

# Journal of the Hellenic Veterinary Medical Society

Vol. 72, 2021



## Evaluation of Milk Yield and Milk Composition of Honamli Goats

AKBAŞ AA	Department of Animal Science, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Turkey
TAŞÇI F	Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Turkey
ELMAZ Ö	Department of Animal Science, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Turkey
SAATCI M	Department of Animal Science Fethiye Faculty of Agriculture, Muğla Sıtkı Koçman University Muğla, Turkey

<https://doi.org/10.12681/jhvms.26760>

Copyright © 2021 AA AKBAŞ, F TAŞÇI, Ö ELMAZ, M SAATCI



To cite this article:

AKBAŞ, A., TAŞÇI, F., ELMAZ, , & SAATCI, M. (2021). Evaluation of Milk Yield and Milk Composition of Honamli Goats. *Journal of the Hellenic Veterinary Medical Society*, 72(1), 2747-2754. doi:<https://doi.org/10.12681/jhvms.26760>

## Evaluation of Milk Yield and Milk Composition of Honamlı Goats

A.A. Akbaş<sup>1\*</sup> , F. Taşçı<sup>2</sup> , Ö. Elmaz<sup>1</sup> , M. Saatci<sup>3</sup> 

<sup>1</sup>Department of Animal Science, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Turkey

<sup>2</sup>Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Turkey

<sup>3</sup>Department of Animal Science Fethiye Faculty of Agriculture, Muğla Sıtkı Koçman University Muğla, Turkey

**ABSTRACT:** The aim of this study was to determine the milk yield and milk composition (total solids, fat, protein and lactose), freezing point depression and somatic cell counts of Honamlı goat during second lactation in Turkey. The animal material of the study consisted of a total of 30 goat. Total milk yield was detected by using Fleischmann's method. Milk composition was analyzed by Bentley 150, and somatic cells were counted by Bentley Somacount FC. One-way ANOVA was used to determine the effect of lactation stages on milk yield and milk composition. In the study, mean lactation period and lactation milk yield of Honamlı goat were detected as 202.4 days, and 92.6 kg, respectively. The percentages of fat, protein, lactose, total solid, freezing point depression, and somatic cell counts /mL of milk were 2.4%, 4.2%, 5.1%, 12.7%, -0.57 °C, 82.8 and 2.9%, 4.2%, 4.7%, 12.7%, -0.59 °C, 483 on the 60<sup>th</sup> and 120<sup>th</sup> lactation day respectively. Total solids, fat, and protein values significantly increased especially towards the end of lactation ( $P < 0.05$ ). Lactose value decreased slowly from the beginning to the end of lactation. The somatic cell counts increased in milk particularly at the end of lactation ( $P < 0.05$ ). The freezing point depression remained stable throughout lactation. It was thought that results of study were important representing the second lactation milk production of Honamlı goats that is one of the native goat breeds of Turkey.

**Keywords:** Honamlı goat, milk composition, second lactation

*Corresponding Authors:*

Aykut asım Akbas, Department of Animal Science, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, 15030, Istiklal Campus, Burdur, Turkey  
E-mail address: icould\_akbas@hotmail.com

*Date of initial submission: 13-04-2020*  
*Date of revised submission: 28-12-2020*  
*Date of acceptance: 09-01-2021*

## INTRODUCTION

Milk is one of the most important food including protein, fatty acid, vitamins, and minerals and also it is contained all the necessary energy and nutrients for growth and development (Pereira, 2014). The biological value of milk is determined by the content of bioactive components that offer health benefits (Reklewska et al. 2005, Wong et al. 2006). Its high nutritive value can be attributed to also its unique chemical composition which supports optimal digestion and absorption (Miciński et al., 2013). Like its composition, the somatic cells count (SCC) determined in milk is of high importance for milk products of hygienic, sanitary, dietetic, nutritious, and gastronomic quality in the dairy industries (Jiménez-Granda et al., 2014; Karagiannis et al., 2018).

The freezing point depression (FPD) is one of the most important indicator of the quality of milk, which is influenced by the composition of cow and goat milk (Genčurová et al., 2008; Kędzierska-Matysek et al., 2011). All components of milk is affected by a number of factors such as breed, parity and lactation stage, milk yield, milking time, feed quality and amount, occurrence of subclinical mastitis, nutritional deficiencies, thermal stress, seasonal influences, and presence of CO<sub>2</sub> in milk (Janštová et al., 2007).

There has been an obvious increase in the demand for goat milk and products in developed and developing countries due to its nutritive and dietetic value (Bernecka, 2011; Akbas et al., 2019). *Caprine* milk contains averagely 12.2% total solids, which is composed of 3.5% protein, 3.8% fat, 4.1% lactose, and 0.8% ash (Park, 2016). While fat content of goat milk across breeds ranges from 2.45 to 7.76% (Jenness, 1980; Haenlein and Caccese, 1984); one of the important components of milk, Lactose make up 44% of the total carbohydrates in goat milk and between 4.1% and 4.8% of the weight of the whole milk (Park et al., 2007; Raynal-Ljutovac et al., 2008). In addition, the unique composition of goat milk, combined with its nutritional value, is related to the release of protein fragments which are more digestible than bovine milk, during digestion or technological processing, which are able to perform specific biological activities (Park et al., 2007; Ceballos et al., 2009). The quality and composition of goat milk is affected several factors that contains genetic factors, environmental conditions, goat farming practices, age, period of lactation, milking type, frequency and period of milking, feeding practices, and udder health situation

(Raynal-Ljutovac et al., 2008; Bolacalı and Küçük, 2012; Park, 2016).

