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Original Article
Özgün Araştırma

Evaluation of the relationship between colostrum quality and lactation number in dairy hair goats

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Abstract: The absence of the passage of immunological cells such as antibodies and lymphocytes with large molecular structures from the placenta of goats leads to newborns being born agammaglobulinemic and sensitive to infectious agents. The only way for the offspring to gain immunity is through passive transfer via colostrum. Therefore, the concentration of immunoglobulin G (IgG) in colostrum is important for high-quality colostrum. Based on this, the aim of this study is to determine the IgG concentration in hair goats with different lactation and offspring numbers. The study was conducted on 52 hair goats giving birth to single (n=38) and twin (n=14) offspring in their 1st (n=8), 2nd (n=16), 3rd (n=12), and 4th (n=14) lactations. The IgG concentration in colostrum was determined using an enzyme-linked immunosorbent assay. The IgG level in goats was measured as 17.76±0.67 µg/mL in the 1st lactation, 23.6±2.56 µg/mL in the 2nd lactation, 22.5±1.45 µg/mL in the 3rd lactation, and 17.35±2.16 µg/mL in the 4th lactation. Additionally, the IgG concentration in goats with a single offspring was determined to be 19.82±1.79 µg/mL, while in those with twins, it was determined to be 22.70±0.76 µg/mL. In conclusion, it has been determined that the hair goats in different lactations included in this study do not have high-quality colostrum. The poor quality of colostrum in goats can lead to the development of colostral passive transfer deficiency in kids. In the future, studies are needed to evaluate the effects of different nutritional supplementations and vaccination applications on improving colostrum quality in goats, with the aim of increasing colostral IgG concentration.

Keywords: colostrum, goat, IgG, number of lactations, number of offspring

Sütçü kıl keçilerinde kolostrum kalitesi ile laktasyon sayısı arasındaki ilişkinin değerlendirilmesi

Özet: Keçilerin plasentasından büyük moleküler yapıya sahip antikor ve lenfosit gibi immunolojik hücrelerinin geçişinin olmaması yavruların agammaglobunemik olarak doğmasına ve enfeksiyöz etkenlere karşı hassas olmasına yol açar. Yavruların bağışıklık kazanmalarının tek yolu kolostrum aracılığıyla pasif transferin sağlanmasıdır. Bundan dolayı kolostrumdaki immunglobulin G (IgG) konsantrasyonu kaliteli bir kolostrum için önemlidir. Buradan hareketle bu çalışmanın amacı farklı laktasyon ve yavru sayılarına sahip olan kıl keçilerindeki IgG konsantrasyonunun belirlenmesidir. Çalışma 1. (n=8), 2. (n=16), 3. (n=12) ve 4. (n=14) laktasyondaki tek (n=38) ve ikiz (n=14) yavru doğuran 52 adet kıl keçisi üzerinde yürütülmüştür. Kolostrumdaki IgG konsantrasyonu enzim bağlantılı immünosorbent analizi ile belirlenmiştir. Keçilerdeki IgG düzeyi 1.laktasyonda 17.76±0.67 µg/mL, 2.laktasyonda 23.6±2.56 µg/mL, 3.laktasyonda 22.5±1.45 µg/m ve 4.laktasyonda 17.35±2.16 µg/mL olarak ölçülmüştür. Ayrıca tek yavruya sahip keçilerdeki IgG konsantrasyonunun 19.82±1.79 µg/mL belirlenirken ikiz yavrularda ise 22.70±0.76 µg/mL olarak belirlenmiştir.

Sonuç olarak bu çalışmada yer alan farklı laktasyonlardaki kıl keçilerinin çok iyi kalitede bir kolostruma sahip olmadığı belirlenmiştir. Keçilerdeki kolostrumun iyi kalitede olmaması oğlaklarda kolostral pasif transfer yetmezliğinin gelişmesine yol açabilir. Gelecekte keçilerdeki kolostral IgG konsantrasyonunun arttırılması amacıyla farklı besinsel suplementasyonlar ile aşı uygulamalarının kolostrum kalitesinin iyileştirilmesi üzerine etkisinin değerlendirildiği çalışmalara ihtiyaç duyulmaktadır.

