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Comparative Evaluation of Colostrum Quality in Karya Ewes and Yearling Lambs Using the Brix Refractometer

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ABSTRACT

The aim of this study was to comparatively evaluate colostrum quality in ewes and yearling lambs using a digital Brix refractometer. A total of 18 Karya sheep, including 9 yearling lambs and 9 ewes, were used in the study. Colostrum/milk samples were collected from the sheep immediately after birth and at 12 and 24 hours, and 2, 3, 4, 7 and 15 days after birth. The Brix percentages of the fresh colostrum/milk samples were measured with a digital Brix refractometer. The colostrum Brix percentages of the ewes and yearling lambs and the change in the colostrum/milk Brix percentages up to 15 days after birth were compared by repeated measure of analysis of variances. The mean colostrum Brix percentages of the ewes immediately after birth, and at 12 and 24 hours and, 2 and 3 days after birth were determined as 32.8 ± 1.7%, 22.6 ± 1.2%, 17.2 ± 1.0%, 15.4 ± 0.8%, and 14.2 ± 0.3%, respectively. The mean colostrum Brix percentages of the yearling lambs immediately after birth, and at 12 and 24 hours, and 2 and 3 days after birth were determined as 33.3±1.8%, 21.0±1.9%, 17.2 ± 1.4%, 15.6 ± 0.6%, and 15.0 ± 0.4%, respectively. No differences were detected between the colostrum and milk Brix percentages of the ewes and yearling lambs. Colostrum Brix percentages decreased significantly from birth to 24 hours postpartum. Colostrum/milk Brix percentages remained at similar values from 24 hours to 15 days postpartum. In conclusion, colostrum quality did not differ between Karya ewes and yearling lambs and colostrum/milk Brix percentages decreased steadily from 24 hours to 15 days after lambing.

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INTRODUCTION

Colostrum, which is the first secretion of the udder tissue after birth, contains antibodies, fat, proteins, vitamins, and many other biological molecules such as hormones, growth factors and cytokines, which are necessary for the health, growth and development of lambs (Agenbag et al., 2021; Uysal and Yörük, 2022; Farooq et al., 2024). The syndesmochorial placental structure of ewes prevents immunoglobulins from crossing the placental barrier. Therefore, lambs are born agammaglobulinemic and get the antibodies they need through the consumption of colostrum (Agenbag et al., 2021). Failure of transfer of passive immunity (FTPI) develops in lambs that do not receive enough immunoglobulins through colostrum consumption. Serum IgG concentrations do not yet have a universally accepted threshold for lambs in determining adequate passive immunity transfer. Even so, considering the mortality and growth performances of lambs, several blood IgG thresholds indicating FTPI or different passive immunity strata have been proposed such as <1500 mg/dL (Alves et al., 2015), <600 mg/dL (Gökçe and Atakişi, 2019), <600 mg/dL, 600-1000 mg/dL, >1000 mg/dL (Gökçe et al., 2022) and <1000mg/dL, 1000-2000 mg/dL, >2000 mg/dL (Gökçe et al., 2013).

The radial immuno diffusion (RID) test is the gold standard method for determining the IgG concentrations of biological fluids. This laboratory method is both expensive and time-consuming, and requires special equipment to display the results of the analysis. A simple and practical method used to determine the quality of colostrum is refractometry. The Brix refractometer enables the simultaneous and rapid estimation of the total solid concentration of colostrum (Todaro et al., 2023). The Brix refractometer has been validated to estimate the IgG concentration of bovine colostrum (Buczinski and Vandeweerd, 2016). It has also been described as a useful and reliable tool for determining the quality of ovine colostrum (Santiago et al., 2020; Swinbourne et al., 2022; Todaro et al., 2023; Sarıca and Aydoğdu, 2024). The Brix refractometer has been previously used in studies on the investigation of factors affecting colostrum quality in sheep (Torres-Rovira et al., 2017; Uysal et al., 2024).