Honamlı goats which are named after the Honamlı nomads are generally reared on the Taurus Mountains considered as one of a native goat breed in Mediterranean region in Turkey. Honamlı goat is a multipurpose breed, but usually mentioned for its big body and meat production. Milk production and reproduction traits have also significant meaning in very limited flocks (Saatcı and Elmaz, 2017). They are officially registered as an original goat breed in the year of 2015 (Official Gazette of Turkish Republic, 2015). The more in-depth knowledge about Honamlı goat milk composition and properties is needed.

Although there are many studies on changes of major components in goat milk during lactation, only little is known about milk yield, composition, freezing point depression and somatic cell count of Honamlı goat milk.

The aim of this study was to determine milk yield, milk composition (total solids, fat, protein, and lactose content), freezing point depression and somatic cell count of Turkish local breed Honamlı goats during the second lactation. The results of the present study are expected to help characterizing the Honamlı goat breed.

## MATERIALS AND METHODS

### Sampling and Analytical Procedures

In this study were used 30 Honamlı goats in second lactation at the Research and Training Farm of the Faculty of Veterinary Medicine of Burdur Mehmet Akif Ersoy University in Turkey.

The goats were grazed on highland pasture and maquis area including mostly kermes oak (*Quercus coccifera*) in formations from cultures of green olive tree (*Phillyrea latifolia*), black pine (*Pinus nigra*), Calabrian pine (*Pinus brutia*), and cedar (*Cedrus*) during spring and summer and they kept out for minimum 8 hours in a day from early in the morning till noon. In addition to grazing and browsing, goats were kept in a barn during winter and fed with 200 g/day concentrate feed (16% crude protein and 2500 kcal metabolisable energy per kg dry matter). Kids continued to suck their mothers until 5 months of age.

Milk samples were provided during the morning and evening milking once a month. Honamlı goats were milked by hand on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>,

180<sup>th</sup> and 210<sup>th</sup> day of lactation. The California Mastitis Test was applied to the goats milk. However, it was not determined mastitis cases during this study.

Measuring of the quantity of milk was determined using a graduated cylinder. Total milk yield (TMYL) is estimated by the centring date method, also known as Fleischmann's method (Maria and Gabina, 1992; Ruiz et al., 2000), which is currently used by the selection program. The general expression of the Fleischmann's method is:

k

$$TMYL = y_1 t_1 + \sum_{i=2}^k (y_i + y_{i+1}) / 2 (t_{i+1} - t_i) + y_{k+1} * 15$$

i=2

Where TMY is total milk yield; y<sub>1</sub> is yield at first milk record, t<sub>1</sub> is interval between lambing and first recording; y<sub>i</sub> is yield of the record i and t<sub>i</sub> is interval between the record i and the record (i+1), (i = 1, ... k), and 15 = assumed number of days between the last recording and the dry-off.

Milk samples were transported to laboratories by using cool boxes without preservatives at temperatures not exceeding 6°C. All milk samples were analysed using the Bentley 150 (Bentley Analytical Instruments, USA) to determine the milk composition, and FPD. The SCC in goat milk samples were counted by Bentley Somacount FC (Bentley Analytical Instruments, USA).

This study was approved by Burdur Mehmet Akif University, Local Ethics Commission of Experimental Animals (6.9.2012, meeting number:1, resolution number:6).

### Statistical Analysis

All statistical analysis were carried out using Minitab 16.1 statistical package (Minitab, 2011). An intense descriptive statistical analysis was applied to the data. Student-t test was employed for the differences between morning and evening milk yields. In addition, One-way ANOVA was used to determine the effect of lactation stages on milk yield and milk composition (total solids, fat, protein, and lactose content), FPD, and SCC. Tukey analysis was used to control for the significance of differences between subgroups.

### RESULTS

Table 1 shows the mean lactation milk yield (kg),

lactation time (days), and daily milk yield (kg) of milk samples for Honamlı goats. Table 2 shows mean milk yield (g) in different lactation stage. Mean lactation period of Honamlı goats was 202.4 days. In this study, the mean lactation milk yield of Honamlı goats was 92.6 kg. The daily milk yield of Honamlı goats was 0.453 kg (Table 1). While the highest peak of total milk yield was 610 g, and 678 g on 60<sup>th</sup> and 90<sup>th</sup> days, respectively; the mean milk yield was decreased towards ends of the lactation (Table 2). It was found to be statistically significant differences among the measurement days of lactation stages (P < 0.05).