Anahtar kelimeler: IgG, keçi, kolostrum, laktasyon sayısı, yavru sayısı

Introduction

Colostrum contains many types of biofunctional components such as carbohydrates, protein, fat, ash, casein, lactose, antioxidants, vitamins and minerals, as well as passive immunity components such as growth factors, anti-pathogenic compounds and immunoglobulins (Ig) (Övet 2023). It is stated that the level of these components is high during

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the first 72 hours. However, the physicochemical properties and production period of each colostrum may vary according to different factors such as age, number of lactations, nutrition and length of dry period (Romero et al. 2013; Övet 2023). The dry matter of colostrum contains protein, fat and sugar, which provide the majority of the nutritional source for the metabolism of newborn kids. It is also stated that the protein content depends on the presence of transferrin, lactoferrin, lysozyme, polypeptides, cytokines, growth hormones, insulin-like growth factors and fibroblasts (Romero et al. 2013; Zhou et al. 2023; Övet 2023). In addition to providing energy to the newborn goat, colostrum also contains very important bioactive components that play a key role in passive immune transfer (Romero et al. 2013). Due to the special anatomical structure of the goat placenta, transfer of immune components, especially immunoglobulins, from mother to fetus does not occur (Zhou et al. 2023; Övet 2023). As a result, goat kids are born agammaglobulinemic and are vulnerable to possible infections. Good quality and sufficient colostrum intake by goat kids is the only valid way for adequate passive transfer (Zhou et al. 2023). Passive immunity is also dependent on the immunoglobulin concentration in colostrum (Higaki et al. 2013). Goat colostrum, like other ruminants, accounts for one third of the total colostrum proteins, with IgG being the major immunoglobulin, accounting for 90% of the total immunoglobulins. In addition to these, colostrum contains 6% IgM and 3.7% IgA (Higaki et al. 2013; Zhou et al. 2023; Agradi et al. 2023). IgG concentration in goat colostrum is considered sufficient for passive transfer when it is equal to or higher than 20 mg/ml (Kessler et al. 2019; Argüello et al. 2006). However, like all components in colostrum, IgG concentration varies depending on various factors including the breed of animal, disease status, number of offspring, postpartum collection time, number of lactations, length of dry period, lambing season, management and distribution (Kessler et al. 2019; Övet 2023). Radial Immunodiffusion (RID) is accepted as the gold reference method for determining IgG concentration in colostrum (Kessler et al. 2019; Övet 2023). Many studies have reported that determining IgG concentration with ELISA is as reliable as RID and produces similar results (Yılmaz and Kaşıkcı 2013; Aydoğdu and Güzelbektaş 2018; Abecia et al. 2020).

In Türkiye, hair goats make up 97% of the total goat population (Kartal et al. 2022). However, despite being so common, there is not enough information about the colostrum IgG concentration in goats. Based on this; i) Determining the IgG concentrations in the colostrum of dairy goats in Bingöl province and ii) Investigating the effect of parity and number of offspring on the amount of colostrum IgG were aimed.

Materials and Methods

This study was initiated after the decision of the Bingöl University Animal Experiments Local Ethics Committee that "no ethics committee permission was required" (Number: E-85680299-020-145137).

Animals

The study was conducted in Bingöl province, which is located between 41º 20 and 39° - 56° east longitudes and 39° - 31 and 36° - 28° north latitudes of Turkey. A total of 52 dairy goats from different villages of Bingöl province were included in the study. All of the enterprises where the study was conducted were family enterprises. Information was obtained from the enterprise owners that the animals in the study were fed with hay, barley straw, barley, and corn silage in the pasture in the summer and in the barns in the winter.

Collection of colostrum samples

All colostrum samples in the study were obtained within a maximum of 4 hours from the moment of birth of the goat. The age of the goats from which colostrum was collected, the number of offspring and the number of lactations were recorded. Colostrum samples were obtained from the goats by hand milking from the udder. In order to prevent keratin plugs and to minimize the risk of bacterial contamination from the udder canal, colostrum was not collected in the first 2-3 flows. In order to prevent contamination in the colostrums, an equal amount of colostrum that is 20 ml was collected from each udder at a 45-degree angle, Immediately after colostrum was obtained, it was delivered to the laboratory and centrifuged at 4500 rpm for 30 minutes. The colostrum obtained samples were stored at -20°C until analyzed. Before starting the analysis process, colostrum samples were allowed to reach room temperature (20-24°C). IgG analysis in colostrum samples was started after they reached room temperature. Colostrum samples were performed using goat-specific IgG ELISA kit (Goat Immunoglobulin G, Shanghai Coon Koon Biotech Co., Ltd, China). ELISA kits were used in accordance with the procedure steps described by the manufacturers. The ELISA double antibody sandwich

