Physicochemical characteristics of raw milk in sheep of Boyacá, Colombia

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Abstract

**Tarazona, L.E.; Andrade, R.; Vargas, J.C.: *Physicochemical characteristics of raw milk in sheep of Boyacá, Colombia. Rev. Vet. 31: 2, 126-130, 2020.* The quality of raw milk is a key factor to consider when selecting the best females for sheep production systems because the lamb growth rate is highly correlated with this. The objective of this work was to determine the physicochemical characteristics of raw milk from Dorper sheep across sixty days of lactation. Parameters evaluated were percentage of fat, protein, lactose, total solids, non-fatty solids and freezing point expressed in degrees centigrade. Animals were randomly assigned to three groups according to days of lactation, as follows: 3-20 days, 21-40 days and 41-60 days (40 ewes each). Milk analysis was performed using *MilkoScan Mars*. Somatic cell count was performed with a *SCC Portacheck* equipment for goats. ANOVA was performed to determine statistical differences among the groups for each parameter ($p < 0.05$). There were no statistical differences for fat, non-fat solids, and total solids; the other parameters have statistical differences. The best results were fat: 8.09% (group 2), protein: 5.45% (group 1), lactose: 5.22% (group 2), nonfatty solids: 11.13% (group 1), total solids: 19.17% (group 2), freezing point -0.5836°C (group 1) and SCC 75.3 x 1000 cells/ml (group 2). The physicochemical characteristics of Dorper's raw milk were better than other breeds, including dairy and meat breeds.

Key words: Dorper sheep, raw milk, physicochemical characteristics, quality.

Resumen

**Tarazona, L.E.; Andrade, R.; Vargas, J.C.: *Características fisicoquímicas de la leche cruda en ovejas de Boyacá, Colombia. Rev. Vet. 31: 2, 126-130, 2020.* La calidad de la leche cruda de las ovejas es un factor muy importante a tener en cuenta cuando se escogen las mejores hembras para los sistemas productivos ovinos, porque el rango de crecimiento de los corderos está altamente relacionado con ello. El objetivo de este trabajo fue determinar las características fisicoquímicas de la leche cruda de ovejas de raza Dorper a través de los días en lactancia. Los parámetros evaluados fueron: porcentaje de grasa, proteína, lactosa, sólidos totales, sólidos no grasos y punto de congelación expresado en grados centígrados. Los animales fueron organizados en tres grupos de acuerdo a sus días en lactancia (3-20 días, 21-40 días y 41-60 días, con 40 ovejas por grupo). El análisis de la leche fue realizado usando un *MilkoScan-Mars®*. El recuento de células somáticas fue efectuado con un equipo *Portacheck* para cabras. Se realizó un ANOVA para determinar las diferencias estadísticas entre los grupos para cada parámetro ($p < 0.05$). No hubo diferencias estadísticas para grasa, sólidos no grasos y sólidos totales; los otros parámetros tuvieron diferencias estadísticas. Los mejores resultados fueron grasa: 8.09% (grupo 2), proteína: 5.45% (grupo 1), lactosa: 5.22% (grupo 2), sólidos no grasos: 11.13% (grupo 1), sólidos totales: 19.17% (grupo 2), punto de congelación -0.5836°C (grupo 1) y recuento de células somáticas: 75.3 x 1000 cel./ml (grupo 2). Los resultados de las características fisicoquímicas de la leche cruda de ovejas Dorper fueron mejores comparados con otras razas (lecheras o cárnicas).

Palabras clave: ovejas Dorper, leche cruda, características fisicoquímicas, calidad.

INTRODUCTION

Worldwide, China is the biggest producer of sheep meat with 24% of total production, followed by Austra-

lia and New Zealand with 8% and 5%, respectively [9]. Current *per capita* worldwide consumption is 1.2 kg , while it is projected to be near of 2 kg by 2027 [24].

In Colombia, there are not reliable data of *per capita* consumption. According to the Instituto Colombiano Agropecuario there are 1.449.705 animals in 2018 [14]. In

Boyacá, there were 105.916 animals, accounting for 7.03% of all sheep population in the country.

However, there are not specific data, on number of animals per breed and the organization of the productive chain. Also, this production system is associated to small farmers for self-consumption and local commerce in the cities.

Then, it is necessary not only to improvie productions through better livestock practices but also to improve databases in all the country, for taking productive decisions for the sector. Taking into account not only the meat chain, but also the milk and wool chains, it seems to be an economic alternative for the sheep farmer [21].

To achieve this, it is necessary to use breeds that can adapt easily to the tropical conditions in Colombia, among the breeds that can adapt and move from arid conditions and low rainfall, onto highlands with tropical conditions, like Colombia, is the Dorper breed [6].

There is only one study in Colombia that explored the productive behavior of Dorper breed, compared with White Dorper breed, reporting better daily weight gains, weaned weight and slaughter weight for the Dorper breed [13].