Figure 1. A Honamlı goat and kids from the research flock



Figure 2. Does of the Honamlı goat, the research flock

Table 1. Mean lactation milk yield of the Honamlı goats

Parameters	n	Mean ± SE
LactationMilkYield (kg)	30	92.6±7.23
Lactation time (days)	30	202.4 ±3.12
Daily milkyield (kg)	30	0.453 ± 0.03

n: Number of theHonamlı goats; SE: Standard Error

**Table 2.** Mean milk yield (g) in different lactation stage (30 - 210<sup>th</sup>days) of Honamlı goats ( $\bar{x} \pm S\bar{x}$ )

MilkingPeriod	n	30 <sup>th</sup> day	n	60 <sup>th</sup> day	n	90 <sup>th</sup> day	n	120 <sup>th</sup> day	n	150 <sup>th</sup> day	n	180 <sup>th</sup> day	n	210 <sup>th</sup> day	P
Morning	30	238.3 <sup>c</sup> ± 17.4	30	375.0 <sup>a</sup> ± 26.6	30	326.7 <sup>b</sup> ± 27.9	30	324.7 <sup>b</sup> ± 33.1	30	184.7 <sup>c</sup> ± 16.6	24	145.8 <sup>d</sup> ± 18.0	7	257.1 <sup>c</sup> ± 77.5	*
Evening	30	190.0 <sup>b</sup> ± 14.1	30	235.0 <sup>b</sup> ± 18.3	30	351.7 <sup>a</sup> ± 25.7	30	144.0 <sup>c</sup> ± 19.5	30	68.3 <sup>d</sup> ± 8.21	24	275.0 <sup>b</sup> ± 36.7	7	142.9 <sup>c</sup> ± 40.0	*
Total	30	428.3 <sup>b</sup> ± 30.7	30	610.0 <sup>a</sup> ± 41.6	30	678.3 <sup>a</sup> ± 47.2	30	468.0 <sup>b</sup> ± 47.3	30	253.0 <sup>c</sup> ± 20.8	24	420.8 <sup>b</sup> ± 51.3	7	400.0 <sup>b</sup> ± 115	*
P		*		*		-		*		*		*		*	

P values at the end of the each row indicate the statistical differences according to measurement days.

P values at end of the each columns how the statistical differences between morning and evening milk in each measurement days.

<sup>a,b,c,d</sup>: Mean with different superscripts (only for rows) are statistically different. \*:P<0.05

**Table 3a.** Milk composition, FPD, and SSC in different lactation stage (30 - 120<sup>th</sup>days) of Honamlı goats ( $\bar{x} \pm S\bar{x}$ )

Parameters	n	30 <sup>th</sup> day			60 <sup>th</sup> day			90 <sup>th</sup> day			120 <sup>th</sup> day			P
		Morning	Evening	Mean	Morning	Evening	Mean	Morning	Evening	Mean	Morning	Evening	Mean	
Fat (%)	30	2.2 ± 0.30	3.8 ± 0.28	3.0 <sup>a</sup> ± 0.27	1.5 ± 0.17	3.2 ± 0.19	2.4 <sup>b</sup> ± 0.17	1.8 ± 0.12	1.5 ± 0.10	1.7 <sup>b</sup> ± 0.10	2.4 ± 0.26	3.4 ± 0.16	2.9 <sup>a</sup> ± 0.19	*
Protein (%)	30	4.6 ± 0.09	4.5 ± 0.09	4.6 <sup>a</sup> ± 0.09	4.2 ± 0.06	4.2 ± 0.05	4.2 <sup>b</sup> ± 0.05	4.2 ± 0.06	4.1 ± 0.06	4.1 <sup>b</sup> ± 0.06	4.3 ± 0.06	4.1 ± 0.06	4.2 <sup>b</sup> ± 0.06	*
Lactose (%)	30	5.1 ± 0.03	4.9 ± 0.03	5.0 ± 0.03	5.2 ± 0.03	5.0 ± 0.02	5.1 ± 0.02	5.0 ± 0.03	5.0 ± 0.02	5.0 ± 0.02	4.8 ± 0.02	4.6 ± 0.03	4.7 ± 0.02	-
Total Solids (%)	30	12.0 ± 0.37	14.1 ± 0.34	13.4 <sup>a</sup> ± 0.34	11.9 ± 0.21	13.5 ± 0.22	12.7 <sup>b</sup> ± 0.21	11.9 ± 0.15	11.5 ± 0.15	11.7 <sup>b</sup> ± 0.15	12.5 ± 0.31	12.9 ± 0.22	12.7 <sup>b</sup> ± 0.25	*
FPD (-°C)	30	0.58 ± 0.01	0.57 ± 0.01	0.57 ± 0.01	0.57 ± 0.01	0.56 ± 0.01	0.57 ± 0.01	0.58 ± 0.01	0.57 ± 0.01	0.57 ± 0.01	0.59 ± 0.01	0.59 ± 0.01	0.59 ± 0.01	-
SCC (x10 <sup>3</sup> cell/ml)	30	115.7 ± 32.20	175.7 ± 66.00	145.7 <sup>b</sup> ± 41.20	53.8 ± 16.00	111.8 ± 25.30	82.8 <sup>c</sup> ± 19.50	92.3 ± 47.90	138.8 ± 75.40	113.1 <sup>b</sup> ± 61.40	331.0 ± 105.63	40 ± 155.48	0 ± 124	*

FPD:Freezing point depression, SCC: Somatic cell count, <sup>a,b,c</sup>: Mean with different superscripts (only for rows) are statistically different.