method was used in this study. Optical density was measured at 450 nm wavelength with a microplate reader (BioTek Instruments®, Winooski, VT, USA). Standard samples were tested in duplicate to increase the reliability of the study. The coefficient of variation (CV) in IgG analysis was determined as <7% for the intra-assay coefficient and <10% for the inter-assay coefficient.

Statistical Analysis

Statistical analysis of the data was performed using IBM SPSS Statistics 26 for Windows (IBM Corp., Armonk, NY, USA). The sample size in this study was determined using statistical analysis methods. Data are presented as mean ± standard deviation values. The Shapiro-Wilk test was used to evaluate whether the data had a normal distribution. Kruskal-Wallis test was applied to determine the differences and make comparisons between the colostrum samples obtained from goats and the lactation number, followed by the Mann-Whitney U test. In addition, the Mann-Whitney U test was applied to compare the number of offspring and the IgG concentration in colostrum. The relationship between the variables was determined by Spearman rank correlation analysis. The values of the correlation coefficients are 0.00-0.10 negligible, 0.10-0.39 weak correlation, 0.40-0.69 moderate correlation, 0.70-0.89 strong correlation, and 0.90-1.00 very strong correlation (Schober et al. 2018).

Results

Descriptive statistics of goats from which colostrum was collected are given in Table 1. In this study, a total of 52 colostrum samples were collected from 10 goats aged 1.5-2 years, 16 goats aged 3 years, 12 goats aged 4 years, and 14 goats aged 5 years. Additionally, 52 colostrum samples were collected from 10 goats in the 1st lactation, 16 goats in the 2nd lactation, 12 goats in the 3rd lactation, and 14 goats in the 4th lactation.

Statistical differences in colostral IgG concentrations in goats according to lactation number were given in Table 2. There was a statistically significant difference in colostral IgG concentration according to lactation number. This difference was between 1st lactation-2nd lactation (P<0.001), 1st lactation-3rd lactation (P<0.001), 2nd lactation-4th lactation (P<0.001) and 3rd lactation-4th lactation (P<0.007). There was a statistically significant difference between the number of offspring in goats and colostral IgG concentration (P<0.031) (Table 3). In the correlation analysis, there was a positive correlation between the number of offspring and colostral IgG concentration (r=0.302, P<0.030). There was also a moderate positive correlation between the number of lactations and the number of offspring (r=0.551, P<0.001).

Table 1. Descriptive statistics of goats from which colostrum samples were collected

Variables	Number of goats
Age	
1.5-2	10
3	16
4	12
5	14
Parity	
1	10
2	16
3	12
4	14

Table 2. Differences in IgG concentration in colostrum according to parity.

Parity	1	2	3	4	P value
IgG (µg/mL)	17.76±0.67[a]	23.6±2.56[b]	22.5±1.45[b]	17.35±2.16[ac]	0.001

a,b,c: Differences between groups with different letters in the same row are significant (p<0.05). Data are given as mean ± standard deviation.

Table 3. Statistical difference between the number of offspring born from goats and colostral IgG

Litter size	1 (n=38)	2 (n=14)	P value
IgG (µg/mL)	21.82±1.79a	22.70±0.76b	0.031

a,b: Differences between groups with different letters in the same row are significant (p<0.05). Data are given as mean ± standard deviation.