One of the most important factors to make lambs express all genetic and productive potential is the quantity and quality of milk supplied by the mothers, also feeding during the pre-weaning period [11, 12, 18]. The sheep milk quality depends on the breed, udder health, age, parturitions, lactation states, nutritional regime, milking techniques, season and hour of milking [5, 10, 19].

That is the reason to know in all productive system the quality of milk of all ewes across lactation, to ensure lamb development and to decrease mortality rates. Therefore, the objective of this work was to determine the physico-chemical characteristics of sheep raw milk across sixty days in lactation, of the Dorper breed in Boyacá, Colombia.

MATERIAL AND METHODS

Site and type of study. The study was developed in Duitama city (Colombia), situated at 2,600 meters above sea level, with a mean temperature of 14°C [15]. A quantitative descriptive study was performed, with samples taken once in April, ergo in winter.

Animals: 120 animals of Dorper breed, between two and three lactations were included in the study. Three groups were performed, completely randomized, according to days in milk (DIM), group one: between 3 and 20 days; group two: 21 and 40 days, and group three: 41 and 60 days each of them with 40 animals [17]. Animals included in each group were weighed. The average weight for the first group was 50 ± 2.7 kg, for the second group was 55 ± 3.5 kg and for the third group was 62 ± 2.0 kg.

Feeding. The animals shepherded in pastures of Kikuyu (*Cenchrus clandestinum),* and received *ad li-*

bitum, in the morning, balanced commercial feed, with values of crude protein of 14%, ash 10%, humidity 13%, fat 2.5% and fiber 25%.

Sampling. Only animals with healthy udders were included in this study, for this determination, a clinic exam was performed to all animals to discard udder inflammation, pain, lacerations, and adhesions. *California mastitis test* was used and only ewes that had negative and trace results were included in the study. Before sampling, udders and teats were cleaned using a soap solution, then rinsed with sterile water and dried with sterile gauze, disinfected with iodine solution. Once asepsis was completed, the first milk jet was discarded and the sample was collected in Whirl-pack bags [4]. The samples were taken in the morning before the lambs were reunited with their mothers. Approximately 20 ml were taken of each ewe (10 ml per teat).

Processing. The samples were processed on sampling day in the laboratory of milk quality and mastitis control in the Pedagogical and Technological University of Colombia (Tunja, Boyacá). Percentages of fat, protein, lactose, total solids, non-fatty solids and freezing point expressed in grades centigrades were determined using a milk analyzer based on *Fourier transformed infrared technology* (MilkoScan Mars). Somatic cell count (SCC) was performed with an *Portacheck* equipment for goats.

Statistical analyses. An analysis of variance (ANOVA) was performed between groups of DIM, using the comparison of means of *low significate difference* of Fisher's procedure, with a confidence level of 95%, using software *Statgraphics Centurion*, Windows 10 version.

RESULTS

Table 1 shows the results of means for each physicochemical parameter for each group of DIM, for sheep raw milk of Dorper breed.

The percentage of fat shows an increase between day 21-40, and then it decreases (group 3), but it is still above the percentage of the first group. However, there were no statistically significant differences between the groups. Percentage of total solids described a similar behavior, with no statistical differences between of the groups (p>0.05), but in this case, the group 3 had a lower value compared with group 1 (Table 1).

Higher protein percentage was found in the first group, and then it decreased across lactation, with statistically significant differences found between group 1 and the other two groups. Lactose content was high in group two (21-40 DIM), decrease later in group three (41-60 DIM) but still is higher than the group one, and found also a statistically significant differences between three groups.

No differences were found between groups of not fatty solids percentage, however, the values were de-

Table 1. Means values for each physicochemical parameters for each group of days in milk.

parameter	G1 (3-20 d)	G2 (21-40 d)	G3 (41-60 d)	p-value
fat (%)*	7.37 ± 2.33	8.09 ± 0.13	7.54 ± 0.10	>0.05
protein (%)	5.45 ± 0.30a	5.04 ± 0.15b	5.06 ± 0.04b	<0.05
lactose (%)	4.77 ± 0.17c	5.22 ± 0.13a	5.07 ± 0.04b	<0.05
NFS (%)*	11.13 ± 0.43	11.07 ± 0.28	10.98 ± 0.08	>0.05
t.solids (%)*	18.70 ± 2.05	19.17 ± 0.20	18.53 ± 0.15	>0.05
f.point (°C)	-0.5836 ± 0,02a	-0.575 ± 0.004ab	-0.5695 ± 0.016b	<0.05
SCC cells/ml	223.5 ± 19.46a	75.3 ± 13.81b	231.8 ± 17.75a	<0.05

G: group, d: days, *no significant differences, NFS: non fatty solids, SCC: somatic cell counts (x1.000 cells/ml), >menor; <mayor, t: total, f: freezing

scended from group one to group three. In the case of freezing point, exist significant statistically difference between group one and three, but there is not differences between group two and others two groups.

For SCC there is not a significant difference between group one and three, but the group two shows a marked reduction, be this group different statistically of the other two groups.