\*:P<0.05 -:Non-significant (P>0.05)

**Table 3b.** Milk composition, FDP, and SSC in different lactation stage (150 - 210<sup>th</sup>days) of Honamlıgoats ( $\bar{x} \pm S\bar{x}$ )

Parameters	n	150 <sup>th</sup> day			180 <sup>th</sup> day			210 <sup>th</sup> day			P
		Morning	Evening	Mean	Morning	Evening	Mean	Morning	Evening	Mean	
Fat (%)	30	3.0 ± 0.21	3.3 ± 0.17	3.2 <sup>b</sup> ± 0.17	4.4 ± 0.26	3.6 ± 0.21	4.0 <sup>b</sup> ± 0.22	5.9 ± 0.85	8.1 ± 0.84	6.6 <sup>a</sup> ± 0.71	*
Protein (%)	30	4.2 ± 0.06	3.9 ± 0.08	4.0 <sup>a</sup> ± 0.07	5.4 ± 0.16	5.2 ± 0.13	5.3 <sup>b</sup> ± 0.12	9.0 ± 0.51	8.7 ± 0.57	8.8 <sup>a</sup> ± 0.43	*
Lactose (%)	30	4.7 ± 0.02	4.7 ± 0.02	4.7 <sup>a</sup> ± 0.02	4.4 ± 0.15	4.5 ± 0.03	4.4 <sup>a</sup> ± 0.07	3.0 ± 0.36	3.4 ± 0.31	3.2 <sup>b</sup> ± 0.25	*
Total Solids (%)	30	12.9 ± 0.26	12.7 ± 0.25	12.8 <sup>c</sup> ± 0.23	14.9 ± 0.35	14.2 ± 0.31	14.6 <sup>b</sup> ± 0.31	16.9 ± 1.02	20.3 ± 0.106	18.6 <sup>a</sup> ± 0.90	*
FPD (-°C)	30	0.59 ± 0.01	0.59 ± 0.01	0.59 ± 0.01	0.60 ± 0.01	0.59 ± 0.01	0.59 ± 0.01	0.61 ± 0.01	0.62 ± 0.01	0.61 ± 0.01	-
SCC (x10 <sup>3</sup> cell/ml)	30	337.0 ± 125.0	527.0 ± 119.0	432.0 <sup>b</sup> ± 118.0	939.0 ± 232.0	728.0 ± 160.0	834.0 <sup>a</sup> ± 176.0	816.0 ± 315.0	977.0 ± 417.0	896.0 <sup>a</sup> ± 339.0	*

FPD:Freezing point depression, SCC: Somatic cell count, <sup>a,b,c</sup>: Mean with different superscripts (only for rows) are statistically different

\*:P<0.05 -:Non-significant (P>0.05)

Table 3a and Table 3b present the milk composition (total solids, fat, protein, lactose), FPD, and SCC in different periods of lactation in this study. As seen from tables, the mean total solids percentage of lactation was 13.4%, 12.7%, 11.7%, 12.7%, 12.8%, 14.6%, and 18.6% on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>, 180<sup>th</sup>, and 210<sup>th</sup> days, respectively. In the present study, it was found to be statistically significant differences among lactation stages (P < 0.05).

The mean fat percentage of lactation was 3.0%, 2.4%, 1.7%, 2.9%, 3.2%, 4.0% and 6.6% on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>, 180<sup>th</sup> and 210<sup>th</sup> days, respectively

(Table 3a and 3b). The fat content decreased during the first three months, and then it started to rise on the 150<sup>th</sup> day and reached the peak on 210<sup>th</sup> day.

The mean protein percentages of lactation were 4.6%, 4.2%, 4.1%, 4.2%, 4.0%, 5.3%, and 8.8% on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>, 180<sup>th</sup>, and 210<sup>th</sup> days, respectively according to Tables 3a and 3b. Additionally, it was found to be statistically significant differences among lactation stages (P < 0.05).

In the present study, the mean lactose percentage of lactation was 5.0%, 5.1%, 5.0%, 4.7%, 4.7%,

4.4%, and 3.2% on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>, 180<sup>th</sup>, and 210<sup>th</sup> days, respectively (Table 3a and 3b). Although the lactose value was high between the 30<sup>th</sup> and the 90<sup>th</sup> days, it started to decrease on the 120<sup>th</sup> day, and remained at the rate of 3.2% on the 210<sup>th</sup> day of lactation.

The calculated average values of freezing points of raw goat milk ranged from -0.570°C to -0.610°C in the course of lactation (Table 3a and 3b). In this study, it was not found to be statistically significant differences between lactation stages ( $P > 0.05$ ).

