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Effects of High and Low Somatic Cell Counts on the Milk Composition and Yield of Saanen Goats

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ABSTRACT

This study was carried out to determine the effects of high and low somatic cell counts (SCC)on milk composition and yield of Saanen goats. The goats were divided into 2 groups and put into trials during the 1stmonth of their lactation. The 2 groups were selected as those with ≤500 cell/mL(low SCC group (E)) and ≥500 cell/mL (high SCC group (T)) with each group consisting of 10goats. It was observed that the T group hada high SCC, which resulted in a significant effect on milk yield, compared to the T group with a low SCC (P<0.05; 1.34vs2.02 kg/day-1). Similarly, the milk samples that were taken from group T had lower (P<0.05) levels of milk lactose and Solids not fat (SNF) percentages than group E (milk lactose=4.15 and 4.65 %, SNF=8.41and 9.23% respectively). However, the effects of SCC on the fat and protein percentages of the milk were not significant (P>0.05). This study also displayed a statistically significant negative correlation between SCC and lactose content (-0.607), as well as daily milk production (−0.673) and SNF (-0.850).

Keywords: *High and Low Somatic Cell Counts; Saanen Goats;*

INTRODUCTION

The somatic cell count (SCC) is an indicator of a mammary gland's health status. Any amount of somatic cells above 1 × 105 cells/ml is an important indicator of mastitis in the flock according to Shearer *et al.* (1992). Milk SCC constitutes a useful tool for measuring milk quality, health status of the mammary gland and changes in milk composition. Lactose (L) can be reduced with the occurrence of mastitis and a subsequent increase in SCC (Hanuš *et al.*, 2010). An increased SCC is associated with a reduction in milk yield and changes in milk quality and composition. Bad milk quality has an economic impact on milk production and technological properties (Pridalova *et al.*, 2009). Determining somatic cell count(SCC) is a method used worldwide in the dairy practice for describing the hygienic control of the milk (Urech *et al.*, 1999; Ma *et al.*,2000; Wellnitz *et al.*, 2009). Having a low somatic cell count is important, with some dairy firms paying a premium price for milk with low SCC (Revilla *et al.*, 2007).Milk SCCs are also important factors for both the processing properties and stability of dairy products. In cheese production, milk with high cell counts lead to lower cheese yields, longer coagulations and ripening times, and weaker curds (Chen *et al.*, 2010).Milk SCCs are the basis for abnormal milk control programs in cows, goats and sheep. In the USA, the legal limit for cows established by the Food and Drug Administration is 750 000 cells/ml^{-1}, and for goats and sheep it is 1 000 000 cells/ml^{-1}. In the European Union (EU), the legal limit for cows is 400 000 cells/ml^{-1} and there is no legal limit for goats and sheep (Paape *et al.*, 2007). Paape *et al.*(2007) also reported that SCCs are lowest at the first parity for goats, averaging approximately 200000 cells/ml^{-1} at 15 days of lactation and reaching maximum counts of approximately 500 000 cells/ml^{-1} at 285 days of lactation. By the fifth parity, the counts averaged approximately 250 000 cells/ml^{-1} at 15 days and increased to a maximum of 1 150 000 cells/ml^{-1} at 285 days of lactation.

Significant increases in SCC are associated with decreases in milk quality and milk production losses (Juozaitiene *et al.*, 2006; Tekeli, 2010). Previous studies have reported that increasing SCC decreases the milk yield in dairy goats (Pizzillo *et al.*, 1996) and dairy ewes (Gonzalo *et al.*, 2002; Nudda *et al.*, 2003). In another study, Jia-zhong *et al.* (2010) reported that daily milk yields were 26.7, 26.3, 25.7 and 24.4 kg for cows with SCCs of ≤200, 201-500, 501-999 and

≥1000 cells/ml, respectively. Cinar *et al.*(2015) observed that SCC had a significant effect on milk yield, milk protein, milk lactose and total solids in dairy cows. The aim of this study was to evaluate the effects of somatic cell counts on the milk composition and yield of dairy goats in early lactation