Many factors such as birth season, feeding conditions, gestational age, dry period length, parity, lamb birth weight, twinning and breed have an effect on colostrum quality in sheep (Torres-Rovira et al., 2017; Campion et al., 2019; Uysal et al., 2024; Sarıca and Aydoğdu, 2024). It has been reported that 22% of sheep cannot produce colostrum with an IgG concentration above 50 g/L (Dwyer et al., 2016). Based on previous research on the colostrum needs of newborn lambs, a lamb requires 200 ml of colostrum per kg of birth weight under mild weather conditions during the first 18 hours of life, and 50% more under rainy and windy conditions. To increase the viability of lambs, 25% of this colostrum needs to be consumed at birth (Banchero et al., 2015). Otherwise, it has been reported that higher passive immunity levels are achieved with bottle feeding compared to natural suckling, such that morbidity and mortality significantly decrease in bottle-fed lambs (Eğdir and Öcal, 2023). Therefore, to ensure adequate passive immunity transfer to newborn lambs, it is necessary to implement an efficient colostrum management and monitor the quality of colostrum (Uysal and Yörük, 2022). So, for this purpose, the quality of the colostrum of ewes is determined, and those of high quality are frozen to be later fed to lambs of ewes that produce poor-quality or not enough colostrum.

The rearing of the Karya sheep is common in western Anatolia (Karaca et al., 2018). While sheep breed is known to have a significant effect on colostrum quality, there is only limited literature information available on colostrum quality in the Karya breed (Eğdir and Öcal, 2023). The aim of this study was to compare the quality of the colostrum of Karya ewes and yearling lambs with the aid of the digital Brix refractometer and to determine any change in the colostrum/milk Brix percentages during the first 15 days postpartum.

MATERIAL and METHOD

Milking is not subject to local ethics committee approval in accordance with the provisions of "Regulation on Working Procedures and Principles of Ethics Committee of Experiments on Animal (Official Gazette No: 28914, 15 February 2014)". This study was conducted on a sheep farm located in the Serinhisar (Kizilhisar) district of the Denizli province in 2021. The sheep were fed with roughage consisting of wheat straw and oats, and concentrated feed (a mixture of barley and wheat) of about 500 g per animal per day. Clean and fresh water was provided ad libitum.

In this study, the data of a total of 18 Karya sheep, including yearling lambs (n=9) and ewes (n=9), were used. The parity number of the ewes ranged from 2 to 5. Five-ml colostrum/milk samples were collected from the sheep immediately after birth and at 12 hours, 24 hours, and 2, 3, 4, 7 and 15 days after birth into Falcon tubes. The quality of the colostrum was determined by analyzing fresh colostrum samples with a digital Brix refractometer (Atago PAL-1, Tokyo, Japan). Both the collection of the colostrum/milk samples and the Brix refractometer analyses were carried out by the farm owner under the supervision of the researcher. In this study, the secretion obtained from the udder of the sheep until the 3rd day after lambing was classified and used as colostrum, and the secretion obtained on the 4th, 7th and 15th days after lambing was classified and used as milk.

Whether the study data met the normality assumptions was determined according to the Shapiro-Wilk test. The postpartum colostrum/milk Brix percentages of the groups were compared using repeated measures of analysis of variance. The results are given in mean±SEM (standard error of mean). The statistical significance level was set at $p<0.05$. Statistical analyses were performed using SPSS version 24.