In the present study, it was determined that SCC was  $145.7 \times 10^3$  cell/ml,  $82.8 \times 10^3$  cell/ml,  $113.1 \times 10^3$  cell/ml,  $483.0 \times 10^3$  cell/ml,  $432.0 \times 10^3$  cell/ml,  $834.0 \times 10^3$  cell/ml, and  $896.0 \times 10^3$  cell/ml on 30<sup>th</sup>, 60<sup>th</sup>, 90<sup>th</sup>, 120<sup>th</sup>, 150<sup>th</sup>, 180<sup>th</sup>, and 210<sup>th</sup> days, respectively (Table 3a and 3b). In this study, it was found to be significantly different among lactation stages ( $P < 0.05$ ).

## DISCUSSION

In the present study, mean lactation period of Honamlı goats was detected as 202.4 days. While this value was lower than the mean lactation period observed for goats by Bolacalı and Küçük (2012), and Králíčková et al. (2013); but higher than the mean lactation period determined for goats by some researchers (Tuncel and Okuyan, 1985; Forik, 1995; Sengonca et al., 2003; Simšek et al., 2006; Ata, 2007; El-Tarabany et al., 2016). When compared with values in the literature, lactation period of Honamlı goats may have been associated with genotype and environmental factors such as management and feeding regime.

The mean lactation milk yield of Honamlı goats was 92.6 kg. In Turkey, the lactation milk yield of Turkish Hair goats, which is one of the native breeds reared under the same conditions with Honamlı goat, was reported to be between 50-90 kg by some researchers (Tuncel and Okuyan, 1985; Cengiz and Yener, 1993; Forik, 1995; Sengonca et al., 2003; Simsek et al., 2006; Ata, 2007). While, the low milk yield might be associated with effecting by the deteriorating quality of the pastures; it was also seen that lactation milk yields of Honamlı show similarity with native goat breeds of Turkey because of same management procedures of goats.

In the present study, the daily milk yield of Honamlı goats was 0.453 kg and it was decreased towards ends the lactation ( $P < 0.05$ ). While this value was compatible with the other studies (Sengonca et al.; 2003; Ata,

2007) related to native goats breeds of Turkey; Simsek et al. (2006) found higher values (0.900 kg.) than the present study. Additionally, there were variability of daily milk yield reports for different goat breeds for numerous authors (Mestawet et al., 2012; Králíčková et al., 2013; El-Tarabany et al. 2016; Idamokoro et al., 2017). The milk yield value of Honamlı goat might be associated with genotype and especially inadequacy of nutritional imbalance because of extensive rearing system. Similarly, Soryal et al. (2004) reported significant pasture quality effects for milk production.

In the present study, the mean total solids percentage increased slowly from 90<sup>th</sup> day of lactation to 210<sup>th</sup> day of lactation. Due to this fact, it is believed that it was affected by the decreasing daily milk yield as a negative correlation between these traits. Similarly, Králíčková et al. (2013) and El-Tarabany et al. (2016) reported increasing of total solids value at the end of lactation. However, Mestawet et al. (2012) found that total solids were significantly higher at the beginning and the end of lactation.

In this study, while the fat content which was the most variable compared to the other parameters decreased during the first three months and then it started to rise, statistically significant differences ( $P < 0.05$ ) were found for fat contents among lactation stages. Similarly to this, Brendehaug and Abrahamsen (1986) reported that fat content decreased over the first 4 months of lactation and increased during the pasture period. Contrary to this, Šlyžius et al. (2017) and Idamokoro et al. (2017) reported that the highest milk fat content was determined during the early stages of lactation. On the other hand, there were some reports related to variations of fat content (Pridalová et al., 2008; Strzałkowska et al., 2010; Králíčková et al., 2013; Klir et al., 2015). When the results of this study were compared with previous studies, it can be said that they were lower than the values reported by some researchers (Klir et al., 2015; Kučević et al., 2016; Idamokoro et al., 2017). Fat composition of Honamlı goat milk may be associated with feeding regime, because it's a fact that fat and protein content of milk is influenced mostly by feeding (Toledo-Alonzo, 2003; Goetsch et al., 2011). Additionally, it was reported that factors such as breed, parity, stage of lactation, and flock had an effect on quantity of goat milk fat (Šlyžius et al., 2017).

In the present study, although protein content changed over the whole period of lactation, an increase in this value was recorded only at the end

of lactation. Similarly to this, Králíčková et al. (2013) reported an increase in protein content value only during last periods of lactation. Kuchčík et al. (2015) detected that total protein was relatively high during early lactation (2.9%), decreased as lactation peaked (2.7%), and increased towards end of lactation (3.7%). Contrary to present study, El-Tarabany et al. (2016) reported non-significant differences for protein percentages (3.6%) at different stages of lactation. In the present study, the protein content of milk was also higher than most of the reported results by other researchers (Kuchčík et al., 2015; El-Tarabany et al., 2016). Additionally, Raynal-Ljutovac et al. (2008) reported that goat milk contains higher levels of protein ranging from 2.6 g/l to 4.1 g/l. The higher content of the milk components along with high protein content is an indication for the presence of higher potential for cheese production (Guo et al., 2001; Soryal et al., 2004; Fekadu et al., 2005). Because of the higher protein content, Honamlı goat milk is more advantageous for making types of cheese.