MATERIALS AND METHODS

This research was conducted in a goat farm located in Karacabey. Goats (3 years old; first stage of lactation, 30-38 days) were divided into two groups according to SCC numbers; a high somatic cell count group (≥500 cell/ml) (T) SCC and a low somatic cell count group (≤500 cell/ml) (E), with each group consisting of 10 goats(Table 1). During the trial, all goats received *ad libitum* pasture feeding as well as corn silage (1.5 kg d^{-1}), alfalfa hay (1000 g), barley hay (0.40 kg), a concentrated feed mixture (0.20 kg) (CFM, 180 g CP kg DM^{-1}) and 2600 ME (Kcal kg DM^{-1})(Table 1). The animals were milked once a day with a milking machine present at both the T and E groups. Each goat's level of milk production was measured daily, and raw milk samples were collected monthly. Each sample was aseptically taken directly from the udder of the individual goats after the foremilk was discarded. The samples were stored at 4 °C and analyzed within 2 hours. Dry matter, organic matter, crude protein, crude fat and ash content of the diets were analyzed according to AOAC. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) values were determined using the methods outlined by Robertson and Vansoest. The metabolizable energy content was also estimated (NRC, 1975).The somatic cell counts (SCC) were determined with a Somacount 150 (Bentley Instruments, Chaska, USA). The non-fat solids (SNF), fat, protein and lactose contents of the milk were analyzed using a Milcosan FT 120 device. The means of each measured parameter of the milk yield and milk composition were analyzed using an analysis of variance with the SPSS version15.0 Statistical Package (2006). The means were compared using a t-test model described by Cochran and Cox (1957):

Yijkl- $\mu+Ti+Pj+Eijk$, where:

Yijk - observation

μ - Population mean

Ti - somatic cell count (high and low)

Pj - animals (j = 1, 2, 3…19 or 20)

Eijk - residual error

RESULTS AND DISCUSSION

The chemical composition of the different diets, alfalfa hay, corn silage and barley hay are presented in Table 1. The mean daily milk production was higher (P< 0.01) in goats with low SCC (E) compared to goats with high SCC (T) (2.02–1.34 kg day^{-1}).The mean milk production values for group T and group E were significantly different (P<0.05; Table 2). The results obtained in the study are similar to other observations (Pizzillo *et al.*, 1996; Gonzalo *et al.*, 2002; Nudda *et al.*, 2003; Juozaitiene *et al.*, 2006; Jia-zhong *et al.*, 2010; Tekeli, 2010; Martí De Olives 2013; Cinar, 2015). The reduced milk production in group T was most likely due to the damaged alveolar cells of the mammary gland and associated with a limited secretory function (Pizzillo *et al.*, 1996). A similar trend was also recorded for 4 % fat-corrected milk (4 % FCM). Yields of 4.0 % FCM were increased (P<0.05) by 25.77 % in milk samples taken with low SCC(2.25 vs. 1.67 kg d^{-1}) for group E and group T(Table 2). Milk parameters taken from the two groups are shown in Table 2. During the trial, the Solids- not- fat (SNF) was 8.41 and 9.23 kg/day^{-1}in the T and E groups (P<0.05, Table 2).This reduction in milk SNF was determined to be 8.88 % for group T. This result agrees with a study by Jaeggi *et al.*(2003), who reported that the total dry matter in sheep's milk was inversely proportional to the number of somatic cells. Similarly, the lactose contents of the milk was lower in group T than in group E (4.15vs 4.65 % (P<0.01); Table 3). These results are consistent with previous reports (Berning and Shook, 1994; Pirisi *et al.*, 1996, 2000, Cinar, 2015; Villalobos *et al.*, 2015), which state that a higher SCC in milk causes a decrease in the lactose content of the milk. Hanuö and Gabriel (1991) reported a statistically significant (P≤ 0.01) lowering of lactose content with SCC levels from 300 x 103/ml milk to 1000.0 x 103/ml. A similar study by Raynal-Ljutovac *et al.* (2007) was reported relating to goat's milk. The negative effects of high SCC on milk lactose content has been related to a decreased synthesizing capacity of the mammary gland due to the damaged epithelial tissue (Kitchen 1981; Martí de Olives *et al.*, 2013).The high or low somatic cell counts had no significant effects on the percentages of fat and protein in the milk (Table 2). However, there are conflicting statements regarding the effects of SCC on protein and fat components in the literature (Villalobos *et al.*, 2015; Pirisi*et al.*,