DISCUSSION

Previous work found improved daily weight gain in Dorper lambs during the first 28 days on lactation [12], which is correlated with milk quality, since this is the principal feed at this stage [8], likewise reported that the capacity of Dorper ewes to produce large quantities of milk, contribute to the high growth potential of the lambs [3].

Moreover, the better quality for raw milk was found in the first and second group. Besides Dorper breed showed a better capacity for maintaining production regimen during gestation and under adverse conditions of feeding, due to maintain better body condition and *greater insulin-like growth factor-1* (IGF-1) concentrations, when it was compared with Ramboulliet breed [30].

The studies about Dorper breed raw milk quality are old and scarce around the world. Researchers [8] mentioned that for ewes after 10 days in lactation, the fat content in milk was 7.1%, value that is similar to in the present findings (Table 1), but they found that after 40 DIM the fat percentage was 5.5% on average, which is different with reported here whose value was 8.09% on average. Likewise, they reported that the average value of protein is 5.6%, which is elevated compared with any of groups analyzed here; also, the value of 4.6% for lactose that they reported is lower than shows here.

Previous work reported values of fat in ½ Lacaune x ½ Ile de France ewes of 4.95%, 5.24% and 4.89% when the animals were fed soybean seed-supplemented diet with 0, 70 and 140 g/kg respectively [17], than was lower if we compare with all groups studied here, this due the differences between productive focus of the two breeds, because this crossbred is half dairy and half meat, meanwhile, the Dorper breed is a meat-breed. Results for protein too were lowers than reported here,

even for diet with mayor content of soybean seed.

In the same way, others found an average fat percentage for Lacaune and East Friesian breeds (both dairy breeds) of 6.86% and 7.31% respectively [27], which are lower for values reported here for Dorper breed in three groups. Lacaune's protein percentage was 4.93%, but for East Friesian this percentage was 5.18%, the first of them is lower for any groups analyzed here, but the second result is higher than groups 2 and 3.

Others performed a study for the determination of the variations that exist between raw milk of Santa Ines ewes [7] (meat breed), undergoing treatment of oxytocin, obtaining an average for percentage of fat of 4.96% for untreated ewes, and 5.84% for treated ewes, which are lower than reported here, due possibly to breed difference and feed regimen. However, the results for not fatty solids were 11.22% for the untreated group and 11.57% for the treated group, values that are higher than reported here for any group studied, due possibly to an increase of other milk constituents.

Scientifics found statistical variations in properties of raw milk of breed Latxa sheep through winter spring and summer in the Basque country [2], for April (winter), the fat percentage were 6.10% and protein were 4.89%, which were lower than reported here, due to distinct climatic, feeding and breeds conditions.

The peak of production is related to the lactose content for Santa Ines ewes, reported the major level of production at 37 DIM [7]. This is correlated with found here for lactose content which was higher in group two (21-40 DIM); also, the results of this study are similar to reported by others [29], who correlated the percentage of lactose and production peak, and found that this occurred in the third week (21 DIM) for Talaverana breed.

Generally in sheep, high content of lactose is associated with low fat and protein values, due to the dilution factors [23]; similar process were found here, where group G2 (highest lactose content) has the lowest percentage of protein compared to G1, but not occur the same for fat percentage.

The *"Guide of udder health for dairy sheep"* stated that a result between 0-200.000 cells/ml are negative results, and 150.000-500.000 cells/ml are trace results, due to apocrine secretion with a cytoplasmic particles normal in milk [20].

The present study shows that group one and three had trace results, and group two has negative results. It has been mentioned [16] that mastitis, even this is subclinical cause loss of milk yield and modification of main components, as a result of damage in the mammary secretory tissue. It has been mentioned [26] that percentage of protein is reduced when the SCC increase above 500.000 cells, while for fat percentage this is reduced when SCC increase above 2.000.000 cells/ml.

SCC varied across lactation in our study. Our values are higher than those reported by others [17] for ½ Lacaune x ½ Ile de France whose results were between 145.750 and 203.000 cells/ml. But our results were lowered than reports of others [2], whose ranked were between 263.000 and 467.000 cells/ml.

Some publications [21] refer that mean freezing point for Lacaune´s milk in Brazil was -0.577 (°C) and were similar to results of group 2, but different for the others two groups. This trait is related with the percentage of total solids that have the milk, and in dairy industries is very important because it can function like an indicator of milk quality through the determination of water addition.

Is well known that climatic conditions can affect milk quality and quantity [25], likewise feeding regimen and quality of feed, numbers of lambs per birth and sex of lambs (males or females) [1, 22, 28, 30].

Statistical differences found between the three groups for percentage of protein and lactose, freezing point and somatic cell counts. There were not statistical differences between fat, total solids and not fatty solids. Physicochemical characteristic of Dorper raw milk were better than others breeds even dairy or meat breeds. The information related with this topic in Colombia is the first, and was updated in the world.

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