In this study, it was not found to be statistically significant differences ( $P > 0.05$ ) among lactation stages for the period between the 30<sup>th</sup> and the 90<sup>th</sup> days for lactose value of Honamlı goats. The lactose content of Honamlı goats were similar to the results reported by Olechnowicz and Sobek (2008), Pridalová et al. (2008), Strzałkowska et al. (2010), and El-Tarabany et al. (2016). Contrary to this, Ibelbachyr et al. (2015) mentioned that lactose content was the lowest in the early lactation stage (4.62%) and highest in the middle lactation (5.70%). Kuchčík et al. (2015) determined that the lactose content increased from 3.83 to 4.58% during lactation. In the present study, decreasing lactose concentration might be associated with a decreased freezing point in the present study.

While the calculated average values of freezing points of raw goat milk ranged from  $-0.570^{\circ}\text{C}$  to  $-0.610^{\circ}\text{C}$  in the present study. Janštová et al., 2007 reported compatible findings with the present study. While Park et al. (2007) reported that the freezing point for goat milk ranged between  $-0.540$  and  $-0.570^{\circ}\text{C}$ ; Strzałkowska et al. (2009) determined that freezing point for the goat milk ranged between  $-0.609^{\circ}\text{C}$ ,  $-0.596^{\circ}\text{C}$  and  $-0.625^{\circ}\text{C}$  for three subsequent lactation stages, respectively. In the present study, there were not statistically significant differences between measuring periods ( $P > 0.05$ ). Contrary to this, Sousa et al. (1993) determined that there was a significant difference ( $P < 0.05$ ) between the freezing points of goat

milk collected in the morning and evening. Milk with the lowest freezing point in the study, was also characterised by the highest concentrations of protein and fat and therefore had the largest total solids content.

The SCC of Honamlı goats which is considered in quality and hygiene standards of milk was changeable in the measurement periods. While SCC of Honamlı goat milk on the 60<sup>th</sup> and 90<sup>th</sup> lactation days was  $82.8 \times 10^3$  cell/ml and  $113.1 \times 10^3$  cell/ml, respectively, daily milk yield of Honamlı goat on the 60<sup>th</sup> and 90<sup>th</sup> lactation days was 610 g and 678.3 g, respectively. While SCC was lower compared to milk of other goat breeds (Pizarro Borges et al., 2004; Pridalová et al., 2009; Martini et al., 2010; Králíčková et al., 2013); Paape et al. (2007) reported that the SCC mean in milk of healthy goats ranged from  $270 \times 10^3$  to  $2.000 \times 10^3$  cell/ml. In the present study, together with the increase of SCC, a decrease occurred in the daily milk yield. High SCCs in goat milk appear to be natural, particularly in the later stages of lactation. As lactation progresses, SCC increases and milk production decreases (Zeng and Escobar, 1995). In the European Union, the legal limit for cows is  $400.0 \times 10^3$  cells/ml, but there is no legal limit for goat or sheep milk (EC, 1992). In the regulation issued by the Republic of Turkey on this subject, there is no legal limit for SCC in goats and also for SCC variation in Honamlı goats in Turkey (TFC, 2011). High SCCs in Honamlı goat milk appear to be natural, particularly at the end of the lactation.

## CONCLUSION

Milk yield of Honamlı goats was determined to be similar to that of other native goat breeds of Turkey. It was thought that the results of the present study would contribute to determination of the SCC of goat milk in the legal regulations and acceptable goat milk FPD standards in Turkey. Additionally, the findings would provide an important database for future studies in order to encourage goat farming and the consumption of dairy products from goat's milk in Turkey.

## ACKNOWLEDGEMENTS

This study is a part of project supported by The Scientific & Technological Research Council of Turkey (TUBITAK), Project No: 112R031.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