1996, 2000). It has also been reported that fat and protein content is not affected by low and high SCCs. However, Pisoni *et al.* (2004) determined that goat milk with high SCC had lower milk fat than goat milk with low SCC. On the other hand, Jaeggi *et al.* (2003) observed that an increase in the number of somatic cells in sheep's milk reduced the milk protein. Martí De Olives *et al.* (2003) and Cınar *et al.* (2015) report that this variation was related to changes in the types of feed available, climatic conditions, lactation stage, parity, and farm conditions. The correlation of somatic cell counts with milk yield and composition is presented in Table 3.

Table1. *Chemical composition of diets and roughages DM (g/kg^{-1})*

Nutrient composition					
		Corn Silage	Alfalfa hay	Barley hay	Diet
DM		316.6	942.5	668.6	880.0
OM		263.0	857.6	599.7	790.0
CP		69.4	128.0	35.3	180.0
EE		25.9	10.3	7.6	44.0
CELL		226.3	328.0	365.2	112.0
CA		53.6	84.9	68.9	90.0
Nitrogen free ext		-	391.3	191.6	454.0
Starch		275.1	19.5	10.8	-
NDF		484.4	511.4	759.7	-
ADF		363.3	450.8	612.9	-
ADL		45.2	124.2	75.0	-
ME (Kcal kg DM^{-1})[3]		731.34	1837.87	1183.42	2600

DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; Cell, cellulose; CA, crude ash; NDF, neutral detergent fiber; ADF, acid detergent fiber; [3] obtained by calculation

Table2. *Effects of high or low somatic cell countson milk composition and milk yield in Goats (mean+SE)*

Parameter	Group T (High SCC)	Group E (Low SCC)	P value
SCC (x log10 mL $^{-1}$)	4878±10.87	205.5±45.52	*
Body weight	51.60±0.83	51.50±0.68	NS
Milk yield (kg d^{-1})	1.34±0.06	2.02±0.11	*
4 % FCM (kg d^{-1})	1.67±0.10	2.25±0.16	*
Fat (%)	5.63±0.32	4.97±0.38	NS
SNF (%)	8.41±0.09	9.23±0.07	*
Protein (%)	3.39±0.21	3.91±0.17	NS
Lactose	4.15±0.26	4.65±0.09	**

*[1]Total DM intake values for buffaloes were not added to pasture consumption. 4 % FCM=4 % fat-corrected milk; SNF: Solids-not-fat; SCC: Somatic Cell Count; NS: Not significant; *P value<0.05*

Table3. *Correlation of somatic cell count with milk yield and composition*

Parameter	Milk yield	SNF	Milk lactose	Milk protein	Milk fat
SCC	−0,673**	-0.850**	-0,607**	-0.078	0.077

***P value<0.01*

SCC was statistically significant for being negatively correlated with milk yield, SNF and lactose (P<0.01). However, the negative correlation between SCC and fat and protein percentages of milk was not significant (P>0.05) (Table 3). The negative correlation between milk yield and SCC has been described in many reports (Koldeweij et al., 1999; Rupp and Boichard, 2000; Rajcevic et al., 2003; Juozaitiene et al., 2006; Jia-zhong *et al*., 2010; Cınar et al., 2015) and are similar to the present study. The negative correlation values between SCC and lactose content was -0.607 (Table 3). In similar studies, the correlation value was reported as -0.250 by Hanuö and Gabriel (1991),-0.423 by Rajcevic et al.(2003) and -206 by Cınar et al.(2015).The results of this study agree with the above reports and indicate that higher SCCs are connected to a lower content of milk lactose.