Discussion and Conclusion

Colostrum is a miraculous food due to its unique components such as vitamins, minerals, hormones, cytokines and growth factors. This food is very important in providing passive transfer and immunity in animals born agammaglobinemic due to the placental structure of ruminants (Gilbert et al. 1988; Csapo et al. 1994). The effects of many factors such as age, dry period length, nutritional supplements and number of calves on colostral quality in dairy cows have been evaluated (Aydogdu and Güzelbektaş 2018). As a result, the immune cell count was increased and animal health was protected by giving quality colostrum to newborn calves (Csapo et al. 1994; Aydogdu and Güzelbektaş 2018). A limited number of studies have been conducted on the importance of lactation number and calves number on colostrum quality in goats. Based on this, the aim was to determine the IgG concentrations in the colostrum of dairy goats in Bingöl province and to investigate the effect of the number of births and the number of offspring on the colostrum IgG amount. Many researchers (Argüello et al. 2006; Kessler et al. 2019; Abecia et al. 2020) recommend that the colostral IgG concentration be above 20 mg/mL for good quality colostrum. It is stated that below this level is not sufficient for colostral passive transfer and plays an important role in the development of passive transfer insufficiency in animals. In this study, it was determined that the IgG concentration in the 2nd and 3rd parity goats was above the threshold value of 20 µg/mL. It was also found that the colostral IgG concentration in twin offspring was significantly higher than in single offspring.

One of the most important indicators of colostrum quality is IgG. It has been reported that lactation number has a significant effect on colostral IgG concentration in dairy cows (Gilbert et al. 1988; Higaki et al. 2013). However, the effect of lactation number on IgG concentration is controversial in studies conducted on goats (Ha et al. 1986; Romero et al. 2013; Taşkın et al. 2018; Kaçar et al. 2021). In a study conducted by Argüello et al. (2006), no statistically significant difference was found between parity and colostral IgG. In another study conducted on Saanen goats, no difference was determined between parity and colostral IgG (Taşkın et al. 2018). Similarly, in the study conducted by Alves et al. (2015) and Turquino et al. (2011), they did not find a relationship between colostral IgG concentration and parity. Unlike these, Kaçar et al. (2021) determined in a study conducted on saanen goats that the IgG concentration in the first and second lactations was higher than the third and fourth lactations. Similarly, Romero et al. (2013) and Ha et al. (1986) reported in their studies that the IgG concentration in primiparous goats was higher than in multiparous goats. However, in the study conducted by Alves et al. (2015), it was reported that there was no statistically significant difference in colostral IgG concentration between primaparous and multiparous sheep. Researchers reported that the possible reason for this discrepancy between parity and colostral IgG in the studies is related to the fact that multiparous animals produce more colostrum than primiparous animals and therefore IgG is concentrated in the colostrum produced in small amounts by primiparous animals (Gilbert et al. 1988; Higaki et al. 2013). In this study, it was found that IgG concentrations were higher in goats that had given birth for the second and third time, which is supported by the results of Kaçar et al. (2021).

In a study conducted on sheep by Gilbert et al. (1988), it was determined that as the number of offspring increased, the colostral IgG concentration in the animals also increased. Similarly, in a study conducted by Csapó et al. (1994) on sheep, goats and dairy cows, it was reported that the IgG level in the colostrum of animals giving birth to twins was significantly higher than that of animals giving birth to a single offspring. However, in contrast to these, a study by Buranakarl et al. (2021) determined that litter size was not related to colostrum quality. Similarly, studies by Argüello et al. (2006), Romero et al. (2013) and Taşkın et al. (2018) reported that the number of offspring had no significant effect on colostral IgG concentration. In this study, it was found that the IgG concentration in the colostrum of goats carrying twins was higher than that of goats carrying a single kid. This is consistent with the results of Gilbert et al. (1988) and Csapó et al. (1994), but inconsistent with the studies conducted by Argüello et al. (2006), Romero et al. (2013) and Taşkın et al. (2018). Variables such as the use of the hair goat breed in this study, the number of offspring and the number of lactations may have played a role in the differences between the studies. It may also be related to the breed and nutritional status of the animals, or it may be due to increased IgG transfer from serum to colostrum in animals carrying twins (Gilbert et al. 1988; Sarica and Aydoğdu 2024).

As a result, it was determined in this study that the colostral IgG concentration of goats in the 2nd and 3rd parity was higher than that of animals in other lactations. It was also determined that the colostral IgG concentration in goats carrying twins

was higher than that of goats carrying singletons. Therefore, the colostrum of goats included in the study was not of sufficient quality and this may lead to colostral passive transfer failure in the offspring. In further studies, there is a need to improve colostrum quality by applying different nutritional or vitamin applications in order to increase colostral IgG concentration.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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