- Akbas AA, Elmaz O, Sari M, Saatci M (2019). Assessment of some udder and teat traits of Honamlı goats in terms of dairy characters. *J Res Vet Med* 38(2):57-64.
- Ata M (2007) Milk yield of Hairy goats in Kahramanmaraş. Master's thesis, University of Kahramanmaraş Sutcu Imam, Institute of Natural and Applied Sciences, Department of Animal Science, Turkey.
- Bernecka H (2011) Health-promoting properties of goat milk. *Med Weter* 67:507-511.
- Bolacalı M, Kūçük M (2012) Fertility and milk production characteristics of Saanen goats raised in Mus region. *KafkasUniv Vet FakDerg* 18:351-358.
- Brendehaug J, Abrahamsen RK (1986) Chemical composition of milk from a herd of Norwegian goats. *J DairySci* 53: 211-221.
- Ceballos LS, Morales ER, Adarve GT, Castro JD, Martinez LP, Sanz-Sampelayo MR (2009) Composition of goat and cow milk produced under similar conditions and analyzed by identical methodology. *J Food Compos Anal* 22:322-329.
- Cengiz F, Yener SM (1993) Sheep and goat production in highland Turkey. Drylan pasture and forage legume network news. In: International Center of Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria:pp 34.
- European Council (EC) (1992) Council Directive 92/46/EEC of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products. *Official Journal of the European* 268:1-34.
- El-Tarabany MS, El-Tarabany AA, Roushdy EM (2016) Impact of lactation stage on milk composition and blood biochemical and haematological parameters of dairy Baladi goats. *Saudi J BiolSci* 25:1632-1638.
- Fekadu B, Soryal K, Zeng S, Van Hekken D, Bah B, Villaquiran M (2005) Changes in goat milk composition during lactation and their effect on yield and quality of hard and semi-hard cheeses. *Small Rumin Res* 59:55-63.
- Forik A (1995) A study on the determination of some characteristics related to milk, progeny and hair yields of hair goats raised in village conditions. Master's thesis, University of Uludag, Institute of Natural and Applied Sciences, Department of Animal Science, Turkey.
- Gençurova V, Hanuš O, Vyleťelová M, Landová H, Jedelská R (2008) The relationships between goat and cow milk freezing point, milk composition and properties. *SciAgricBohem* 39:324-328.
- Goetsch AL, Zeng SS, Gipson TA (2011) Factors affecting goat milk production and quality. *Small Rumin Res* 101:55-63.
- Guo MR, Dixon PH, Park YW, Gilmore JA, Kindstedt PS (2001) Seasonal changes in the chemical composition of commingled goat milk. *J DairySci* 84:79-83.
- Haenlein GFW, Caccese R (1984) Goat milk versus cow milk. In: *Extension Goat Handbook*. USDA Publications, Washington.
- Ibnelbachyr M, Boujenane I, Chikhi A, Noutfia Y (2015) Effect of some non-genetic factors on milk yield and composition of Draa indigenous goats under an intensive system of three kiddings in 2 years. *Trop Anim HealthProd* 47:727-733.
- Idamokoro EM, Muchenje V, Masika PJ (2017) Yield and milk composition at different stages of lactation from a small herd of Nguni, Boer, and Non-Descript Goats raised in an extensive production system. *Sustainability* 9:1000.
- Janštová B, Dračková M, Navrátilová P, Hadra L, Vorlová L (2007) Freezing point of raw and heat-treated goat milk. *Czech J AnimSci* 52:394-398.
- Jenness R (1980) Composition and characteristics of goat milk: review 1968-1979. *J DairySci* 63:1605-1630.
- Jiménez-Granado R, Sánchez-Rodríguez M, Arce C, Rodríguez-Estévez V (2014) Factors affecting somatic cell count in dairy goats: a review. *Span J Agric Res* 12:133-150.
- Karagiannis I, Brozos C, Kioussis E, Boscos C, Fthenakis G, Panousis N (2018) Associations of periparturient  $\beta$ -hydroxybutyric acid and non-esterified fatty acids blood serum concentrations with milkyield, milk composition and milk somatic cell count of intensively managed Chios dairyewes. *J HellenicVetMedSoc* 69(4):1195-1204.
- Kędzierska-Matysek M, Litwińczuk Z, Florek M, Barłowska J (2011) The effects of breed and other factors on the composition and freezing point of cow's milk in Poland. *Int J Dairy Technol* 64:336-342.
- Klirž, Potočnik K, Antunović Z, Novoselec J, Barać Z, Mulc D, Kompan D (2015) Milk production traits from alpine breed of goats in Croatia and Slovenia. *Bulg J AgricSci* 21: 1064-1068.
- Králíčkováš, Kuchtík J, Filipčík R, Lužová T, Šustová K (2013) Effect of chosen factors on milk yield, basic composition and somatic cell count of organic milk of Brown Short-Haired goats. *ActaUnivAgric Silvica Mendel Brun* 61:99-105.
- Kučević D, Pihler I, Plavšić M, Vuković T (2016) The composition of goat milk in different types of farmings. *BiotechnolAnimHusb* 32:403-412.
- Kuchtik J, Králíčkováš, Zapletal D, Węglarzy K, Šustová K, Skrzyżala I (2015) Changes in physico-chemical characteristics, somatic cell count and fatty acid profile of Brown Short-Haired goat milk during lactation. *Anim SciPapRep* 33:71-83.
- Maria G, Gabina D (1992) Simplification of milk recording scheme in Latxa milking sheep. *Livest Prod Sci* 31:313-320.
- Martini M, Salari F, Altomonte I, Rignanese D, Chessa S, Gigliotti C, Caroli A (2010) The Garfagnina goat: A zootechnical overview of a local dairy population. *J DairySci* 93:4659-4667.
- Mestawet TA, Girma A, Adnoy T, Devold TG, Narvhus JA, Vegarud GE (2012) Milk production, composition and variation at different lactation stages of four goat breeds in Ethiopia. *Small Rumin Res* 105:176-181.
- Miciński J, Zwierzchowski G, Kowalski IM, Szarek J (2013) Health-promoting properties of selected milk components. *J Elem* 18(1):165-186.
- MinitabInc (2011) Minitab 16.1.1 for Windows. Minitab Inc., State College, PA, USA.
- Official Gazette of Turkish Republic (2015) Communiqué on the registration of national animal breeds and lines, Turkey: National Official Gazette No: 2015/43, No: 29535.
- Olechnowicz J, Sobek Z (2008) Factors of variation influencing production level, SCC and basic milk composition in dairy goats. *J Anim FeedSci* 17:41-49.
- Paape MJ, Wiggans GR, Bannerman DD, Thomas DL, Sanders AH, Contreras A, Moroni P, Miller RH (2007) Monitoring goat and sheep milk somatic cell counts. *Small Rumin Res* 68:114-125.
- Park YW, Juárez M, Ramos M, Haenlein GFW (2007) Physico-chemical characteristics of goat and sheep milk. *Small RuminRes* 68:88-113.
- Park YW (2016) Production and composition of milk are affected by multivariate factors. *J Adv Dairy Res* 4:131.
- Pereira PC (2014) Milk nutritional composition and its role in human health. *Nutrition* 30:619-27.
- Pizarro Borges CH, Cordeiro PRC, Bresslau S (2004) Seasonal variation of goat milk composition and somatic cell count in Southeastern Brazil. In: International Symposium The Future of The Sheep and Goat Dairy Sectors, Zaragoza, Spain.
- Pridalová H, Janštová B, Cupáková S, Dracková M, Navrátilová P, Vorlová L (2009) Somatic cell count in goat milk. *Folia Vet* 53:101-105.
- Pridalová H, Janštová B, Dracková M, Navrátilová P, Vorlová L (2008) Safety and quality of milk products from goat's farm in Czech Republic. *ActaSciPolTechnolAliment* 7:13-20.
- Raynal-Ljutovac K, Lagriffoul G, Paccard P, Guillet I, Chillard Y (2008) Composition of goat and sheep milk products: an update. *Small Rumin Res* 79:57-72.
- Reklewska B, Bernatowicz E, Reklewski Z, Kuczyńska B, Zdziarski K, Sakowski T, Słoniewski K (2005) Functional components of milk produced by Polish Black and White, Polish Red and Simmental cows. *El J Pol AgriUniverAnimHusb* 8(3).
- Ruiz R, Oregui LM, Herrero M (2000) Comparison of models for describing the lactation curve of Latxa sheep and an analysis of factors affecting milk yield. *J Dairy Sci* 83:2709-2719.