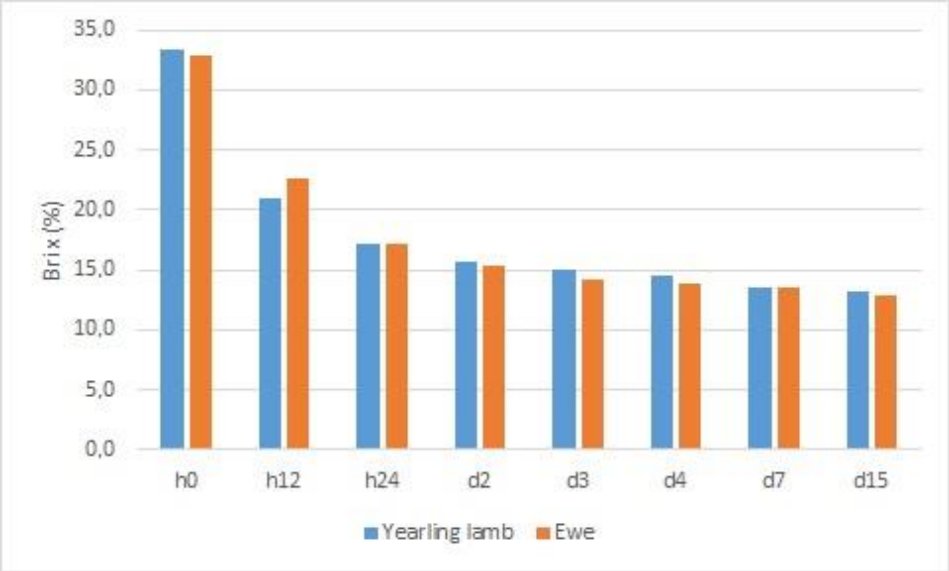
RESULTS

The changes in the colostrum and milk Brix percentages over time are presented in Table. The colostrum Brix percentages of the ewes immediately after birth, and at 12 and 24 hours and 2 and 3 days after birth were determined as 32.8±1.7%, 22.6±1.2%, 17.2±1.0%, 15.4±0.8%, and 14.2±0.3%, respectively. The colostrum Brix percentages of the yearling lambs immediately after birth, and at 12 and 24 hours, and 2 and 3 days after birth were determined as 33.3±1.8%, 21.0±1.9%, 17.2±1.4%, 15.6±0.6%, and 15.0±0.4%, respectively. There was no difference between the ewes and yearling lambs for the quality of colostrum determined with the Brix refractometer. The Brix percentages of the colostrum samples collected immediately after parturition ranged from 24.7% to 41.2%. The colostrum and milk Brix percentages of the Karya ewes and yearling lambs throughout the 15 days after lambing are presented in Figure. There was no difference between the Brix percentages of the ewes' milk on days 4, 7 and 15 (13.9 ± 0.3%, 13.5 ± 0.3%, 12.9 ± 0.3%, respectively) and the yearling lambs' milk (140.6 ± 0.4%, 13.6 ± 0.2%, 13.3 ± 0.1%, respectively). The colostrum Brix percentages decreased significantly until the 24th hour after birth. However, there was no difference between the Brix percentages of the colostrum and milk samples after 24 hours.

Table. Colostrum and milk Brix percentages of Karya ewe and yearling lambs throughout the 15 days after lambing

Group (G)	Time (T)									p		
	Birth	Hour 12	Day 1	Day 2	Day 3	Day 4	Day 7	Day 15	LS Mean (Group)	Group	Time	G*T
Yearling lambs	33,29 ± 1,77	21,01 ± 1,88	17,18 ± 1,38	15,64 ± 0,64	15,03 ± 0,38	14,59 ± 0,38	13,60 ± 0,16	13,27 ± 0,10	17,95 ± 0,57	0,865	<0,001	0,781
Ewes	32,81 ± 1,68	22,58 ± 1,22	17,23 ± 0,98	15,41 ± 0,77	14,21 ± 0,30	13,87 ± 0,26	13,47 ± 0,30	12,91 ± 0,29	17,81 ± 0,59			
LS Mean (Time)	33,05 ± 1,22[a]	21,79 ± 1,12 [b]	17,21 ± 0,85 [c]	15,53 ± 0,50 [c]	14,62 ± 0,24 [c]	14,23 ± 0,23 [cd]	13,53 ± 0,17 [de]	13,09 ± 0,16 [e]				

Figure. Colostrum and milk Brix percentages of Karya ewes and yearling lambs throughout the 15 days after lambing. h, hour; d, day.



