%N and are influenced by breed, stage of lactation, feeding, climate, parity, season, and udder health status. Milk fat and protein content were determined mainly by the dietary energy balance (Sauvant et al., 1987).

A maximum of 5.27 ± 1.05% lactose was recorded in the intensive feeding of Boer goats in week 5 which is in line with our results (Banda et al., 1992). The highest mean daily milk lactose content (5.0 ± 0.7%) was recorded by Boer does managed intensively (Greyling et al., 2004). Goat milk is often considered as a viable dairy option to those infants showing allergic reactions to both cow milk and soya-based formula because of its lower lactose content for lactose intolerant individuals. Our result was in agreement with Singh and Sengar (1979), who observed that lactose content showed a tendency to decline as the lactation period progresses.

The study of Zamuner et al. (2020) explained that the goats with single kids produce milk with higher fat% and protein% than goats delivering multiple kids. The subsequent decrease in milk fat, protein, lactose, and S.N.F content of Boer goat with single, twins, and triplets was recorded respectively (Lacasse et al., 2014). Goats nursing two kids produce

more milk (Non-significant) than a single kid (Alkass and Merkhan, 2011). Milk yield and milk composition are negatively correlated (Simos et al., 1991). Suckling reflex post-partum and the physiological mechanism during pregnancy prepares udder to produce more milk for does carrying multiple fetuses (Macciotta et al., 2008). Some contrasting theories are also present explaining that there is no effect of litter size on milk composition (Carnicella et al., 2008). Several studies had suggested that seasonal variations such as temperature, relative humidity, rainfall, and solar radiation/photoperiod showed a significant effect on milk physicochemical composition (Clark and García, 2017). Mammary development and subsequent milk production and its composition are influenced by pre-partum photoperiod in dairy cows, ewes, and does.

## CONCLUSION

Lactation length showed a significant effect on lactose, solids nonfat, protein, and freezing point of milk except for fat content in Boer goats within 1 month of parturition. Besides, litter size had a significant influence on the freezing point of milk. Twinning did not significant influence fat, protein, lactose and solids nonfat content of goat milk. All constituents were weakly correlated to litter size however freezing point showed moderately strong correlation. Thus, more focus must be given to the nutritional management of triplets and twins to improve their growth rate compared to a single kid.

## DECLARATIONS

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### Competing Interest

We have no conflicts of interest to disclose concerning the research, authorship, and publication of this article.

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### Authors' contribution

S.Regmi performed conceptualization, methodology, analysis and writing-original draft; P.Mahato performed conceptualization, methodology, analysis; Kh.R. Sapkota performed writing- review editing.

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