- Saatci M, Elmaz Ö (2017) Honamlı, Newly registered special goat breed of Turkey. In: Sustainable Goat Production in Adverse Environments: Volume II. Springer, Cham, pp 131-146.
- Sengonca M, Taşkın T, Koşum N (2003) Simultaneous comparison of various production traits of Saanen x Hair crossbred and pure Hair goats. *Turk J Vet Anim Sci* 27:1319-1325.
- Simşek ÜG, Bayraktar M, Gürses M (2006) Çiftlikkoşullarında Kılkeçilere ait bazı verim özelliklerinin araştırılması. *Fırat Üniv Sağlık Bil Derg* 20:221-227.
- Šlyžius E, Šlyžienė B, Lindžiūtė V (2017) Factors affecting goat milk fat yield. *Žemės ūkio mokslai* 24:91-100.
- Soryal KA, Zeng SS, Min BR, Hart SP, Beyene FA (2004) Effect of feeding systems on composition of goat milk and yield of Domiati cheese. *Small Rumin Res* 54:121-129.
- Sousa JT de, Dias MJ, Tanezini CA, D'Alessandro WT, Oliveira BC de, Melo Rocha J de, Santos Pontes I dos (1993) Freezing point depression of raw goat's milk from the region of Goiania, Brazil. *Asian-Australas J Anim Sci* 6:555-559.
- Strzałkowska N, Jóźwik A, Bagnicka E, Krzyżewski J, Horbańczuk K, Pyzel B, Horbańczuk JO (2009) Chemical composition, physical traits and fatty acid profile of goat milk as related to the stage of lactation. *Anim Sci Pap Rep* 27:311-320.
- Strzałkowska N, Jóźwik A, Bagnicka E, Krzyżewski J, Horbańczuk K, Pyzel B, Sloniewska D, Horbańczuk JO (2010) The concentration of free fatty acids in goat milk as related to the stage of lactation, age and somatic cell count. *Anim Sci Pap Rep* 28:389-395.
- Toledo-Alonzo P (2003) Studies of raw milk from sustainable organic production systems. Licentiate thesis, Swedish University of Agricultural Sciences, Sweden.
- Tuncel E, Okuyan R (1985) Present status and future of goat husbandary in Turkey. commission on sheep and goat production. In: 35<sup>th</sup> Annual Meeting of the European Association for Animal Production, Halhidi, Greece.
- Turkish Food Codex (TFC) (2011) Regulation of special hygiene rules for animal food. Turkey: National Official Gazette No: 28155.
- Wong WMJ, De Souza R, Kendall CWC, Emam A, Jenkins DJA (2006) Colonic health: fermentation and short chain fatty acids. *J Clin Gastroenterol* 40:235-243.
- Zeng SS, Escobar EN (1995) Effect of parity and milk production on somatic cell count, standard plate count and composition of goat milk. *Small Rumin Res* 17:269-274.