RESULTS

The results of this study show that somatic cell values below 500 ml in goat milk caused an increased milk yield, SNF and lactose without affecting other milk components (fat and protein).

The poor quality of milk production is an ongoing issue in some areas of Turkey; therefore, using goat milk with low-somatic cell counts is important for the quality of the final products. It is possible to overcome these problems by keeping track of somatic cell counts and by being careful of hygiene rules in the shelter and during milking.

REFERENCES

[1] Aoac, 1990.Official methods of analysis.15th ed. Assoc. Off. Anal Chem, Arlington, VA.

[2] Berning L., Shook G.E. Prediction of mastitis using milk somatic cell count. N-Acety-(bete)-D-Glucosaminidase and lactose. J. Dairy Sci. 1994;. 75(7):1840-1848.

[3] Cochran, W. G. and G. M. Cox.In Experimental Designs.2nd ed. John Wiley and Sons, New York, N.Y., 1957.p. 536.

[4] Chen SX, JS Wang, JS Kessel, FZ Ren and SS Zeng.Effect of somatic cell count in goat milk on yield, sensory quality and fatty acid profile of semisoft cheese. J Dairy Sci, , 2010; 93: 1345-1354.

[5] Cinar, M., Serbester,U., Ceyhan, A., Gorgulu, M. Effect of somatic cell count on milk yield and composition of first and second lactation dairy cows. Italian Journal of Animal Science volume 2015;14:3646.

[6] Gonzalo, C., Ariznabarreta, A., Carriedo, J.A., San Primitivo, F. Mamamry pathogens and their relationship to somatic cell count and mik yield losses in dairy ewes. J. Dairy Sci. 2002; 85, 1460-1467.

[7] Hanuö O., Gabriel B. The effect of lactation stage and order on lactose content in milk with respect to the health of mammary gland. éivocisnañVyroba, 1991; 36(10): 817-823

[8] Hanuš, O., Hronek, M., Hyšpler R.,, Yong, T., Tichá, A., Fikrová P.,, Hanušová KSojková, K., Kopecký4, J., Jedelská, R. Relationship between somatic cell count and lactose content in milk of various species of mammals. Acta Univ. Agric. Silvic.MendelianaeBrun. 2010; 58, 87-100

[9] Jaeggi, J.J., Govindasamy-Lucey, S., Berger, Y.M., Johnson, M.E., McKusick, B.C., Thomas, D.L., Wendorff, W.L. Hard ewe's milk cheese manufactured from milk of three different groups of somatic cell counts. J. Dairy Sci., 2003; 86, 3082-3089.

[10] Jia-zhong, G., Xiao-lin, L., A-Juan, X., Zhi, X. Relationship of somatic cell count with milk yield and composition in chinese Holstein population. Agric. Sci. China 2010; 9:1492-1496

[11] Juozaitiene, V., Juozaıtıs, A., Micikeviciene, R. Relationship between somatic cell count and milk production or morphological traits of udder in Black-and-White cows. Turk. J. Vet. Anim. Sci. 2006; 30:47-51.

[12] Kitchen B.J. Review of the progress of dairy science: bovine mastitis: milk compositional changes and related diagnostic tests. J.Dairy Res., 1981; 48: 167-188.

[13] Koldeweij, E., Emanuelson, U., Janson, L. Relation of milk production loss to milk somatic cell count. Acta Vet. Scand. 1999; 40:47-56

[14] Ma Y, C Ryan, DM Barbano, DM Galton, MA Rudan and KJ Boor, Effects of somatic cell count on Quality and shell-life of pasteurized fluid milk. J Dairy Sci, 2000; 83: 264-274.

[15] Martí De Olives, A., Díaz, J.R., Molina, M.P., Peris, C. Quantification of milk yield and composition changes as affected by subclinical mastitis during the current lactation in sheep, Journal of Dairy Science. 2013; 96 (12): 7698-7708.

[16] NRC, Nutrient requirements of dairy goat 5 threved. Washington, DC: National Academy of Sciences, 1975.