DISCUSSION

Higher colostrum IgG concentrations are expected in older animals due to both their increased lifetime exposure to pathogens (Devery-Pocius and Larson, 1983), and the age-related increase observed in the secretory capacity of ovine udder epithelial cells (Campion et al., 2019). However, it was determined similar colostrum quality by means of digital Brix refractometry in ewes and yearling lambs. The current study results agree with studies reporting the age or parity of ewes not being associated with colostral IgG concentrations (Campion et al., 2019; Sarıca and Aydoğdu, 2024) and colostrum IgG concentrations of primiparous and multiparous ewes being similar (Alves et al., 2015). In contrast, there are also study results reporting higher (Gilbert et al., 1988; Torres-Rovira et al., 2017) and lower (Chniter et al. 2016) colostral IgG concentrations in primiparous ewes, compared to multiparous ewes. The reason for the difference between the results of these studies could be differences in the analytical methods used, the breed of the study animals or the system of feeding management.

In agreement with a previous study by Eğdir and Öcal (2023), reporting high colostral IgG concentrations in Karya ewes, the present study demonstrated high Brix percentages for colostrum samples collected immediately after parturition. The mean postpartum colostrum Brix percentage

(33.1%) determined in the present study is higher than the colostrum Brix percentages reported to have been measured at the first hour after parturition in a study evaluating the colostrum quality of different breeds of ewes using the Brix refractometer (Uysal et al., 2024). Similarly, the mean Brix percentage determined in the present study is higher than the mean Brix percentages reported in several other previous studies (Santiago et al., 2020; Kessler et al., 2021; Hamer et al., 2024; Sarıca and Aydoğdu, 2024). A high Brix value of colostrum or milk is closely related to the concentration of total protein (especially IgG) contained in colostrum/milk (Santiago et al., 2020; Todaro et al., 2024). It has been reported that colostral IgG concentrations vary among different breeds of sheep (Campion et al., 2019; Uysal et al., 2024) and also with the increased or decreased milk production capacity of ovine udder epithelial cells (Boutinaud et al., 2004). Karya sheep used in the present study are prolific and have high milk yields (Karaca et al., 2018). It is considered that Karya sheep may have genetically more functional mammary tissue epithelial cells, and therefore, may produce colostrum with higher Brix percentages.

Consistent with previous studies, colostrum Brix percentages decreased from hour 0 to hour 24 postpartum in the present study. Santiago et al. (2020) reported that colostrum Brix percentages gradually decreased until 48 h post-lambing. Decreasing Brix percentages in relation to the time elapsed after lambing were also reported by Uysal et al. (2024). The decrease in the amount of colostrum in the udder due to suckling by lambs and, concurrently the continued secretion of transition milk in the epithelial cells are thought to be effective in the decrease of colostrum Brix percentages. In the present study, the Brix percentages of milk on days 4, 7 and 15 after lambing (14.2, 13.5, and 13.0, respectively) were consistent with the Brix value (13.9%) reported by Todaro et al. (2024).

CONCLUSION

This study showed that while there was no difference between the Karya ewes and yearling lambs for the colostrum qualities determined with the Brix refractometer, the colostrum quality decreased significantly from the time of birth to 24 hours after lambing. The colostrum/milk Brix percentages decreased steadily from 24 hours to 15 days after birth.

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Ethics Approval

Milking is not subject to local ethics committee approval in accordance with the provisions of "Regulation on Working Procedures and Principles of Ethics Committee of Experiments on Animal (Official Gazette No: 28914, 15 February 2014)"

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Conflict of Interest

The author declares that there is no conflict of interest.

Author Contributions

Research Design (CRediT 1) Author 1 (%100)
Data Collection (CRediT 2) Author 1 (%100)
Research - Data analysis - Validation (CRediT 3-4-6-11) Author 1 (%100)
Writing the Article (CRediT 12-13) Author 1 (%100)
Revision and Improvement of the Text (CRediT 14) Author 1 (%100)

Sustainable Development Goals (SDG)

2 Zero Hunger
3 Good Health and Well-Being
12 Responsible Consumption and Production

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