[17] Nudda, A., Feligini, M., Battacone, G., Maciotta, N.P.P., Pulina, G. Effect of lactation stage, parity, bate lactoglobulin genotype and milk SCC on whey protein composition in Sarda dairy ewes, Ital, J. Anim. Sci. 2003; 2, 29-39.

[18] Paape MJ, GR Wiggens, DD Bannerman, DL Thomas, AH Sanders, A Contreras, P Moroni and RH Miller, Monitoring goat and sheep milk. Small Rum Res, 2007; 68: 114-125.

[19] Pirisi, A., Piredda, G., Podda, F., Pinitus, S. Effect of somatic cell count on sheep milk composition and cheese making properties. In: Somatic Cells and and Milk of Small Ruminants. EAAP Pubblication No: 77. Wageningen Pers, Wageningen, The Netherlands, 1996. pp. 245-251.

[20] Pirisi, A., Piredda, G., Corona, M., Pes, M., Pintus, S., Ledda, A. Influence of somatic cell count on ewe's milk composistion, cheese yield and cheese qality. In: Proceedings of Sixth Great Lakes Dairy Sheep Symposium, Guelph, Canada, 2000. pp. 47-59.
Pridalova H, B Janstova, S Cupakova, M Drackova, P Nauratilova and L Vorlova, Somatic cell count in goat milk. Folia Veterinaria, 2009; 53: 101-105.

[21] Pizzillo, M., Cogliandro, E., Rubino, R., Fedele, V. Relationship between somatic cells and milk quality in different goat production systems. In: Rubino, R. (Ed.), Proceedings of International Symposisum on Somatic cells and Milk of Small Ruminants. EAAP Publicatiın No.77, Wageningen Pers, Bella, Italy, September, 25-27, 1994, pp, 269-273.

[22] Raynal-Ljutovac, K., Pirisi, A., de Cremoux, R., Gonzalo, C.Soamtic cells of goat and sheep milk: Analytical, sanitary, productive and technological aspects. Small Ruminant Research 2007; 68: 126-144.

[23] Rajcevic, M., Potocnık, K., Levstek, J.E. Correlations between somatic cells count and milk composition with regard to the season. Agric. Conspectus Sci. 2003; 68:221-226.

[24] Revilla I, JM Rodriquez-Nogales and A Quintana, Proteolysis and texture of herd ewes milk cheese during ripening as affected by somatic cell counts. J Dairy Res, 2007; 74: 127-136.

[25] Robertson JB and PJ Vansoest, The detergent system of analysis and its application to human foods. In The Analysis of dietary fiber in food.WPT James and O Theander, Ed. Marcel Dekker, New York, NY, 1981.page 123.

[26] Rupp, R., Boichard, D., Relationship of early first lactation somatic cell count with risk of subsequent first clinical mastitis. Livest. Prod. Sci. 2000; 62:169-180.

[27] Shearer, J.K., Bachman, K.C., Boosinger, J.The production of quality milk. Dairy Prod Guide. Florida Cooperative Extension Service. 1992.

[28] SPSS, Statistical package for social sciences.Pc version 15.SPSS Inc. 444. N. Michigan Avenue Chicago: United States of America, 2006.

[29] Tekeli, T., Meme Sağlığıve KaliteliSüt Üretimi. Süt Sığırlarında Besleme, Üremeve Meme Sağlığı Paneli. Niğde Universities Publ., Niğde, 2010.Turkey.

[30] Urech E, Z Puhan and M Schallibaum, Changes in milk protein fraction as affected by subclinical mastitis. J Dairy Sci, 1999; 82: 2402-2411.

[31] Javier Caballero Villalobos, Ana I. Garzón Sigler , BonastreOliete , Ramón Arias Sánchez, Lorena Jiménez , Nieves Núñez Sánchez , Andrés L. Martínez Marín. Relationship of somatic cell count and composition and coagulation properties of ewe's milk Mljekarstvo , 2015; 65 (2), 138-143

[32] Wellnitz O, MG Doherr, M Woloszyn and RM Bruckmaier, Prediction of total quarter milk somatic cell counts based on foremilk sampling. J Dairy Res, 2009; 79: 326-330.